# Programming for Problem Solving-II

COURSE CODE: 19B11CI111

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 2-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs (in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. To use arrays, pointers and structures to formulate algorithms and programs.
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
8. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

**Course outcomes:**

| S.NO | Course outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To formulate simple algorithms for arithmetic and logical problems. | Familiarity |
| CO-2 | To translate the algorithms to programs (in C language). | Familiarity |
| CO-3 | To test and execute the programs and correct syntax and logical errors. | Usage |
| CO-4 | To implement conditional branching, iteration and recursion. | Usage |
| CO-5 | To decompose a problem into functions and synthesize a complete program using divide and conquer approach. | Usage |
| CO-6 | To use arrays, pointers and structures to formulate algorithms and programs. | Usage |
| CO-7 | To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. | Assessment |
| CO-8 | To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Programming (4 lectures)**<br>Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture).<br><br>**Idea of Algorithm:** steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. (1 lecture)<br><br>From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable | 4 |

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| | | |
|---|---|---|
| | code- (2 lectures) | |
| 2 | **Arithmetic expressions and precedence** | 2 |
| 3 | **Loops:**<br>Conditional Branching and Loops (6 lectures)<br><br>Writing and evaluation of conditionals and consequent branching (3 lectures)<br>Iteration and loops (3 lectures) | 6 |
| 4 | **Arrays:**<br>Arrays (1-D, 2-D), Character arrays and Strings | 6 |
| 5 | **Basic Algorithms:**<br>Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required. | 6 |
| 6 | **Function:**<br>Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference<br><br>**Recursion:**<br>Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort. | 5<br><br>4 |
| 7 | **Structure:**<br>Structures, Defining structures and Array of Structures | 4 |
| 8 | **Pointers:**<br>Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)<br><br>**File handling** | 3<br><br>2 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Byron Gottfried, Schaum's Outline of Prokli[gramming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

**Suggested Reference Book(s):**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

**Other useful resource(s):**

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18-cs10

2. Link to topics related to course:
   a. **https://www.learn-c.org/**
   b. **https://www.programiz.com/c-programming**
   c. **https://www.codechef.com/ide**

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |

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|---|---|---|---|---|
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Programming for Problem Solving ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | **2.5** |
| **CO-2** | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | **2.6** |
| **CO-3** | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | **2.4** |
| **CO-4** | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | **2.5** |
| **CO-5** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | **2.4** |
| **CO-6** | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | **2.6** |
| **CO-7** | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | **2.4** |
| **CO-8** | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | **2.5** |
| **Average** | **2.6** | **2.1** | **2.6** | **2.1** | **2.4** | **2.6** | **2.5** | **2.6** | **2.1** | **2.5** | **2.9** | **2.8** | |

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# Programming for Problem Solving Lab-II

COURSE CODE: 19B17CI171

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

**Pre-requisite:** No prior programming experience is expected however, mathematical maturity level of science or engineering undergraduate is assumed.

**Course Objectives:**

1. Develop problem solving ability using programming.
2. To impart adequate knowledge on the need of programming languages and problem solving techniques.
3. To develop a methodological way of problem solving
4. Analyze and construct effective algorithms
5. Employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines
6. Learn a programming approach to solve problems

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the Typical C Program Development Environment, compiling, debugging, Linking and executing. | Familiarity |
| CO-2 | Introduction to C Programming using Control Statements and Repetition Statement | Usage |
| CO-3 | Apply and practice logical formulations to solve some simple problems leading to specific applications. | Assessment and Usage |
| CO-4 | Design effectively the required programming components that efficiently solve computing problems in real world. | Assessment & Usage |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | Getting acquainted with the C program Structure and basic I/O.<br>Getting acquainted with the various data types and arithmetic operator used in C. | 2 |
| 2 | Write a program to obtain the reversed number and to determine whether the original and reversed numbers are equal or not. | 2 |
| | Write a program to check whether a triangle is valid or not, when the three angles of triangle are entered through the keyboard. A triangle is valid if the sum of all three angles is equal to 180 degrees.<br>Check a given I/P is character, number or special symbol. | |
| 3 | WAP to check a given number is Armstrong or not. Calculate factorial of a number<br>Given number is prime or not. | 2 |
| 4 | Write a program to add first seven terms of the following series using any loop: 1/1! + 2/2! + 3/3! +…..<br>Any five pattern program. | 2 |
| 5 | WAP to swap two numbers with function using 3rd variable or without using (call by value & reference). | 2 |

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|---|---|---|
| | Write a function to find out the roots of quadratic equation. | |
| 6 | Factorial using recursion<br>Fibonacci series using recursion. | 2 |
| 7 | WAP to sort N elements of an array using bubble sort.<br>WAP for Binary search & linear search. | 2 |
| 8 | Find Max, Min, 2nd Max, Standard Deviation.<br>Reverse elements of an array. | 2 |
| 9 | Matrix addition, Multiplication and Transpose. | 2 |
| 10 | WAP to handle pointer variables and access the elements of an array using pointers.<br>WAP to insert a string and perform operations: string length, copy, concatenation, compare, lower to upper, etc. | 2 |
| 11 | Write a program to find whether the string is palindrome or not using pointers<br>Write a program to delete all vowels from sentence, assume that sentence is not more than 80 character long using pointers. | 2 |
| 12 | Enter the detail of 5 students using structure and print the details of all students including pointers and also sort the detail of students using DOB. | 2 |
| 13 | Dynamic allocation function and random function with string and integer array. | 2 |
| 14 | Perform operation on files: open, read, write, close etc. | 2 |
| | **Total Lab hours** | **28** |

**Suggested/Resources:**


1. Yale N. Patt and Sanjay J. Patel, Introduction to Computing Systems, from bits & gates to C & beyond, 2nd Edition, 2004.
2. Deitel and Deitel, C How to Program, 7th Edition, 2013.
3. Venugopal Prasad, Mastering C, Tata McGraw Hill.
4. Complete Reference with C, Tata McGraw Hill.
5. Drmey, How to solve it by Computer, PHI.
6. Kerninghan and Ritchie, The C Programming Language.
7. http://www.acm.uiuc.edu/webmonkeys/book/c_guide/
8. http://msdn.microsoft.com/en-us/library/25db87se.aspx


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | **1.7** |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | **1.8** |
| **CO3** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | **2.1** |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | **2.2** |
| **Average** | **3** | **3** | **2** | **1.8** | **2.5** | **2** | **1.3** | **1** | **1** | **2** | **1.3** | **2.3** | |

## Data Structure and Algorithms

COURSE CODE: 18B11CI211

COURSE CREDIT: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisites:** C/C++

**Course Objectives:**

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help offundamental data structures
5. Introduce students to data abstraction and fundamental data structures.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To gain knowledge on the notions of data structure, Abstract Data Type. | Familiarity |
| CO-2 | For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness. | Assessment |
| CO-3 | For a given Search problem (Linear Search and Binary Search) student will able to implement it. | Assessment |
| CO-4 | For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity. | Assessment |
| CO-5 | Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity. | Assessment |
| CO-6 | Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|

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| | | |
|---|---|---|
| 1 | **Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis. | 7 |
| 2 | **Stacks:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. | 5 |
| 3 | **Queues:** ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis. | 5 |
| 4 | **Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. | 8 |
| 5 | **Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis. | 6 |
| 6 | **Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. | 6 |
| 7 | **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis. | 5 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press

**Suggested Reference Book(s):**

1. "Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
3. "Data structures and Algorithms Made Easy" 5th edition by Narasimha Karumanchi, Career monk publications
4. "Data Structure and Algorithms in C" 2nd edition by Mark Allen Weiss (2002), Pearson Education

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106102064/
2. Link to topics related to course:
   a. https://onlinecourses.nptel.ac.in/noc18_cs25/preview
   b. https://nptel.ac.in/courses/106103069/

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c. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course Outcomes (Data Structure and Algorithms) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.4 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 2.4 |
| CO-4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO-6 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| **Average** | **3** | **3** | **3** | **2** | **2.7** | **2.8** | **2** | **2** | **2.5** | **3** | **1** | **3** | |

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# Data Structure and Algorithms Lab

COURSE CODE: 18B17CI271

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisites:** None

**Course Objectives:**

1. Develop problem solving ability using Programming
2. Develop ability to design and analyze algorithms
3. Introduce students to data abstraction and fundamental data structures
4. Develop ability to design and evaluate Abstract Data Types and data structures
5. Apply data structure concepts to various examples and real life applications

**Course outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To gain knowledge on the notions of data structure, Abstract Data Type | Familiarity |
| CO-2 | To have hands on skills to evaluate different kinds of linked lists and their applications in day to day problem solving. | Usage |
| CO-3 | To have hands on skills to evaluate different kinds stacks and their applications and implementations in day to day problem solving | Assessment |
| CO-4 | To have hands on skills to evaluate different kinds queues and their applications and implementations in simulations. | Assessment |
| CO-5 | To acquire knowledge of various sorting algorithms | Usage |
| CO-6 | To learn Searching: Balanced tree, red-black tree, lower bounds for searching | Usage |
| CO-7 | To learn to code for operations on Tree or BST (Creation; Traversing like pre-order,post-order and in-order; Searching element; finding height etc.) | Usage |
| CO-8 | Introduction to Heaps | Usage |
| CO-9 | To learn to code for operations on Graphs (Creation; entering info, printing output and deleting; traversal of BFS and DFS algorithm ) | Assessment |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | **Getting acquainted with**<br>a) Arrays and Strings, Structures,<br>b) Recursion, Pointers<br>c) Dynamic memory allocation | <br>2<br>4<br>4 |
| 2 | **Operations on: (Creation, insertion, deletion, sorting, traversing, reversing etc)**<br>a) Linear Linked List,<br>b) Doubly and<br>c) Circular Linked List | <br><br>4<br>4<br>2 |

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|---|---|---|
| 3 | **Operations on Stacks:**<br>a) Creation; pushing; popping;<br>b) testing underflow, overflow;<br>c) prefix and postfix | 4<br>2<br>2 |
| 4 | **Operations on Queues:**<br>a) Creation;<br>b) enqueue; dequeue;<br>c) testing underflow, overflow | 4<br>2<br>2 |
| 5 | **Operations on Tree or BST:**<br>Creation;<br>a) Traversing like preorder, post-order and in-order;<br>b) Searching element; finding height etc. | 4<br>2 |
| 6 | **Implementation of sorting algorithms 1:**<br>Insertion Sort and Selection Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 7 | **Implementation of sorting algorithms 2:**<br>Bubble Sort and Merge Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 8 | **Implementation of sorting algorithms 3:**<br>Implementation of Radix Sort and Quick Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 9 | **Operation on Heaps:**<br>a) Heaps,<br>b) Heap Sort | 2<br>2 |
| 10 | **Implementation of Searching algorithms:**<br>Linear Search Algorithm and Binary Search Algorithm using dynamic memory allocation. | 2 |
| 11 | **Operations on Graphs :**<br>(Creation; entering info; printing Output and deleting;<br>traversal of BFS and DFS algorithm etc.) | 2 |
| **Total Lab hours** | | **56** |

**Minor Project(s) – (*Only for 2 credit lab)***

- Design GUI based program to solve any binary equation.
- Design GUI based program to find the roots of quadratic equation.

- Design a program that picks the characters at equal interval from the given text/paragraph and generate a new paragraph in which each set of word can't have more than 4 characters. Last word of the paragraph can have <=4 characters.
- Program to input following data into disk file. Code, name, department and salary of employee in a firm. After creating file read the file and find following-

Methodology
algorithms
Code execution
Future scope
Count number of employees as per department
Search record of employee
Display record of employee
Display list of employee in alphabetical order as per department
Read record from file

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**Suggested Books/Resources:**


1. Langsam, Augestein, Tenenbaum : Data Structures using C and C++, 2nd Edn, 2000, Horowitz and Sahani : Fundamental of Data Structures in C, 2nd Edn, 2008
2. Weiss : Data Structures and Algorithm Analysis in C/C++, 3rd Edn, 2006
3. Sahani : Data Structures, Algorithms and applications in C++, 1997.
4. Corman et al : Introduction to Algorithms, 3rd Edn., 2009
5. http://www.nptel.iitm.ac.in/video.php?subjectId=106102064, last accessed Mar 13, 2014.
6. http://www.cs.auckland.ac.nz/~jmor159/PLDS210/ds_ToC.html, last accessed Mar 13, 2014.
7. http://courses.cs.vt.edu/csonline/DataStructures/Lessons/index.html, last accessed Mar 13, 2014.
8. Link to topics related to course:
    a. http://cse.iitkgp.ac.in/~pallab/pds16/pds16.htm
    b. https://onlinecourses.nptel.ac.in/programming101/preview


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2.5 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2.8 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2.7 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.8 |
| CO-5 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2.6 |
| CO-6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.8 |
| CO-7 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2.8 |
| CO-8 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2.8 |
| CO-9 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2.8 |
| Average | 3 | 2.9 | 2.9 | 2.4 | 2.7 | 2.9 | 2.9 | 2.7 | 2.6 | 2.9 | 2.4 | 2.7 | |

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# Digital Electronics and Logic Design

COURSE CODE: 18B11EC312

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: None

Course Objectives:

1. To understand the fundamental characteristics of digital logic levels.
2. To apply the knowledge to understand digital electronics circuits.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Have a thorough understanding of the fundamental concepts and techniques used in digital electronics. | Familiarity |
| CO2 | To understand and examine the structure of various number systems and its application in digital design. | Familiarity |
| CO3 | The ability to understand, analyze and design various combinational and sequential circuits. | Usage |
| CO4 | Ability to identify basic requirements for a design application and propose a cost effective solution. | Usage |
| CO5 | The ability to identify and prevent various hazards and timing problems in a digital design | Assessment |
| CO6 | To develop skill to build, and troubleshoot digital circuits. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems- binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes. | 7 |
| 2 | Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices. | 9 |
| 3 | Sequential circuits and systems: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters. Finite state machines, Design of synchronous FSM. | 12 |
| 4 | Logic Families: Characteristics of digital ICs, digital logic families, RTL,DTL, TTL, Schottky TTL, $I^2L$ and CMOS logic, interfacing CMOS and TTL, Tri-state logic. | 5 |
| | A/D and D/A Converters: Digital to analogue converters: weighted resistor/converter, R- | |

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|---|---|---|
| 5 | 2R Ladder D/A converter, specifications for D/A converters, sample and hold circuit, analogue to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters. | 6 |
| 6 | Programmable logic devices: Commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA). | 3 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Kumar, "Fundamentals of Digital Circuits", 4th Edition, Prentice Hall India, 2016.
2. M. M. Mano, Michael D Ciletti, "Digital Logic and Computer Design", 4th Edition, Pearson Education India, 2008.
3. R. P. Jain, "Modern Digital Electronics", 4th Edition, McGraw Hill Education, 2010.


Other useful resource(s):

1. https://onlinecourses.nptel.ac.in/noc18_ee33/ (Prof. Santanu Chattopadhyay, IIT Kharagpur)
2. https://nptel.ac.in/courses/117106086/ (Prof. S. Srinivasan, IIT Madras)

Evaluation Scheme:

| S. No. | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course Outcomes (Digital Electronics and Logic Design) | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO-6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 3 | 2 | 2 | 3 | 2.08 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2.42 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 2.50 |
| CO4 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 3 | 1 | 2 | 3 | 3 | 2.17 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 2.42 |
| CO6 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 2 | 2.42 |
| Average | 2.67 | 2.67 | 2.50 | 2.50 | 2.83 | 2.67 | 1.66 | 1.66 | 1.83 | 2.67 | 2.17 | 2.83 | |

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# Digital Electronics & Logic Design Lab

COURSE CODE: 18B17EC372

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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Pre-requisite: None

Course Objectives:

1. To provide students basic experimental experiences in constructing digital circuits.
2. Design simple digital systems based on digital abstractions.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To acquire knowledge about electronic components and hardware devices required for designing digital electronics circuits. | Familiarity |
| CO2 | Foster ability to identify, analyze and design combinational circuits. | Familiarity |
| CO3 | Foster ability to design various synchronous and asynchronous sequential circuits. | Usage |
| CO4 | To acquire knowledge about internal circuitry and logic behind any digital system. | Usage |
| CO5 | To develop skill to build, and troubleshoot digital circuits. | Assessment |

List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | To implement Logic gates using TTL ICs (7400, 7402, 7404, 7408, 7410, 7411, 7420, 7427, 7432, and 7486). | 2 |
| 2 | Implementation of Combinational Circuits. | 2 |
| 3 | To verify NAND and NOR gates are universal gates. | 2 |
| 4 | Implementation of Combinational Logic Design using 74** ICs. | 2 |
| 5 | Simplification of Boolean expression using Karnaugh Map Method. | 2 |
| 6 | To design a 4 bit Binary to Gray code Converter, bit Gray to Binary code Converter, 3 bit Binary to Excess-3 code Converter. | 2 |
| 7 | To implement Adder and Subtractor circuits:- (Half and Full using simple gates and universal gates). | 2 |
| 8 | Implement multiplexer using gates and TTL IC's. | 2 |
| 9 | To verify the truth table of Binary (2 bit) to decimal decoder and octal to decimal decoder. | 2 |
| 10 | To verify the truth table of one bit and two bit Comparators using logic Gates. | 2 |
| 11 | To verify the truth tables for each (a) DDL OR gate (b) DDL AND gate (c) TTL OR gate (d) TTL AND gate (e) TTL NAND gate (f) TTL NOR gate. | 2 |
| 12 | Functional table verification of Latches:<br>• SR-Latch with NOR Gates<br>• SR-Latch with NAND Gates<br>• SR-Latch with control input using NAND Gates<br>• D Latch<br>• T Latch | 2 |
| Total Lab hours | | 24 |

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Suggested/Resources:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India.
2. M. M. Mano, "Digital Logic and Computer Design", Pearson Education India.
3. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education.
4. https://onlinecourses.nptel.ac.in/noc18_ee33/ (Prof. Santanu Chattopadhyay, IIT Kharagpur)
5. https://nptel.ac.in/courses/117106086/ (Prof. S. Srinivasan, IIT Madras)

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Electronic Devices and Circuits

COURSE CODE: 18B11EC313

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: None

Course Objectives:

1. Understanding the principle of operation of various electronic devices.
2. Learn characteristics and applications of Diode, Bipolar junction Transistor and Field effect transistors for the design and analysis of variety of electronic circuits.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the construction and working of a diode and its application as an electronic switch. Its use in clipper and clamper circuits as a wave shaping electronic component. | Familiarity |
| CO-2 | Understand the construction and working of a BJT and the different biasing networks used to stabilize the operating point for it to work in the active region or saturation and cut off region. | Familiarity |
| CO-3 | Small signal analysis of BJT using the transistor and hybrid equivalent models. Estimation of various parameters (gain, input/output impedance) of CE and CB configurations. | Assessment |
| CO-4 | Understand the construction and working of a JFET, Depletion type and enhancement type MOSFET. Applications of JFET, and CMOS in design of logic gates. | Assessment |
| CO-5 | Understanding the various biasing schemes for FET amplifiers, and FET small signal analysis using Ac equivalent model. | Usage |
| CO-6 | Understanding the Low-frequency response of BJT amplifier, Low- frequency response of FET amplifier, High frequency transistor models, frequency response of single stage and multistage amplifiers. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Intrinsic and extrinsic semiconductor, Charge carriers, Energy bands, Carrier transport: diffusion current, drift current, mobility and resistivity, Poisson and continuity equation, P-N junction characteristics, I-V characteristics, and small signal switching models, Diode Equivalent Circuits, Diode equation, Ideal diode, Zener and avalanche breakdown, Zener diode, Diode Circuits: Half-wave and full-wave rectifiers, Clippers, Clampers, Voltage regulator. | 7 |
| 2 | Transistor construction & operation, Various configurations (such as CE, CB, CC) and their I/O characteristics, Biasing schemes for BJT amplifiers, Transistor Saturation, Load-Line Analysis, Bias stability. | 8 |
| 3 | Transistor models (transistor and hybrid equivalent models), Estimation of various parameters (gain, input/output resistance) of CE, CB and CC transistor amplifiers, Effect of $R_L$ and $R_S$. | 8 |
| 4 | Basic construction, operation and characteristics of JFETs, Depletion- type MOSFET and Enhancement-type MOSFET, Various configurations (such as CS, CG, CD) of FETs and their features | 6 |
| 5 | Various biasing schemes for FET amplifiers, Q-point, Bias stability, FET small signal analysis: Model, AC equivalent circuit | 8 |

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| | | |
|---|---|---|
| 6 | Low-frequency response of BJT amplifier, Low-frequency response of FET amplifier, High frequency transistor models, frequency response of single stage and multistage amplifiers. | 5 |
| | Total lectures | 42 |

Suggested Text Book(s):

1. Robert L. Boylestad and Lois Nashelsky "Electronic Devices and Circuit Theory", 9th Edition, PHI, 2007.

Suggested Reference Book(s):

1. Sedra Smith, "Microelectronic Circuits", 5th Edition, Oxford Press, 2012.
2. Bell "Electronic Devices and Circuits", 5th Edition, Oxford Press, 2011.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117103063/
2. Link to topics related to course: https://ocw.mit.edu/courses/electrical-engineering-and-computer- science/6-012-microelectronic-devices-and-circuits-spring-2009/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Class performance, Tutorials & Assignments - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Electronic Devices and Circuits) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2.17 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2.17 |
| CO-3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1.75 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO-6 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2.25 |
| Average | 3 | 2.5 | 3 | 2.5 | 2.84 | 2.17 | 1.84 | 1.67 | 1.5 | 1.5 | 1.5 | 1.67 | |

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# Electronic Devices and Circuits Lab

COURSE CODE: 18B17EC373

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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Pre-requisite: None

Course Objectives:

1. To analyze the characteristics and applications of Diode, BJT, and FET.
2. To design the amplifiers using BJT & FET and analyze their frequency responses

Course Outcomes:

Upon successful completion of this course the students will be able to:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the V-I characteristics of diodes and its application as a switch and in wave shaping circuits. | Familiarity |
| CO-2 | Design of voltage regulator circuits using zener diode and half wave / full wave rectifiers using PN junction diodes. | Familiarity |
| CO-3 | Understand the V-I characteristics of BJTs and its use in design of voltage and current amplifiers | Usage |
| CO-4 | Understand the Drain and transfer characteristics of FETs and its use in design of logic gates | Usage |
| CO-5 | Design of single stage RC coupled amplifiers using BJTs and verifying the AC equivalent model for them. | Assessment |
| CO-6 | Study the frequency response of BJTs and FETs | Assessment |

List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | To plot the characteristics of a diode in forward and reverse biased conditions. | 2 |
| 2 | i) To plot the Zener diode characteristics and find the Zener voltage.<br>ii) To plot its transfer characteristics for a given load. | 2 |
| 3 | To implement a Half-Wave Rectifier circuit with and without a capacitive filter and to calculate its ripple factor. | 2 |
| 4 | To implement a full-Wave Rectifier circuit with and without a capacitive filter and to calculate its ripple factor. | 2 |
| 5 | To implement diode clipper and clampers circuits and observe the output waveforms on the CRO. | 2 |
| 6 | To plot input and output characteristics of a transistor in Common- Emitter configuration. | 2 |
| 7 | To compare the performance of fixed bias, emitter stabilized bias and voltage divider bias circuit. | 2 |
| 8 | To investigate the effect of R2 and RE on the stability of operating point for voltage divider bias circuit. | 2 |
| 9 | To design single stage CE amplifier using BJT and calculate the h- parameter model. | 2 |
| 10 | To plot the drain and transfer characteristics of a JFET in common- source configuration. | 2 |
| 11 | To design a two stage RC coupled amplifier and observe frequency response | 2 |

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| | | |
|---|---|---|
| 12 | To design a RC coupled amplifier and observe frequency response | 2 |
| | Total Lab hours | 24 |

Suggested Resources:

1. Robert L. Boylestad and Lois Nashelsky "Electronic Devices and Circuit Theory", 9th Edition, PHI, 2007.
2. Sedra Smith, "Microelectronic Circuits", 5th Edition, Oxford , 2012.
3. Bell "Electronic Devices and Circuit ", 5th Edition, Oxford, 2011
4. Link to NPTEL course contents: https://nptel.ac.in/courses/117103063/
5. Link to topics related to course: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic- devices-and-circuits-spring-2009/

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.8 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.8 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.8 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.3 |
| Average | 2.7 | 2.8 | 2.8 | 2.8 | 2.5 | 2.2 | 1.3 | 1.17 | 1.17 | 1.17 | 1.3 | 1.5 | |

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# Automatic Control Systems

COURSE CODE: 18B11EC311

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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Pre-requisite: Fundamentals of Electrical Circuits

Course Objectives:

1. To understand procedures for developing mathematical models of physical systems, and related analytical and numerical methods for predicting their behavior.
2. To develop the skills of designing compensating networks according to the desired design specifications.
3. To understand and design advance control systems for industrial applications.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The ability to analyze any physical system using mathematical model. | Familiarity |
| CO-2 | The skill to analyze the response of any LTI system. | Assessment |
| CO-3 | The ability to design control system with desired specifications both in time and frequency domain. | Assessment |
| CO-4 | The ability to derive, interpret and solve problems using modern state space control methods for continuous time and discrete time systems. | Assessment |
| CO-5 | The skill to apply advance control schemes for various applications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Control System Concepts and Classification: Open loop, Closed loop, Continuous, Discrete, Linear and non-linear control systems | 2 |
| 2 | Mathematical Models of Systems: Laplace and z-transform, Impulse response and transfer function, Block-diagram model and signal flow graphs, Masons gain formula | 5 |
| 3 | Time Domain Analysis: Standard test input signals, Transient and steady state responses of first and second order systems, Steady state errors, Control of transient response, Basic control actions and their effects on transient and steady state responses | 7 |
| 4 | Stability Analysis: Absolute stability, Relative stability, Routh- Hurwitz criterion, Root loci, Properties and construction of root loci, Effects of adding and moving poles and zeros, Root locus of conditionally stable systems | 7 |
| 5 | Frequency Domain Analysis: Frequency response, Frequency domain specifications, Bode and Nyquist plots, Gain margin and phase margin, Conditionally stable system | 6 |
| 6 | Compensator Design: Introduction, Phase lead compensation, Phase lag compensation, Design of phase-lead and phase-lag compensation by Bode plot and root locus methods, Concepts and applications of P, PD, PI and PID controllers | 6 |
| 7 | State Variable Technique: Derivation of state model of LTI continuous time systems, State equations, State transition matrix, Solution of state equations, Stability, Controllability and observability | 5 |
| 8 | Basics of Nonlinear System Analysis: Linearization, Describing function and Phase plane methods, Stability concepts and Lyapunov functions | 4 |
| | Total lectures | 42 |

Suggested Text Book(s):


1. M. Gopal, "Control Systems: Principle and Design", 4th Edition, Tata McGraw-Hill, 2012.
2. B.C. Kuo, "Automatic Control Systems", 9th Edition, Wiley India, 2014.


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Suggested Reference Book(s):


1. K. Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2010.
2. R.C. Dorf and R.H. Bishop, "Modern Control Systems", 12th Edition, 2007.
3. N. S. Nise, "Control Systems Engineering", 7th Edition, Wiley India, 2013.


Other useful resource(s):

1. Link to NPTEL course contents:https://nptel.ac.in/courses/108102043/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignments (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Automatic Control Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1.7 |
| CO-2 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1.6 |
| CO-3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1.6 |
| CO-4 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1.7 |
| Average | 3 | 2.4 | 2 | 1.8 | 2.2 | 1 | 1.2 | 1 | 1.2 | 1 | 3 | 2.4 | |

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# Automatic Control Systems Lab

COURSE CODE: 18B17EC371

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. To use computational tools in the modeling, simulation and analysis of control systems.
2. To understand procedures for modeling of physical systems, and related analytical and numerical methods for predicting their behavior.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understanding of mathematical modeling of electrical-mechanical systems and knowing their behavior. | Familiarity |
| CO2 | The skill to analyze the response of any LTI system using software tools. | Assessment |
| CO3 | The ability to design any system with desired specifications both in time and frequency domain and analyze systems using different techniques. | Assessment |
| CO4 | Design of different types of controller and tuning their parameters to get optimized results. | Usage |

List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | To determine a transfer function and draw its pole-zero plot for (a) mechanical system (b) electrical system. | 2 |
| 2 | To obtain the overall transfer function of a given complex system represented in either the block diagram representation or signal flow graph representation by using masons gain formula. | 2 |
| 3 | To obtain the time response of a given system and obtain the steady state error for different inputs. | 2 |
| 4 | To obtain the time-domain specifications of a given second order systems for step input. | 2 |
| 5 | To determine the stability of a given LTI system using locations of poles. | 2 |
| 6 | To determine the range of the forward path gain for the system to be stable using root locus technique. | 2 |
| 7 | To design, simulate and analyze the stability and frequency domain specifications of LTI systems using Bode and Nyquist plots. | 2 |
| 8 | To design compensating networks to achieve the desired time domain and frequency domain specifications using (a) root locus and (b) bode plots. | 2 |
| 9 | To design and analyze the state space model of given LTI systems. | 2 |
| 10 | To study and analyze the responses of proportional, proportional derivative, proportional integral and proportional integral derivative controllers. | 2 |
| 11 | To perform Zeigler-Nichols tuning methods for tuning controller parameters. | 2 |
| 12 | To design and analyze state-feedback controller using pole-placement technique (Ackerman's formula). | 2 |

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| | | |
|---|---|---|
| 13 | To design and analyze a servomechanism control system in Simulink. | 2 |
| 14 | To design and simulate a nonlinear control system and analyze the effects of various nonlinear elements on the system performance. | 2 |
| Total Lab hours | | 28 |

Suggested Resources:

1. N. S. Nise, "Control Systems Engineering", 7th Edition, Wiley India,2013.
2. K. Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2010.

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1.58 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1.75 |
| CO3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1.50 |
| CO4 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1.42 |
| Average | 2.50 | 2.50 | 2.25 | 1.50 | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | |

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# Analog Integrated Circuits

COURSE CODE: 18B11EC411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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Pre-requisite: Basic Electronics and Electrical circuit Analysis

## Course Objectives:

1. To provide the student with an understanding of the fundamental characteristics, operations, stabilization, and feedback techniques of operational amplifiers.
2. To make the students acquainted with the applications of special ICs like timers, PLL circuits, regulator circuits, ADCs.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques. | Familiarity |
| CO-2 | Elucidate and design the linear and non-linear applications of an opamp and special application ICs. | Usage |
| CO-3 | Explain and compare the working of multivibrators using special application IC 555 and general purpose opamp. | Usage |
| CO-4 | Develop skills to design simple filter circuits and various amplifiers and can solve problems related to it. | Assessment |
| CO-5 | Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication. | Assessment |

## Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1. | Introduction to Operational Amplifiers: Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR, General operational amplifier stages and internal circuit diagrams of IC 741, Op- Amp basics, Ideal properties, Op-Amp specifications, DC and AC performance characteristics, slew rate, Open and closed loop configurations, Parameters of OP- Amps. | 9 |
| 2. | Feedback topologies & Oscillators: Negative feedback in amplifier: Voltage-Series, Voltage-Shunt feedback, Current-Series, Current- Shunt feedback, Effect of feedback on gain, bandwidth etc., Calculation of stability, gain margin and phase margin. Positive Feedback in oscillators: Review of the basic concept, Barkhousen criteria for oscillators. Design of oscillator circuits: Clapp, Colpitt, Hartley, Wein Bridge and RC phase shift Oscillator. | 9 |
| 3. | OP-AMP applications: Inverting & Non-inverting configuration, DC & AC amplifiers, Peaking Amplifier, Summing, Scaling and Averaging Amplifiers, Voltage to current and current to voltage converter, Op- amp as integrator and differentiator, Precision diode, Logarithmic and Anti-logarithmic Amplifier, Zero crossing detector, A/D and D/A Converters. | 8 |
| 4. | Active Filter & Wave shaping circuits: First order and second order filter design: Low pass, High pass, Band pass, Band Reject & All pass, Universal active filter, Multi-vibrators (Astable, Mono-stable, Bi- stable), Schmitt Trigger, Sample and Hold Circuit, Clippers and Clampers, Comparator. | 8 |
| 5. | Waveform generators and special function ICs: Square wave generator, Triangular wave generator, Saw-tooth wave generator, Timer IC 555, Voltage-Controlled Oscillator (VCO), Phase-Locked Loop (PLL). | 8 |

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| | |
|---|---|
| Total lectures | 4<br>2 |

Suggested Text Book(s):

1. R. Gayakwad, "Op-amps and Linear Integrated Circuits", 4th ed., Prentice Hall of India.
2. D. Roy Choudhary S. Jain, "Linear Integrated Circuits", 4th ed., New Age International (P) limited.

Suggested Reference Book(s):

1. William D. Stanley, "Operational amplifiers and Linear Integrated Circuits", 4th ed, Pearson.
2. Sergio Franco, "Design With Operational Amplifiers and Analog Integrated Circuits", 3rd ed., Mcgraw Higher Education.
3. Johan H. Huijsing, Operational Amplifiers – Theory and Design, 3rd edition, Springer.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117103063
2. Link to topics related to course:
   - https://nptel.ac.in/courses/122104013/11
   - https://nptel.ac.in/courses/108101091
   - https://nptel.ac.in/courses/117103063/17

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Analog Integrated Circuits) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.75 |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.75 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| CO-5 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| Average | 2 | 2.6 | 2.6 | 2.6 | 2.8 | 1 | 1 | 1 | 2 | 2.2 | 1.4 | 2 | |

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# Analog Integrated Circuits Lab

COURSE CODE: 18B17EC471

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

Pre-requisite: Basic Electronics lab, Electrical Circuit Analysis Lab

## Course Objectives:

1. To provide students a thorough understanding of the analog circuits using different ICs.
2. To learn generation of different kind of waveforms using opamps.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand basics of different electronics circuits using op amps. | Familiarity |
| CO-2 | Learn how to generate different frequencies using various oscillators. | Familiarity |
| CO-3 | Design different types of filters. | Usage |
| CO-4 | Design Schmitt Trigger using op amp. | Usage |
| CO-5 | Learn the generation of different waveforms using op amp. | Assessment |
| CO-6 | Study the working of op amp as multivibrator. | Assessment |

## List of Experiments

| S. No. | Description | Hours |
|---|---|---|
| 1 | To become familiar with the use and characteristics of a 741 Op-Amp, in an ideal amplifier configuration as an; inverting amplifier, noninverting amplifier, and voltage follower. | 2 |
| 2 | Simulate and design Adder and Subtractor circuits using Op-Amp. | 2 |
| 3 | Simulate and design Integrator and Differentiator using operational amplifier and characterize their performance in various regions of operation. | 2 |
| 4 | Design and verify the characteristics of RC pahse shift oscillator for required frequency | 2 |
| 5 | Design and verify the characteristics of Wein Bridge oscillator for required frequency | 2 |
| 6 | Simulate and design 1st order HPF and LPF filters and plot their Frequency responses, respectively. | 2 |
| 7 | Simulate and design a Schmitt trigger, using a standard IC741 Op-Amp, to produce a custom voltage transfer characteristic. | 2 |
| 8 | Simulate and design triangular/square waveform generator using IC741 | 2 |
| 9 | Simulate and design a monostable multivibrator for required pulse width using IC555 Timer | 2 |
| 10 | Simulate and design astable multivibrator for required frequency and duty cycle using IC555 Timer | 2 |
| 11 | Simulate and design and A-D converter using OPAMP 741 | 2 |
| 12 | Simulate and design and D-A converter using OPAMP 741 | 2 |
| | Total Lab hours | 24 |

## Suggested/Resources:


1. R L Boylestad and Nachelsky: Electronic Devices & circuit Theory, 10th Ed.Pearson.
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004
3. Link to NPTEL course contents:
   - https://nptel.ac.in/courses/11710306
   - https://nptel.ac.in/courses/117103063 /1
   - https://nptel.ac.in/courses/117103063 /7
   - https://nptel.ac.in/courses/117103063/17


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Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Fundamentals of Signals and Systems

COURSE CODE: 18B11EC412

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: Basic mathematics like integration, differentiation, differential equations, and trigonometry formulae

## Course Objectives:

1. To understand the various types of signals, types of systems, characteristics, operations, and sampling theorem.
2. To learn the different transform like Fourier series, Fourier Transform, Laplace Transform and Z-Transform and also understand their importance for signals and systems analysis.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Classify signals and systems based on their properties and determine the mathematical representations of signals and systems. | Familiarity |
| CO-2 | Explain the role of convolution in the analysis of LTI systems and also able to formulate and solve differential /difference equations describing LTI systems. | Familiarity |
| CO-3 | Analyze the spectral characteristics of signals using Fourier analysis and analyze system properties based on impulse response and Fourier analysis. | Usage |
| CO-4 | Apply the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems. | Usage |
| CO-5 | Understand the process of sampling and the effects of under sampling. | Assessment |

## Course Contents:

| S. No. | Contents | Contact Hours |
|---|---|---|
| 1 | Continuous-time and discrete-time signals, signal energy and power, periodic signals, even- odd signals, exponential and sinusoidal signals, Unit impulse and step functions, continuous and discrete time systems, system classifications, system properties. | 8 |
| 2 | Convolution integral and convolution sum, properties of LTI systems, LTI systems described by differential and difference equation, response of LTI systems. | 5 |
| 3 | Fourier series representation of continuous and discrete time signals, properties, Fourier Transform representation of continuous-time signals, properties, system characterization by linear constant coefficient difference equation. | 13 |
| 4 | The Laplace Transform, ROC, Properties of Laplace-transform, analysis and characterization of LTI systems using Laplace Transform. | 6 |
| 5 | The z-transform, ROC and pole-zero-plot, properties of z-transform, analysis and characterization of LTI system using z-transform, Stability criterion. | 7 |
| 6 | Sampling, types of sampling, Analog to digital conversion, Signal reconstruction. | 3 |
| | Total lectures | 42 |

## Suggested Text Book(s):

1. A.V. Oppenheim & A.S. Willsky & S.H. Nawab: Signals & Systems, 2nd Edition, Prentice- Hall of India, 2015.

## Suggested Reference Book(s):

1. B.P. Lathi: Signal Processing and Linear Systems, 2nd Edition. Oxford University Press, 2006.
2. Simon Haykin, Barry Van Veen, Signals & Systems, 2nd Edition., John Willey and Sons, 2007

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Other useful resource(s):

1. http://nptel.ac.in/courses/108104100/ (Prof Aditya K. Jagannatham, IIT Kanpur)
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/ (Prof. Alan V. Oppenheim)

Evaluation Scheme:

| S. No. | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) – 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Fundamentals of Signals and Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO-2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.3 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.4 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.4 |
| CO-5 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.3 |
| Average | 2.6 | 3 | 2.6 | 2.8 | 2.4 | 1 | 1 | 1 | 1.8 | 3 | 3 | 3 | |

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# Fundamentals of Signals & Systems Lab

COURSE CODE: 18B17EC472

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

Pre-requisite: None

## Course Objectives:

The primary objective of this course is

1. To provide a thorough understanding and analysis of signals and systems using MATLAB.
2. To become familiar with some signal processing capabilities of MATLAB.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand basics of MATLAB syntax, functions and programming. | Familiarity |
| CO2 | Generate and characterize various continuous and discrete time signals. | Familiarity |
| CO3 | Perform the basic operations on the signals. | Usage |
| CO4 | Design and analyze linear time-invariant (LTI) systems and compute its response. | Usage |
| CO5 | Analyze the spectral characteristics of signals using Fourier analysis. | Assessment |
| CO6 | Analyze the systems using Laplace transform and Z-transform. | Assessment |

## List of Experiments:

| S. No | Description | Hours |
|---|---|---|
| 1 | Introduction to MATLAB | 2 |
| 2 | To create user defined functions for generating sinusoidal signal, delta function, unit step function and periodic signal. | 2 |
| 3 | To create user defined functions for signal operation: signal addition, time shifting, time scaling and time inversion. | 2 |
| 4 | To compute convolution of two signals and verify its properties. | 2 |
| 5 | To compute auto-correlation and cross-correlation of two signals and verify its properties. | 2 |
| 6 | To obtain the response of LTI system defined by linear constant coefficient difference Equations | 2 |
| 7 | To synthesize the periodic signal using Fourier series. | 2 |
| 8 | To analyze the spectrum of the signal using Fourier transform and verify its properties. | 2 |
| 9 | To compute and plot the impulse response and pole-zero diagram of transfer function using Laplace transform. | 2 |
| 10 | To compute and plot the impulse response and pole-zero diagram of transfer function using Z-transform. | 2 |
| 11 | To create user defined functions for upsampling and downsampling of given discrete time signals. | 2 |
| 12 | To demonstrate the effects of aliasing arising from improper sampling. | 2 |
| | Total Lab hours | 24 |

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Suggested/Resources:


1. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems, 2nd Edition, PHI, India, 2015.
2. Alex Palamides, Anastasia Veloni, Signals and Systems Laboratory with MATLAB, 1st Edition, CRC Press, 2010.
3. Sudhakar Radhakrishnan , Practicing Signals and Systems Laboratory Using MATLAB, Lambert Academic Publishing, 2011.
4. https://www.iitg.ac.in/cseweb/vlab/signals-and-systems-laboratory/


Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.83 | 2.83 | 2.50 | 2.17 | 1.33 | 1.17 | 1.17 | 1.17 | 1.33 | 1.50 | |

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# Modern Analog and Digital Communication

COURSE CODE: 18B11EC413

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

Pre-requisite: None

Course Objectives:

1. Introduce students to basic concepts of analogue and digital communicationsystems.
2. To acquaint the students with various modulation and demodulation techniquesused for communication.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To familiarize students with the fundamentals of analog and digital communication systems. | Familiarity |
| CO2 | To familiarize students with basic techniques used for modulation and demodulation of signal. | Familiarity |
| CO3 | Understanding of various approaches to convert analog signal to digital signal. | Assessment |
| CO4 | Analyze mathematical background for communication signal analysis. | Assessment |
| CO5 | To analyze performance of a communication system. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Review of fundamental concepts: Review of Fourier series and Fourier transforms, Power Spectral Density, review of probability and random processes, spectral analysis, Gaussian process, Gaussian and white noise characteristics. | 4 |
| 2 | Modulation techniques: Concept of modulation and demodulation, Continuous wave (CW) modulation: AM, DSB, SSB, and VSB modulation, Angle modulation - PM & FM wave equations; relationships between PM and FM. Narrow band FM. Spectra of AM and FM waves. AM and FM detectors. Phase Lock loop (PLL) and its application as FM demodulator, Discriminator, FM Pre-emphasis and De-emphasis, capture effect. Comparison of CW modulation systems. Receivers for CW modulation: Superheterodyne receivers | 13 |
| 3 | Pulse modulation: Sampling process, Pulse modulation: Pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM), Quantization, Pulse code modulation (PCM), differential pulse code modulation (DPCM); delta modulation (DM). Noise consideration in PCM and DM.<br>Line coding schemes, Comparison of RZ, NRZ, Polar, Unipolar, Manchester, and their spectral analysis. | 7 |
| 4 | Baseband Pulse Transmission: Baseband transmission, matched filter, probabilty of error of matched filter, Inter symbol Interference and Nyquist criterion, Eye-pattern, Signal to noise ratio. | 5 |
| 5 | Pass band Digital Modulation schemes: Amplitude shift keying (ASK), Phase shift keying (PSK), Frequency shift keying (FSK) and Quadrature amplitude modulation (QAM). Basics of CPFSK and MSK, Signal constellations, Probability of error analysis of digital modulation schemes. Comparison of bandwidth and bit rate of digital modulation schemes. Multiplexers, Timing and frequency synchronization: TDM, FDM, North American Digital Hierarchy, T1 carrier, carrier synchronizers, symbol synchronization, early-late gate synchronizer | 13 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. Simon Haykin, "An introduction to analog and digital communications", 2nd Ed., John Wiley & Sons,2012
2. B.P.Lathi, "Modern Analog and Digital Communication Systems", 4th Ed., Oxford.,2017
3. Taub Schilling, "Principles of Communication Systems", 4th Ed., McGrawHill.,2007

Other useful resource(s):

1. https://nptel.ac.in/courses/117101051/ (Prof. Bikash Kumar Dey, IIT Bombay)
2. https://onlinecourses.nptel.ac.in/noc17_ec11/preview (Prof. Goutam Das, IIT Kharagpur)

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course Outcomes (Modern Analog and Digital Communication) | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO-6 | PO 7 | PO 8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1.58 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1.67 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2.00 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1.83 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2.00 |
| Average | 2.6 | 2.4 | 2.6 | 2.2 | 2.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2 | 1.2 | 1.8 | |

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# Modern Analog and Digital Communication Lab

COURSE CODE: 18B17EC473

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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Pre-requisite: None

## Course Objectives:

1. To make the students familiar with the basic analog and digital communication circuits.
2. To design the circuits to convert analog signal into digital signal and vice versa.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand basic elements of a communication system. | Familiarity |
| CO2 | Able to design analog modulation circuits as amplitude and frequency modulation. | Assessment |
| CO3 | Design various line coding techniques. | Assessment |
| CO4 | Design the circuit to convert analog signals to digital signals. | Assessment |
| CO5 | Design different digital modulation circuits. | Usage |

## List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | To design and implement Amplitude modulator and Demodulator. | 2 |
| 2 | To design and implement Frequency Modulator and Demodulator. | 2 |
| 3 | To design and implement Pulse Amplitude Modulator (PAM) | 2 |
| 4 | To design and implement Pulse Width Modulator (PWM). | 2 |
| 5 | To design and implement Pulse Position Modulator (PPM). | 2 |
| 6 | To design and implement sample and hold circuit. | 2 |
| 7 | Design and Generation of random binary signals. | 2 |
| 8 | Generation Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line codes. | 2 |
| 9 | Design and implementation of Delta Modulator for analogue signals | 2 |
| 10 | Design, implementation and study of BASK Modulator and demodulator | 2 |
| 11 | Design, implementation and study of BPSK Modulator and demodulator | 2 |
| 12 | Design, implementation and study of BFSK Modulator and demodulator. | 2 |
| Total Lab hours | | 24 |

## Suggested/Resources:


1. Simon Haykin, "An introduction to analog and digital communications", 2nd Ed., John Wiley & Sons.,2012.
2. B.P.Lathi, "Modern Analog and Digital Communication Systems", 4th Ed., Oxford.,2017.
3. https://nptel.ac.in/courses/117101051/ (Prof. Bikash Kumar Dey, IIT Bombay)


## Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.83 | 2.50 | 2.17 | 1.33 | 1.17 | 1.17 | 1.17 | 1.33 | 1.50 | |

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# Python Lab

COURSE CODE: 18B17EC474

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. Develop problem solving ability using python.
2. Learn python programming approach to solve engineering problems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand the python program development environment, debugging, and executing. | Familiarity |
| CO2 | To understand the usage of control statements in python program. | Usage |
| CO3 | To practice programming in python for solving some simple problems leading to specific applications. | Usage |
| CO4 | Able to design a project on python. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to Python, Python IDE, Variable types and basic operators in Python. | 2 |
| 2 | Programs on conditional statements using if statement, if-else statement, and nested if statement. | 2 |
| 3 | Programs on loop control statements using while loop, for loop, and nested loop. | 2 |
| 4 | Programs on string handling with and without importing toolbox. | 2 |
| 5 | Usage of list and tuples in the program. | 2 |
| 6 | Programs for creating and using dictionaries. | 2 |
| 7 | Definition, declaration, and call of functions in python. | 2 |
| 8 | Programs using classes and objects. | 2 |
| 9 | Program on basic file handling operations like opening and closing of a file, creating a text file, copy the content of one file into another. | 2 |
| 10 | Handling of exceptions in python. | 2 |
| 11 | Programs for sorting the sequence of numbers using different sorting algorithms. | 2 |
| 12 | Mini project. | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. A N Kamthane and A A Kamthane: Programming and Problem Solving with Python, 1st Edition, McGraw Hill Education, 2017.
2. A Downey: Learning with Python, 1st Edition, Dreamtech Press, 2015.
3. M C Brown: Python The Complete Reference, 1st Edition, McGraw Hill Education, 2001.


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Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 1.67 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2.08 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2.08 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 2.25 |
| Average | 3.00 | 3.00 | 2.25 | 2.50 | 2.75 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.75 | 3.00 | |

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# Principles of Digital Signal Processing

COURSE CODE: 18B11EC511

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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Pre-requisite: Basic knowledge of Signals and Systems

## Course Objectives:

1. To provide the knowledge of different aspects of transform techniques including analog and digital communication schemes used in modern telecommunication systems.
2. Discussion of basic concepts of energy-power signal, use of Fourier series and Fourier Transform, correlation function and power spectral density.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To interpret, represent and process discrete/digital signals and systems | Familiarity |
| CO-2 | To acquire thorough understanding of frequency domain analysis of discrete time signals | Usage |
| CO-3 | To acquire the ability to design & analyze DSP systems like FIR and IIR Filter etc. | Usage |
| CO-4 | To deal with practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors. | Assessment |
| CO-5 | To apply important algorithmic design paradigms and method of analysis. | Assessment |

## Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction of discrete signals and systems: Signal energy and power, periodic signals, even-odd signals, exponential and sinusoidal signals, Unit impulse and step functions, discrete time systems and their classifications. Analysis of Discrete LTI Systems. Convolution Sum and Linear Constant Coefficients Difference Equations. | 5 |
| 2 | Z-Transforms: Origin of Z – transform, Region of Convergence, Properties of Z – transform, Pole – zero plot, Inverse Z – transform, Analysis of LTI systems using Z – transform. | 5 |
| 3 | Fourier Analysis: Fourier series representation of discrete time signals, properties. Frequency sampling theorem. Discrete Fourier Transform and its properties, Radix-2 Fast Fourier Transform, decimation in time and frequency. Real value FFT and Chirp Z-transform. | 9 |
| 4 | Filter Design: Frequency response characteristics, Window based FIR filter design, Linear phase FIR filter design, IIR filter design using Bilinear Transformation, Frequency Transformation, Butterworth Design and Chebyshev Design method, Realization of FIR and IIR filter. | 5 |
| 5 | Multi-rate rate signal processing: Introduction to multi-rate rate signal processing, Up-sampling and down sampling, Filter design with sampling rate conversion, Introduction and applications of adaptive filters. | 9 |
| 6 | Random Signal Analysis: Random Signal Analysis & Spectral Estimation, Autocorrelation and cross correlation with examples, power spectral density and Spectral estimation | 9 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing", 4th Edition, Prentice Hall, 2007.
2. A. V. Oppenheim and R. W. Schafer, "Digital Signal Processing", 1st Edition, Pearson Education, 2015.

Suggested Reference Book(s):

1. B.P. Lathi, "Principles of Signal Processing and Linear Systems", 1st Edition, Oxford International Publication, 2009.
2. Mitra, S.K, "Digital Signal Processing: A Computer Based Approach", 4th Edition, TMH, 2011.
3. Tamal Bose, "Digital Signal and Image Processing", 1st Edition, John Wiley & Sons, 2003.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117102060/
2. Link to topics related to course:

   https://nptel.ac.in/courses/117102060/1
   https://nptel.ac.in/courses/117102060/12
   https://nptel.ac.in/courses/117102060/28
   https://nptel.ac.in/courses/117102060/41

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Principles ofDigital Signal Processing) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.7 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2.1 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| Average | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.0 | 1.0 | 1.0 | 1.0 | 2.2 | 1.0 | 2.0 | |

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# Principles of Digital Signal Processing Lab

COURSE CODE: 18B17EC571

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: None

Course Objectives:

1. To provide a thorough understanding and analysis of digital signal processing systems using LabVIEW.
2. To familiar with usage of code compressor studio.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand the basics of Lab VIEW Programming and code compressor studio. | Familiarity |
| CO2 | Generate the discrete time signals using sampling and conversion of analog signals in to digital signals. | Familiarity |
| CO3 | Analyze the FFT Algorithm based frequency domain representation. | Usage |
| CO4 | Design the FIR and IIR filter for specified parameters. | Usage |
| CO5 | Apply the adaptive filtering for systems identification. | Assessment |
| CO6 | Perform the linear and circular convolution using DSP kit to get the LTI system response.. | Assessment |

List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | Getting Familiar with LabVIEW. | 2 |
| 2 | Generate a discrete signal by sampling a sinusoidal signal and I investigate the aliasing effect. | 2 |
| 3 | Convert analog signal to digital signal (A/D) and digital signal to analog signal (D/A) using LabVIEW | 2 |
| 4 | Design FIR filter using LabVIEW to meet specifications on their frequency response using window design. | 2 |
| 5 | Design IIR Filter using LabVIEW to meet specifications on their frequency response using the bilinear transformation. | 2 |
| 6 | Use LabVIEW to analyze and display signals in the frequency- domain using the FFT algorithm. | 2 |
| 7 | Design an adaptive filter for system identification using LabVIEW. | 2 |
| 8 | Getting familiar with code compressor studio. | 2 |
| 9 | Perform and verify linear convolution of two signals using DSP Kit. | 2 |
| 10 | Perform and verify circular convolution of two signals using DSP Kit. | 2 |
| 11 | Binary Phase Shift Keying using LabVIEW. | 2 |
| 12 | Design of FIR Filter by interfacing MATLAB with code composer studio. | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.


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# Microprocessor and Interfacing

COURSE CODE: 18B11EC512

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

Pre-requisite: None

Course Objectives:

1. To study the architecture, instruction set and interfacing of the Intel microprocessors.
2. To gain proficiency in assembly language programming.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand Standard Architecture of Intel Microprocessors | Familiarity |
| CO-2 | Learn the instruction set of Intel 80x86 processors and to gain proficiency in assembly language programming | Usage |
| CO-3 | Know the concepts associated with interfacing a microprocessor to memory and to I/O devices and to learn the programming of peripheral I/O devices | Usage |
| CO-4 | Learn the control components of a microprocessor based system though the use of interrupts | Assessment |
| CO-5 | Acquaint with the background knowledge for understanding next-generation CPUs | Familiarity |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Overview of the Intel Family of the Microprocessors. Introduction to 8085 Microprocessor | 4 |
| 2 | The 8086 microprocessor architecture, Addressing Modes; Register Addressing; Immediate Addressing; Direct Data Addressing; Register Indirect Addressing; Base- Plus-Index Addressing; Register Relative Addressing; Base Relative-Plus-Index Addressing | 4 |
| 3 | 8086 Instruction Set | 4 |
| 4 | Using assembly language with C/C++; Using Assembly Language with C++ for 16- Bit DOS Applications, Mixed Assembly and C++ Objects | 2 |
| 5 | Programming the 8086 microprocessor; Modular Programming, Using the Keyboard and Video Display, Disk Files | 2 |
| 6 | 8086 Hardware specifications; Pin-Outs and the Pin Functions, Clock Generator (8284A), Bus Buffering and Latching, The 8288 Bus Controller | 4 |
| 7 | 8086 Memory Interface; Memory Devices, Address Decoding, Memory Interface, Dynamic RAM | 4 |
| 8 | Basic I/O Interface; I/O Port Address Decoding, Programmable Peripheral Interface (8255), Programmable Interval Timer (8254), Programmable Communications Interface (16550), ADC(ADC804) and DAC (DAC830) | 6 |
| 9 | Interrupts; 8259A Interrupt controller | 2 |
| 10 | Direct memory access and DMA-controlled I/O; 8237 DMA controller | 2 |
| 11 | The arithmetic coprocessor; MMX, and SIMD technologies, 8087 arithmetic coprocessor | 2 |
| 12 | Bus interface; ISA Bus, PCI Bus, Parallel Printer Interface, Serial COM Ports, Universal Serial Bus (USB), Accelerated Graphics Port (AGP) | 2 |
| 13 | Intel Pentium and Core2 Processors | 4 |
| | Total lectures | 42 |

Suggested Text Book(s):

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1. Berry B.Brey, "The Intel Microprocessors : Architecture, Programming, and Interfacing," 8th Ed., Prentice Hall, 2009.

2. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085," 6th Ed., Penram, 2013.

Suggested Reference Book(s):

1. Douglas V Hall, "Microprocessors & Interfacing," 3rd Ed., McGraw Hill, 2017.

2. Yu-Cheng Liu,Glenn A. Gibson , "The 8086/8088 Family Architecture, Programming & design", 2nd Ed., PHI, 2011.

3. Kenneth Ayala "The 8086 microprocessor programming and Interfacing the PC," 1st Ed., Cengage Learning, 2007.

4. Tom Shanley, "Protected Mode Software Architecture," Addison-Wesley, 1996.

Other useful resource(s):

1. NPTEL ONLINE COURSES: Microprocessors and Microcontrollers
   https://nptel.ac.in/courses/106108100/ (Prof. Krishna Kumar ,IISc Bangalore)
   https://nptel.ac.in/courses/108105102/ (Prof. Santanu Chattopadhyay, IIT Kharagpur)

2. MIT OPEN COURSE WARE: Computer System Architecture
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/ (Dr. Joel Emer, Prof. Krste Asanovic, Prof. Arvind)

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course Outcomes (Microprocessor and Interfacing) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | x | 3 | 3 | 3 | 2 | x | x | x | x | x | 1 | 1.17 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | x | x | 3 | 3 | 2 | 3 | 2.17 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | x | x | 3 | 2 | 2 | 3 | 2.17 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 3 | x | x | 1 | x | x | 3 | 1.67 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | x | x | x | x | x | 3 | 1.67 |
| Average | 2.80 | 2.40 | 3.00 | 2.40 | 2.40 | 2.40 | 0.00 | 0.00 | 1.40 | 1.00 | 0.80 | 2.60 | |

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# Microprocessor and Interfacing Lab

COURSE CODE: 18B17EC572

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

Pre-requisite: Digital Electronics & Logic Design Lab

## Course Objectives:

1. To develop, implement, and debug 8086 assembly languageprograms
2. To familiarize the students with memory organization and interfacing of microprocessor with various peripheral devices.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Gain proficiency with using assembly language to develop microprocessor based applications | Familiarity |
| CO-2 | Learn control components of a microprocessor based system though the use of interrupts | Usage |
| CO-3 | Gain practical experience in programming memory and peripheral devices like timers/counters, parallel peripheral devices, serial communication interfaces and I/O devices | Usage |
| CO-4 | Gain practical experience in programming with coprocessor and DMA controller | Usage |
| CO-5 | Develop a microprocessor based system, using assembly language programming concepts, for handling a real life task | Assessment |

## List of Experiments

| S. No. | Description | Hours |
|---|---|---|
| 1 | Introduction to 8085/8086 based systems, ET-8085LCD /ET-8086LCD | 2 |
| 2 | To add, subtract, multiply and divide two 16bit nos. stored at locations 1000:0000H and 1000:0002H. Store the results starting from 1000:0004H. Find the total program memory size and number of machine cycles to execute the program. | 2 |
| 3 | To sort an array of 16 bytes stored at memory location starting from 1000:0300H. Store the array in ascending order at memory location starting from 1000:0310H and array in descending order at memory location starting from 1000:0320H. | 2 |
| 4 | To read a temperature in degree centigrade from keyboard when prompted, convert to degree Fahrenheit and display it on the LCD of ET-8086LCD microprocessor trainer kit | 2 |
| 5 | To interface an array of LEDs using 8255 parallel peripheral interface | 2 |
| 6 | To read a sensor input data from Port-A of 8255, filter it and output at Port-B of 8255 | 2 |
| 7 | To program the 8253 timer for generating delay | 2 |
| 8 | To use 8259 interrupt controller for interfacing external interrupts | 2 |
| 9 | To communicate between two microprocessor kits using 8251 serial communication interface | 2 |
| 10 | To do floating point operations using mathematical coprocessor 8087 | 2 |
| 11 | To do data transfer using DMA controller 8089 | 2 |
| 12 | To create, edit and display a text file in PC using BIOS and DOS interrupts | 2 |
| | Total Lab hours | 24 |

## Suggested Resources:


1. Berry B.Brey, "The Intel Microprocessors : Architecture, Programming, and Interfacing," 8th Ed., Prentice Hall, 2009.


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2. Kenneth Ayala, "The 8051 microcontroller," 3rd Ed., Thomson, 2005
3. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085," 6th Ed., Penram, 2013.
4. Official IA-32 Programmer Reference Manuals online at: https://software.intel.com/en-us/articles/intel-sdm

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 3 | 2.33 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 1 | x | x | 1 | 1 | x | 2 | 1.50 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | x | 1 | 2 | 2 | 1 | 3 | 2.00 |
| CO4 | 2 | 3 | 1 | 3 | 2 | x | x | 1 | x | 1 | x | 3 | 1.33 |
| CO5 | 3 | 3 | 3 | 3 | 2 | x | x | 2 | 3 | 3 | 3 | 3 | 2.33 |
| Average | 2.80 | 3.00 | 2.60 | 3.00 | 1.80 | 0.80 | 0.20 | 1.20 | 1.80 | 1.80 | 1.00 | 2.80 | |

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# Electromagnetic Waves

COURSE CODE: 18B11EC513

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: Basics of Engineering Mathematics

Course Objectives:

1. To lay the foundations of electromagnetic engineering and its applications in modern communication systems.
2. To analyze the wave propagation on transmission lines and wave guides.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To apply vector calculus to static electric-magnetic fields in different engineering situations. | Familiarity |
| CO-2 | To analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems. | Familiarity |
| CO-3 | To examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering. | Usage |
| CO-4 | To analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications. | Assessment |
| CO-5 | To analyze the wave propagation on two wire transmission lines and to study the applications of transmission lines in real time applications. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Review of Fields: Review of scalar and vector fields. Electrostatic and Magneto static Fields. | 4 |
| 2 | Maxwell's Equations: Inconsistency of Amperes law, Continuity equation, Displacement current, Maxwell's equations, Boundary conditions. | 4 |
| 3 | Wave propagation in space: Wave propagation in free space, Conductors and dielectrics, Polarization, Plane wave propagation in conducting and non conducting media, Phasor notation, Phase velocity, Group velocity; Reflection at the surface of the conductive medium, Surface Impedance, Depth of penetration. Transmission line analogy. | 11 |
| 4 | Poynting theorem: Poynting theorem, Poynting Vectors and power loss in a plane conductor. | 4 |
| 5 | Transmission Lines: Transmission line equations, characteristic impedance, open and short circuited lines, standing wave and reflection losses. Impedance matching, Smith Chart, Simple and double stub matching. | 6 |
| 6 | Waveguides: Rectangular and circular wave guides- Modes in rectangular and cylindrical coordinates, characteristics, power transmission and losses, excitation of modes. Microwave coaxial connectors. Rectangular, Circular and semi-circular cavity resonators, Q factor. | 8 |
| 7 | Radiation Basics: Scalar and vector potentials. Radiation from a current filament, half-wave dipole and small loop antennas. Antenna characteristics, radiation pattern, radiation intensity, directivity and power gain. Antenna arrays, effective area and Friss equation. | 5 |

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| | |
|---|---|
| Total lectures | 42 |

Suggested Text Book(s):


1. Hayt Jr, William H. John A. Buck, "Engineering Electromagnetic". 8th Edition, Tata McGraw-Hill, 2013.
2. Pozar, David M. "Microwave engineering"4th Edition, John Wiley & Sons, 2011.
3. Ballanis, Constantine A. "Antenna theory analysis and design", 3rd John Willey and Son's Inc., New York, 2005.


Suggested Reference Book(s):


1. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetic", 1st Edition, Oxford University press, 2012.
2. Cheng, David Keun. "Field and wave electromagnetic", 2nd Edition Pearson Education India, 2011.
3. Elliot, Robert S. "Antenna theory and design". Revised Edition, John Wiley & Sons, 2005.


Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117103065/
4. Link to topics related to course:
   - https://nptel.ac.in/courses/117103065/1
   - https://nptel.ac.in/courses/117103065/5
   - https://nptel.ac.in/courses/117103065/7
   - https://nptel.ac.in/courses/117103065/10

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Electromagnetic Waves) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.7 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2.1 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| Average | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.0 | 1.0 | 1.0 | 1.0 | 2.2 | 1.0 | 2.0 | |

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# Wireless and Data Communication

COURSE CODE: 18B11EC611

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

Pre-requisite: None

Course Objectives:

1. To understand the fundamentals of wireless and data communication networks.
2. To allow the students to learn network architecture and protocols of trending wireless networks.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of wireless communication system and various wireless standards. | Familiarity |
| CO-2 | Have the basic knowledge of computer networks and its applications in communication engineering. | Familiarity |
| CO-3 | Understand the behavior of wireless channel. | Usage |
| CO-4 | Have the knowledge of data sharing and their protocols. | Usage |
| CO-5 | Brief the recent protocols and standards of various communication networks. | Assessment |
| CO-6 | Get familiar with the recent wireless communication systems. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Review of Wireless Communication: Introduction to Wireless Communication, Basic building blocks of wireless system: source coding & channel coding, base band & band pass signal representation; 1G, 2G, 2.5G, 3G, 4G and 5G wireless standards and their Comparison; Multiple Access techniques: TDMA, FDMA, CDMA, OFDMA. | 6 |
| 2 | Wireless Channel: Linear Time Varying System; Path loss model; Multipath Propagation; Doppler Shift; Parameters of Wireless Multipath Channel; Small-scale and large-scale fading; Shadowing, Types of Fading: flat fading, frequency selective fading, slow fading and fast fading; Capacity of wireless channel: Capacity of AWGN, Flat Fading and Frequency Selective Channels. | 10 |
| 3 | Data Communication: OSI vs TCP/IP model; Wired vs Wireless; Circuit switching/ Packet switching; Flow control and error control; CRC; Connection oriented/connection less transmission; Bit stuffing. | 7 |
| 4 | MAC, Network and transport layer protocols: Dynamic multiple access methods: ALOHA, slotted ALOHA, CSMA/CD etc; Routing algorithms: DSDV, LSR, AODV; Broadcasting methods: flooding, spanning tree, multicasting; UDP, TCP, IP, IPv4, IPv6, QoS. | 8 |
| 5 | Wireless Networks: Introduction to WiFi; 802.11, 802.11a and 802.11 b Wireless LANs; Frame structure; Modes of operation; Data rates; Power management; Handoff strategies, Medium access control etc. Bluetooth networks: Piconet, scatternet, frame structure, data rates; synchronous and asynchronous services, power saving etc | 8 |
| 6 | Recent Trends: Introduction to WiMAX and ZigBee Networks; Software Defined Radio; UWB Radio; Wireless Adhoc Network and Mobile Portability; Security issues and challenges in a Wireless network. | 3 |

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| | |
|---|---|
| Total lectures | 42 |

Suggested Text Book(s):

1. T.S. Rappaport, "Wireless Communication", 2nd Edition, Prentice Hall., 2010.
2. A. Tanenbaum, "Computer Networks", 5th Edition, Prentice Hall, 2011.
3. Bahrouz Forouzan, "Data communication & Networking," 5th Edition, McGraw Hill, 2017.

Suggested Reference Book(s):

1. William Stallings, "Data and Computer Communications," 10th Edition, Pearson.,2013.

Other useful resource(s):

Link to NPTEL course contents:

1. https://nptel.ac.in/courses/117102062/36
2. https://nptel.ac.in/courses/106105082/31

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Wireless and Data Communication ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1.58 |
| CO-2 | 3 | 3 | 1 | 3 | 2 | 1 | 1 | 3 | 1 | 2 | 1 | 2 | 1.92 |
| CO-3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 2 | 2 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 2 | 2.17 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2.33 |
| CO-6 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 2.67 |
| Average | 3 | 3 | 2.17 | 3 | 2.17 | 1 | 1.83 | 2.67 | 1.5 | 2 | 1.33 | 2 | |

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# VLSI Technology

COURSE CODE: 18B11EC612

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: None

## Course Objectives:

1. To bring both Circuits and System views on design together so as to offers a profound understanding of the design of complex digital VLSI circuits.
2. To use computer aided simulation and synthesis tools for hardware design.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model. | Familiarity |
| CO-2 | To be aware about the trends in semiconductor technology, and how it impacts scaling and its effect on device density, speed and power consumption. | Familiarity |
| CO-3 | To understand MOS transistor as a switch and its capacitance. | Usage |
| CO-4 | Student will be able to design digital systems using MOS circuits (Static and Switching characteristics of inverters). | Usage |
| CO-5 | Able to learn Layout, Stick diagrams, Fabrication steps. | Usage |
| CO-6 | Understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry. | Assessment |

## Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to VLSI technology, VLSI design flow, Digital Design Cycle, Physical Design Cycle. | 3 |
| 2 | MOS fundamentals, Device Structure and Physical Operation, Current- Voltage Characteristics, channel length modulation, body effect, biasing of MOSFETs, capacitances in MOS, VLSI circuit and system representation. | 11 |
| 3 | Logic gate characteristics, Design of MOS inverter with different loads, Determination of pull up and pull down ratio for an nMOS inverter driven by another n MOS inverter, Design of W/L, power dissipation, propagation delay, and noise margin analysis. | 11 |
| 4 | CMOS inverter, static and dynamic characteristics of CMOS inverter, DC Characteristics: NAND and NOR Gates, NAND and NOR transient response, System design using HDL. | 11 |
| 5 | Stick diagram, Layout, Fabrication. | 6 |
| Total lectures | | 42 |

## Suggested Text Book(s):


1. Sung-Mo Kang, Yusuf Leblebici : CMOS Digital Integrated Circuits Analysisand Design, Tata McGraw-Hill, 2003.
2. Adel S. Sedra, Kenneth C. Smith: Microelectronics Circuits, 5th Ed., Oxford University, 2004.
3. John P. Uyemura: Introduction to VLSI Circuits and Systems, John Wiley & Sons, Inc., 2002.


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Suggested Reference Book(s):

1. Neil Weste and David Harris CMOS VLSI Design", 4th Ed., Addison Wesley, 2011.
2. Douglas A Pucknell et al, "Basic VLSI Design", 3rd Ed., Prenctice Hall, 2004.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/108106069/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Class performance, Tutorials & Assignments - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (VLSI Technology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2.08 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 2.08 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2.08 |
| CO5 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1.75 |
| CO6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2.33 |
| Average | 3.00 | 2.83 | 2.67 | 2.67 | 2.67 | 2.33 | 1.67 | 1 | 1 | 1.17 | 1.17 | 2.50 | |

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# VLSI Technology Lab

COURSE CODE: 18B17EC672

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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Pre-requisite: None

Course Objectives:

1. To study the constructs, conventions and design capabilities of the Verilog HDL and to learn to implement a given algorithm into an FPGA breaking it into modules and sub modules.
2. To study gate level , dataflow (RTL), behavioral, and switch level modeling, describes leading logic synthesis methodologies using the xilinx platform to write test benches and simulate the digital system designs

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Apply the techniques of design, simulation and synthesis of digital circuits to design FPGA based systems or/and ASICs using Xilinx design tools | Familiarity |
| CO2 | Explain and design the test benches for verification of the given IP core or HDL based design. | Usage |
| CO3 | Able to explain the System Modeling with Tasks and Functions | Usage |
| CO4 | Design digital circuits for implementing a signal processing algorithm using different Verilog modeling styles. | Assessment |

List of Experiments

| S. No | Description | Hours |
|---|---|---|
| 1 | Learn how to use of XILINX ISE simulator by writing the Verilog code to simulate a half adder; where a, b are 1-bit input | 1 |
| 2 | Write data flow Verilog HDL model for Half Adder using different modeling technique | 1 |
| 3 | Write data flow Verilog HDL model for Full Adder | 1 |
| 4 | Using structural modeling of Verilog HDL perform the following:<br>Half adder with proper test stimulus.<br>Full adder (using half adder module of part 1) with proper test stimulus | 2 |
| 5 | Write down Verilog HDL code of the following<br>Data flow model of 2x1 Multiplexer with proper test stimulus.<br>Structural model of 2x1 Multiplexer with proper test stimulus. | 2 |
| 6 | Write the hardware description of a 4:1 multiplexer<br>Using behavioural modelling<br>Using structural modelling<br>Using 2:1 multiplexer | 2 |
| 7 | Write down Verilog HDL code of 2x1 Multiplexer and 4x1 Multiplexer using if-else statement, case statement and ternary operator. | 2 |
| 8 | Write the hardware description of a 2:1 multiplexer and 4:1 multiplexer, each input and output of this multiplexer is of 4-bit. | 2 |
| 9 | Write the hardware description of a 4-bit adder/Subtractor | 2 |
| 10 | Write data flow Verilog HDL model for Encoder/ Decoder using any modeling technique | 2 |
| | Simulate the Verilog HDL code for the following | |

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| | | |
|---|---|---|
| 11 | • D-Latch using proper test stimulus.<br>• D-flip flop using proper test stimulus. | 2 |
| 12 | Write the Verilog HDL code for a JK Flip flop, and its test-bench | 1 |
| 13 | Write the hardware description of a 8-bit register with shift left and shift right modes of operation | 2 |
| 14 | Write the Verilog HDL code of a 4-bit PRBS (pseudo-random Binary sequence) generator using a linear feed-back shift register and test it. Choose your own polynomial for the generator | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. John P. Uyemura: Introduction to VLSI Circuits and Systems, John Wiley & Sons, , Inc, 2002
2. Samir Palnitkar, "Verilog HDL", Pearson Education (2nd edition)


Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Advance Communication Lab

COURSE CODE: 18B17EC673

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. Understand the concepts of various digital modulation techniques.
2. To get familiar with the practical implementation of various communication systems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of LabView, MATLab and WiCOMM-T kit | Familiarity |
| CO-2 | Understand the design, application and practical implementation of various digital modulation techniques. | Usage |
| CO-3 | Gain practical experience of the functioning of advance communication systems. | Usage |
| CO-4 | Analyze the performance of communication systems. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to LabView, Matlab and WiComm-T (SDR) kit. | 2 |
| 2 | Implementation of Quadrature Phase Shift Keying Modulation and Demodulation system.<br>• Constellation plots<br>• Phase and frequency offset | 2 |
| 3 | Implementation of Quadrature Amplitude Modulation and Demodulation (QAM)<br>• 16-QAM<br>• 64-QAM | 2 |
| 4 | Implementation of Gaussian Minimum Shift Keying (GMSK) modulation and demodulation system. | 2 |
| 5 | Performance analysis of baseband digital communication link. | 2 |
| 6 | Eye diagram measurement for Inter Symbol Interference (ISI). | 2 |
| 7 | To demonstrate Time Division Multiplexing and Demultiplexing. | 2 |
| 8 | To demonstrate Frequency Division Multiplexing and Demultiplexing. | 2 |
| 9 | Implementation of source coding techniques. | 2 |
| 10 | Implementation of channel coding and error control coding techniques. | 2 |
| 11 | To demonstrate GSM communication system. | 2 |
| 12 | To demonstrate OFDM communication system. | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. T.S. Rappaport, "Wireless Communication", 2nd Edition, Prentice Hall, 2002.
2. Lazos Hanzo: OFDM and MC-CDMA:a primer, 1st Edition, Wiley-IEEE Press, 2006.


Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |


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Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 2.08 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 2.00 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1.92 |
| Average | 3.00 | 3.00 | 2.75 | 2.75 | 2.50 | 1.25 | 1.00 | 1.25 | 1.00 | 1.50 | 1.00 | 3.00 | |

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# Network Analysis and Synthesis

COURSE CODE: 18B1WEC534

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. Circuit analysis in the S domain using Laplace transforms. Analysis of two port networks.
2. Design and analysis of filters and attenuators. Elements of realizability and synthesis of one port networks.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the need and foundation of network analysis | Familiarity |
| CO-2 | Analyze two port networks, filters and attenuators | Assessment |
| CO-3 | Analysis of problem solving, knowledge and reasoning | Assessment |
| CO-4 | Study of application domains for network analysis and synthesis. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Laplace transform and its application in circuit analysis : Laplace Transformation, laplace transforms of some important functions, properties of laplace transforms, step function, impulse function, laplace transform of periodic functions, inverse transforms, initial and final value theorms. Circuit elements in the S domain, Transfer function, use of transfer function in circuit analysis, the transfer function and the convolution integral, the transfer function and the steady state sinusoidal response, the impulse function in circuit analysis. | 8 |
| 2 | S- Domain Analysis: Concept of complex frequency, physical interpretation of complex frequency, transform impedance and transform circuits, series and parallel combinations of elements, terminal pair or ports, network function for one port and two port networks, poles and zeros of network functions, significance of poles and zeros, properties of driving point functions, properties of transfer functions, necessary condition for a driving point function, necessary condition for transfer functions, time domain response from pole zero plot, amplitude and phase response from pole zero plot, stability criteria for an active network, routh criteria. | 9 |
| 3 | Two- Port networks: Two port networks, open circuit (Z) parameters, short circuit (Y) parameters, transmission (ABCD) parameters, inverse transmission (A' B'C'D')parameters, Hybrid (H) parameters, Inverse Hybrid(G) parameters, inter relationships of different parameters, interconnection of two port networks, T and $\prod$ representations, terminated two port network, lattice network, Image networks. | 8 |
| 4 | Filters and Attenuators: Classification of filters, filter networks, equation of filter networks, classification of pass band and stop band, characteristic impedance in the pass band and stop bands, constant –K low pass filter, constant –K high pass filter, m derived T- section, band pass filter, band elimination filter, attenuators, T- type attenuator, $\prod$- type attenuator, lattice attenuator, bridged –T attenuator, L- type attenuator, equalizers, inverse network, series equalizer, full series equalizer, shunt equalizer, full shunt equalizer, constant – resistance equalizer, bridged –T attenuation equalizer, bridged –T phase equalizer, lattice attenuation equalizer, lattice phase equalizer. | 9 |
| 5 | Elements of realizability and synthesis of one port networks : Hurwitz polynomials, positive real functions, frequency response of reactive one ports, synthesis of reactive one ports by foster's method, synthesis of reactive one ports by Cauer's method, synthesis of R-L network by foster's method, synthesis of R-L network by Cauer's method, synthesis of R-C network by foster's method, synthesis of R-C network by Cauer's method. | 8 |
| | Total lectures | 42 |

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Suggested Text Book(s):

1. A sudhakar, shyammohan S palli" Circuits and networks Analysis and synthesis", Fifth Edition, Tata Mcgraw Hill.
2. M E Van Vakenburg,"Network Analysis and synthesis", Third edition, Pearson

Suggested Reference Book(s):

1. Ravish R Singh, "Network Analysis and synthesis", Tata Mcgraw Hill.

Other useful resource(s):

Link to topics related to course: https://nptel.ac.in/courses/106105154

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Network Analysis and Synthesis ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2.08 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.83 |
| CO-3 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.83 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 2.00 |
| Average | 2.25 | 2.75 | 2.75 | 2.75 | 2.25 | 1 | 1 | 1 | 2 | 2.25 | 1.25 | 2 | |

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# Communication Engineering

COURSE CODE: 18B1WEC535

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Signals & Systems, Basic Course in Probability.

Course Objectives:

1. To understand the use of communication in the field of satellites and the concept of spread spectrum.
2. To make the students familiar with the implications of laws of information theory and coding with reference to the application in communication engineering.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will be familiar with the various fields/trends of communications like Satellite communication, Information theory and coding, and spread spectrum technique related to radio and telecommunication. | Familiarity |
| CO-2 | To analyze the error performance of digital modulation systems in the presence of noise. | Assessment |
| CO-3 | Design link power budget for satellite communication. | Assessment |
| CO-4 | Design the channel based on given constraint using information theory. | Assessment |
| CO-5 | Apply various codes like linear block codes, convolution codes etc. for channel performance analysis. | Usage |
| CO-6 | Analyze the performance of spread spectrum systems in jamming environment. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Baseband Transmission and Pass band Digital Modulation: Matched Filter, Inter Symbol Interference, Eye Pattern, Overview of ASK, FSK, PSK, and QAM, Basics of MSK, Signal Constellations, Probability of error analysis of modulation schemes. | 6 |
| 2 | Communication Link Analysis: The Channel, Error-Performance Degradation, Sources of Signal Loss and Noise, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, System temperature, Sample Link Analysis. | 9 |
| 3 | Fundamental Limits in Information Theory: Uncertainty, Information, Entropy, Source-Coding Theorem, Data Compaction, Discrete Memoryless Channels, Mutual Information, Channel Capacity, Channel-Coding Theorem. | 9 |
| 4 | Error-Control Coding: Introduction, Linear Block Codes, Syndrome, Syndrome Decoding, Cyclic Codes, Generator Polynomial, Parity-Check Polynomial, Convolution Codes, Code tree, Trellis Diagram, Maximum Likelihood Decoding of Convolution Codes, Viterbi Algorithm. | 10 |
| 5 | Spread-Spectrum Modulation: Introduction, Pseudo-Noise Sequences, Direct Sequence Spread Spectrum with coherent BPSK, Signal-Space Dimensionality and Processing Gain, Frequency Hopping Spread Spectrum. | 8 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. Simon Haykin, "Communication Systems", 4th Ed., John Wiley & Sons, 2004.
2. Bernard Sklar and P. K. Ray, "Digital Communications: Fundamentals and Applications", 2nd Ed., Pearson Education, 2012.

Suggested Reference Book(s):

1. B. P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", 4th Ed., Oxford, 2010.

Other useful resource(s):

Link to NPTEL course contents: https://nptel.ac.in/courses/117105131/16
Link to NPTEL course contents: https://nptel.ac.in/courses/117101053/1
Link to NPTEL course contents: https://nptel.ac.in/courses/117105136/1

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (1) - 5<br>Quizzes (2) - 15<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course Outcomes (Communication Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2.17 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 2.25 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2.58 |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2.08 |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2.33 |
| CO-6 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.58 |
| Average | 3.00 | 3.00 | 2.83 | 2.50 | 2.17 | 2.17 | 1.83 | 1.83 | 1.17 | 2.00 | 2.50 | 3.00 | |

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# Fundamentals of Digital Image Processing

COURSE CODE: 18B1WEC536

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. Describe and explain basic principles of digital image processing.
2. Design and implement algorithms for basic and advanced image analysis
3. Assess the performance of image processing algorithms and systems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Analyze general terminology of digital image processing. | Familiarity |
| CO-2 | Examine various types of images, intensity transformations and spatial filtering. | Familiarity |
| CO-3 | Develop Fourier transform for image processing in frequency domain. | Assessment |
| CO-4 | Evaluate the methodologies for image segmentation, restoration etc. | Usage |
| CO-5 | Implement image process and analysis algorithms. | Usage |
| CO-6 | Apply image processing algorithms in practical applications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Digital Image Fundamentals: Introduction, Image sensing and acquisition, Image Sampling and quantization, Spatial and Gray level resolution, Zooming and Shrinking, Relationships between pixels, Linear and Nonlinear operations. | 7 |
| 2 | Image Enhancement in the Spatial Domain: Gray Level Transformation, Histogram Processing Techniques, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filters. | 8 |
| 3 | Image Enhancement in the Frequency Domain: Properties of frequency domain, two dimensional Fourier Transform and its properties, Correspondence between filtering in spatial and frequency domain, Smoothing and Sharpening frequency domain filters, Homomorphic Filtering. | 6 |
| 4 | Image Restoration: Model of the Image Degradation/Restoration Process, Noise Models, Noise reduction in spatial domain and frequency domain, Inverse filtering, Wiener filtering. | 6 |
| 5 | Image Compression: Fundamentals of image compression, Image compression models, Variable length coding, Huffman coding, Near optimal variable length coding, Arithmetic coding, Constant area coding, Run length coding, Image compression standards (JPEG, JPEG2000). | 7 |
| 6 | Image Segmentation: Detection of discontinuities (point, line edge), Edge Linking and Boundary Detection, Thresholding, Basic global Thresholding, Adaptive Thresholding, Region-Based Segmentation. | 8 |
| | Total lectures | 42 |

Suggested Text Book(s):

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", fourth Edition, Pearson Education, 2018.

Suggested Reference Book(s):

1. Anil K. Jain, "Fundamentals of Digital Image Processing", First Edition, PHI Learning Pvt. Ltd, 2015.

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2. Willliam K Pratt, "Digital Image Processing", Fourth Edition, John Willey, 2007.
3. S.Sridhar, "Digital Image Processing", Second Edition, Oxford University Press, 2016
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Fundamentals of Digital Image Processing ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1.92 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.08 |
| CO-3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1.92 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.17 |
| CO-5 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2.42 |
| CO-6 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2.00 |
| Average | 3.00 | 2.50 | 2.50 | 2.67 | 2.3 | 1.67 | 1.33 | 1.17 | 2.00 | 2.33 | 2.00 | 2.00 | |

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# Digital Filter Design and Applications

COURSE CODE: 18B1WEC631

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Signals & Systems

Course Objectives:

1. To understand the basics and practical limitations of digital filterdesign.
2. To study the digital filters applications.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of the digital Filters | Familiarity |
| CO-2 | Design and analysis of the FIR filters | Usage |
| CO-3 | Design and analysis of the IIR filters | Usage |
| CO-4 | Understand the limitation of IIR and FIR Filters in implementation | Familiarity |
| CO-5 | Study the applications of digital filters | Assessment |

Course Contents:

| S. No. | Contents | Contact Hours |
|---|---|---|
| 1. | Introduction to Filters: Butterworth filters, Chebyshev filters, Elliptical Filters, Bessel Filters, FIR filters, IIR Filters. | 10 |
| 2. | FIR Filters: One dimensional FIR filter design using rectangular window, triangular window, hamming window, dolph-chebyshev window, and Kaiser window. Two dimensional FIR filter design. | 10 |
| 3 | IIR Filters: One dimensional and two dimensional IIR filter design. | 06 |
| 4. | Practical Considerations in implementation<br>Coefficient Quantization in Digital Filters, Scaling in Fixed-Point Arithmetic, Quantization Noise. | 04 |
| 5. | Applications of Digital Filters, Noise suppression, Enhancement of selected frequency ranges, Removal or attenuation of selected frequencies, Bandwidth limiting. Analysis of digital filters for signal and image processing using MATLAB, and LABVIEW. | 12 |
| | Total | 42 |

Suggested Text Book(s):


1. Andreas Antoniou, Digital Filters: Analysis, Design and Applications, Second edition, Tata Mc Graw Hill, 1999.
2. M. Ahmadi, M. Azimi-Sadjadi, R. Gorgui-Naguib, R. King, A. Kwabwe,Digital Filtering in One and Two Dimensions, 1st Edition, Springer Science & Business Media, 1989.
3. Jackson, Leland B. Digital Filters and Signal Processing: with MATLAB®Exercises. Springer Science & Business Media, 2013.


Suggested Reference Book(s):


1. Wu-Sheng Lu, Two-Dimensional Digital Filters, 1st Edition, CRC Press,2001.
2. Winder, Steve, Analog and digital filter design, 2nd Edition, Newness Publishers, 2002
3. Schaumann, Rolf, Haiqiao Xiao, and Van V. Mac. "Design of Analog Filters 2nd Edition (The Oxford Series in Electrical and Computer Engineering)." (2009).
4. C. Britton Rorabaugh, "Digital Filter Designer's Handbook: With C++ Algorithms",2nd, Volume1, McGraw-Hill, 1997
5. Jolyon M.DeFreitas, Digital Filter Design and solutions, Artech house publishers, 2005


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6. Andreas Antoniou, Digital Filters: Analysis, Design and Applications, Second edition, Tata Mc Graw Hill, 1999
7. Taylor, Fred. Digital filters: principles and applications with MATLAB. Vol. 30. John Wiley & Sons, 2011.

Other useful resource(s):

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/lecture-17-design-of-fir-digital-filters/, | Prof. Alan V. Oppenheim
2. http://web.stanford.edu/class/archive/ee/ee264/ee264.1072/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Digital Filter Design and Applications) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1.8 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2.2 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 2.3 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2.8 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2.7 |
| Average | 3 | 3 | 3 | 2.8 | 2.8 | 1.8 | 1.8 | 1.8 | 2.2 | 2.2 | 1.8 | 1.8 | |

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# Intelligent Control Systems

COURSE CODE: 18B1WEC632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Fundamentals of Control Systems

Course Objectives:

1. To explain the basic disciplines of artificial intelligence, and show the possibilities of their application in control systems, for creation of intelligent control systems.
2. To study the control-theoretic foundations such as stability and robustness analysis in the framework of intelligent control.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Obtain a basic understanding of artificial intelligence techniques and know how these techniques are applied to engineering problems | Familiarity |
| CO-2 | Select appropriately from a range of techniques when implementing control systems. | Assessment |
| CO-3 | Know control-theoretic foundations such as stability and robustness in the frame work of intelligent systems and control. | Assessment |
| CO-4 | Design and develop control system using artificial intelligence techniques and exposure to many real world control problems | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Intelligent Control Systems: Machine intelligence, Sensors, Actuators, Controllers, External I/O devices, Applications | 4 |
| 2 | Computational Intelligence Techniques Applied to Control Systems Design I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks | 8 |
| 3 | Computational Intelligence Techniques Applied to Control Systems Design II: Fuzzy logic, Knowledge representation and inference mechanism, Fuzzy neural networks, Deep neural networks, Optimization techniques | 8 |
| 4 | Typical and Special Fuzzy Controllers: Fuzzy and expert control, Parametric optimization of fuzzy logic controller, System identification using neural and fuzzy neural networks | 6 |
| 5 | System Stability and Robustness Analysis: Lyapunov's stability theory and Passivity Theory | 4 |
| 6 | Adaptive Control: Direct and Indirect adaptive control, and Self-tuning Pill Controllers | 6 |
| 7 | Applications to Engineering Problems: Robot manipulator control, Flight control, Under-actuated systems control, Creation of a Neural Networks with MATLAB Neural Network Toolbox | 6 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, Menlo Park, CA, 1998.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson, 1997.


Suggested Reference Book(s):


1. Panos J. Antsaklis, Kevin M. Passino, eds., "An Introduction to Intelligent and Autonomous Control", Kluwer



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Academic Publishers, Norwell, MA, 1993.
2. T. Nanayakkara, F. Sahin, and M. Jamshidi, Intelligent Control Systems with an Introduction to Systems of Systems, CRC Press, 2008.
3. A. E. Ruano, "Intelligent Control Systems using Computational Intelligence Techniques", IET, 2005.

Other useful resource(s):

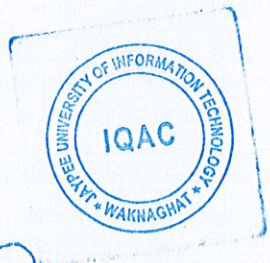
1. Link to NPTEL course contents: https://nptel.ac.in/courses/108104049/
2. Link to COURSERA course contents: https://www.coursera.org/learn/neural-networks-deep-learning/home/welcome

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignments (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Intelligent Control Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2.2 |
| CO-2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| CO-3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 1.8 |
| CO-4 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO-5 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| Average | 2.2 | 2.4 | 2.8 | 3 | 2.4 | 1.8 | 1 | 1.2 | 1.6 | 5 | 2.2 | 2.4 | |

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# Optical Communication Systems

COURSE CODE: 18B1WEC633

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Communication Systems

Course Objectives:

1. To understand the constituents of the fiber optics communication system and optoelectronics.
2. To have an in depth knowledge of practically used optical communication systems

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand basics of optical communication systems. | Familiarity |
| CO-2 | The principles that govern optical communication systems. | Familiarity |
| CO-3 | Behavior of light as electromagnetic waves in different types of fibers. | Assessment |
| CO-4 | The hardware components required to implement optical communication systems. | Assessment |
| CO-5 | To efficiently design an optical communication system for practical purpose. | Usage |
| CO-6 | The practical techniques involved in optical communication systems. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Fiber optics and Optoelectronics, Historical developments, Fiber optic communication system, Advantages, Emergence as a key technology, Role of Fiber optics technology. | 5 |
| 2 | Ray Propagation in Optical Fibers: Review of fundamental laws of optics, Ray propagation in Step-index and Graded-index Fibers, Effect of material dispersion, The combined effect of multipath and material dispersion, Calculation of rms pulse width. | 8 |
| 3 | Wave propagation in Waveguides: Maxwell's equations, Solution in a inhomogeneous medium, Planar optical waveguide, TE modes of a symmetric step-index planar waveguide, Power distribution and confinement factor, Modal analysis of an ideal SI optical fiber. | 8 |
| 4 | Single-mode Fibers and Multimode Fibers: Single-mode fibers, Characteristics parameters of SMFs, Dispersion in SMFs, Attenuation in SMFs, Graded-index fibers, Limitations of multimode fibers. | 7 |
| 5 | Optoelectronic Sources and Detectors: Fundamental aspects of semiconductor physics, the p-n junction, Current densities and injection efficiency, The basic principle of optoelectronic detection. Types of photodiodes, Photoconducting detectors, Noise considerations. | 8 |
| 6 | Optoelectronic Modulators and Amplifiers: Review of basic principles, Electro-optic modulators, Semiconductor optical amplifiers. | 6 |
| Total lectures | | 42 |

Suggested Text Book(s):

1. Optical Fiber Communications, John M Senior, 3rd Edition, PHI,2009.
2. Fiber Optic Communication Systems, Govind P. Agarwal, 4th Edition, Wiley, 2010.
3. Fiber Optics and Optoelectronics, R.P. Khare Oxford University Press, 2015

Suggested Reference Book(s):

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1. Fiber Optic Communications, S. Kumar and M. J. Deen, Wiley,2014.
2. Optical Fiber Communications, G. Keiser, 5th Edition, Tata McGraw Hill, 2009.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117101002/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Optical Communication Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.75 |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.75 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| CO-5 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| CO-6 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| Average | 2 | 2.66 | 2.66 | 2.66 | 2.66 | 1 | 1 | 1 | 2 | 2.5 | 1.66 | 2 | |

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# Microwave Theory and Techniques

COURSE CODE: 18B1WEC746

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Basics of Electromagnetic Engineering

Course Objectives:

1. To learn the basic principles of microwave generators and amplifiers.
2. To have foundations on microwave design principles and measurement.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To identify different microwave components and their applications. | Familiarity |
| CO-2 | To study the performance of specialized microwave tubes such as klystrons. | Familiarity |
| CO-3 | To understand the principle of operation of magnetrons, traveling wave tubes and BWOs. | Assessment |
| CO-4 | To understand the working principle of microwave solid state devices and their applications. | Assessment |
| CO-5 | To design of microwave filters, amplifiers and oscillators. | Usage |
| CO-6 | To learn about microwave power, VSWR, impedance and attenuation measurements. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Introduction to microwaves, Scattering matrix of microwave waveguide junction, properties of S-matrix, E-plane tee, H-plane tee, magic tee, attenuators, directional couplers, ferrite devices, Faraday rotation, gyrator, isolator, circulators and cavity resonators. | 8 |
| 2 | Microwave Tubes: Limitations and losses of conventional tubes at microwave frequencies, microwave tubes-O-type and M-type classifications. O-type tubes: Two cavity klystron-structure, reentrant cavities, velocity modulation process and apple gate diagram, bunching process and small signal theory- expression for output power and efficiency. Reflex Klystron-Structure, velocity modulation and apple gate diagram, mathematical theory of bunching, power output, efficiency, oscillating modes and output characteristics. | 9 |
| 3 | Microwave Crossed-Filed Tubes:<br>M-Type tubes: Introduction, cross filed effects, magnetrons-different types, cylindrical travelling wave magnetron-Hull cut-off and Hartree conditions, mode of resonance and PI-mode of operations, separation of PI-mode, output characteristics, Backward wave crossed field oscillator (Carcinotron). | 6 |
| 4 | Helix TWTs: Significance, types and characteristics of slow wave structures, structure of TWT and amplification process (qualitative treatment), suppression of oscillations, gain considerations. | 5 |
| 5 | Microwave Solid state Devices: Introduction, classification, applications. TEDs-Introduction, Gunn diodes-principle, RWH theory, characteristics, modes of operations, IMPATT diode, TRAPATT Diode, BARITT diode, PIN diode, Tunnel diode. | 7 |
| 6 | Microwave Design Principles and Measurements: Microwave Filter Design, Microwave Amplifier Design, Low Noise Amplifier Design, Microwave Oscillator Design, VSWR and impedance measurement, attenuation measurement and power measurement. | 7 |
| Total lectures | | 42 |

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Suggested Text Book(s):


1. Samuel Y.Liao, " Microwave Devices and Circuits", 3rd Edition, Pearson education, 2003.
2. R.E.Collin, "Foundations for microwave Engineering", 2nd Edition, Tata Mc Graw Hill, 1992.
3. Pozar, David M. "Microwave engineering", 4th Edition, John Wiley & Sons, 2013.


Suggested Reference Book(s):


1. Annapurna Das, Sisir.K.Das, "Microwave Engineering",1st Edition, Tata McGraw Hill, 2000.


Other useful resource(s):

1. Link to topics related to course: https://nptel.ac.in/courses/108101112

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Microwave Theory and Techniques) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1.58 |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1.92 |
| CO-3 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1.83 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 2.0 |
| CO-5 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 1 | 2.08 |
| CO-6 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1.83 |
| Average | 2.5 | 2.5 | 2.5 | 2.33 | 2.33 | 1.16 | 1.33 | 1.16 | 1.5 | 2.33 | 1.5 | 1.33 | |

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# Next Generation Communication Systems

COURSE CODE: 18B1WEC745

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Basic knowledge of wireless communication and probability theory

Course Objectives:

1. To analyze the channel parameters effects on communication system.
2. Understanding of advanced techniques employed for improvement of communication system.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of communication system and various standards used in different generation. | Familiarity |
| CO-2 | Understand the modeling of channel used in communication. | Familiarity |
| CO-3 | Analyze the effect of various parameters on the performance of communication system. | Assessment |
| CO-4 | Demonstrate the various techniques for performance improvement of communication system | Assessment |
| CO-5 | Apply advanced techniques to next generation communication system | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | CDMA: Introduction to various generation of cellular communication systems and standards, Introduction to CDMA and Spread Spectrum, Generation and Properties of PN Sequences, correlation between PN Sequences, Walsh Code, Variable tree OVSF, LFSR, Rake Receiver, Near-Far effect, Multi user CDMA uplink and downlink. | 9 |
| 2 | Channel Characterization of Next generation communication system: BER and SNR analysis of wired and wireless channels, Effect of various channel parameters on performance of wireless communication system, Doppler shift. | 6 |
| 3 | Diversity & Equalization: Diversity System Model, Receiver Diversity: selection diversity, feedback diversity, maximal ratio combining, equal gain combining, Equalizers, Types of Equalizers: linear equalizers, non-linear equalizers. | 9 |
| 4 | Principles of OFDM and MIMO wireless communication: Introduction to OFDM, OFDM Block Diagram, MIMO Wireless Communication, Benefits of MIMO Technology, MIMO OFDM Building Block, Capacity Comparisons of SISO, SIMO, MISO, and MIMO. | 9 |
| 5 | Singular Value Decomposition, Software Defined Radio , Cognitive Radio | 9 |
| | Total lectures | 42 |

Suggested Text Book(s):


1. T.S. Rappaport, "Wireless Communication", 2nd Edition, Prentice Hall.,2002.
2. A.Goldsmith, " Wireless communication" 1st Edition , Cambridge University Press,2005.
3. Ye Li and Gordon L. Stuber, "Orthogonal Frequency Division Multiplexing for Wireless Communications" 1st Edition, Springer, 2006.


Suggested Reference Book(s):


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1. Huseyin Arslan: Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, 1st Edition, Springer, 2007.

2. Hui Liu, "OFDM based broadband wireless networks: design and optimization" , 1st Edition, John Wiley & Sons, 2006.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117104099/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programmed Outcomes (POs)

| Course outcomes (Next Generation Communication Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1.92 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2.08 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1.83 |
| CO-4 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1.83 |
| CO-5 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2.00 |
| Average | 2.6 | 2.8 | 2.6 | 2.4 | 2 | 1.6 | 1.4 | 1.2 | 1 | 2 | 1.6 | 2 | |

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# FPGA based Instrumentation System Design

COURSE CODE: 18B1WEC744

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Digital Electronics, Basic Electronics

Course Objectives:

1. Learn and understand the FPGA design flow
2. Learn to implement basic arithmetic circuits and DSP algorithms in FPGA using IP cores.
3. Learn to determine circuit speed, to check timing violations and techniques to fix them.
4. Learn to apply the knowledge gained to break an algorithm into arithmetic functions and implement in FPGA with/without using IP cores.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Explain the concept and basic structures of Field Programmable Gate Array (FPGA), and techniques to implement programmable logic circuits using typical FPGA design flow | Familiarity |
| CO-2 | Implementing basic arithmetic circuits and ASICs for simple DSP functions, such as filters using user defined or vendor provided IP cores | Assessment |
| CO-3 | Determining circuit speed, checking timing violations and techniques to fix the timing violations. | Usage |
| CO-4 | Design issues in cross clock domains communication in high-speed ASIC design | Assessment |
| CO-5 | Break any given algorithm to sub-modules and implement the same on FPGA using HDLs and various IP cores | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to FPGA : From discrete logic to FPGAs, flexibility and functionality, FPGA vs Programmable DSPs, FPGA technology - roadmap, clocking, data and sample rates, slices and configurable logic blocks, memory and registers, performance ratings, families DSP and FPGAs: FPGA elements for DSP algorithms, FPGA- Based System Design Examples | 6 |
| 2 | Verilog HDL: Data types, operators, Multiplexers, decoders, adders, Subtractor, de-multiplexers, flip-flops, counters, state machine, ALU with adder/Subtractor and shifter, multiply and divide hardware synthesis, memory, using a test bench for verification and simulation Concept of state machine and VHDL implementation, simulation synthesis, verification, : FSM Types, Implementation in HDLs, a simple computer design, other Design examples and case studies | 12 |
| 3 | Digital System Design: Combinational and sequential circuits, Classification of sequential circuits, Registers. Design & analysis of synchronous and asynchronous sequential circuits: Counters. | 6 |
| 4 | Embedded Systems & FPGAs: FPGA as a systems on chip platform, FPGA on-chip network standards, FPGAs as custom microcontroller and hybrid DSP microcontroller devices, Multiple cock domains on chip, Multi FPGA systems, multiple-clock domains, program and data memory, SRAM and DRAM., ROM, PAL, and PLA, Timing Constraints, using IP cores: instantiation and simulations | 6 |
| 5 | Instrumentation System: Basic concepts, Weighted Resistor D/A converter, A/D Converter, programmable ICs, digital potentiometers, various data communication and interfacing protocols (UART, SPI, I2C and others) and FPGA implementation case studies | 12 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. Michael D. Ciletti: Advanced Digital Design with the Verilog HDL, 2nd Edition, Pearson, 2011.
2. Jean- Pierre Deschamps, Gustavo D. Sutter, Enique Cano: Guide to FPGA Implementation of Arithmetic Functions, Springer, 2012.

Suggested Reference Book(s):

1. Hamblen, J.O, Hall, T.S, and Furman, M.D., "Rapid Prototyping of Digital Systems, SOPC Edition." Springer, 2008.
2. Zainalabedin, Navabi, "Digital Design and Implementation with Field Programmable Devices", Springer, 2005.
3. Jean- Pierre Deschamps, Gery Jean Antoine Bioul, Gustavo D. Sutter, "Synthesis of Arithmetic Circuits-FPGA ASIC and Embedded Systems" , a John Wiley & sons, inc, publication, 2006.

Other useful resource(s):

1. FPGA manufacturer's web resources:
   Altera Inc.: https://www.altera.com/products/general/fpga/stratix-fpgas/about/stx-asic-prototyping.html
   Xilinx: https://www.xilinx.com/applications/asic-prototyping.html
2. Other Journal/research resources:
   http://biomedical-engineering-online.biomedcentral.com/articles/10.1186/1475-925X-13-126
   http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.6049&rep=rep1&type=pdf
3. NPTEL Resources
   https://nptel.ac.in/courses/117108040/
   https://nptel.ac.in/courses/117106092/55
   https://nptel.ac.in/syllabus/117108040/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (FPGA based Instrumentation System Design) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 1 | 2 | 2 | x | 1 | 3 | 3 | 1 | 2 | 1.67 |
| CO-2 | 3 | 2 | 3 | 1 | 2 | 2 | x | x | 3 | 1 | 1 | 2 | 1.67 |
| CO-3 | 3 | 3 | 3 | 2 | 3 | 2 | x | x | 3 | 2 | 1 | 2 | 2.00 |
| CO-4 | 3 | 3 | 3 | 2 | 3 | 2 | x | x | 3 | 2 | 1 | 2 | 2.00 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | x | x | 3 | 2 | 1 | 2 | 2.08 |
| Average | 3 | 2.6 | 3 | 1.8 | 2.6 | 2 | 0 | 0 | 3 | 1.6 | 1 | 2 | |

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# Optimum Array Processing

COURSE CODE: 18B1WEC743

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Linear Algebra, Signals & Systems and Discrete-Time Signal Processing

Course Objectives:

1. To introduce traditional methods of array signal processing for multi-antenna transceivers.
2. To develop a deeper understanding of several major topics of array processing including spatial filtering (beamforming), direction of arrival estimation.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Extrapolate the fundamentals of arrays, signal models in various domains. | Familiarity |
| CO-2 | Apply the principal techniques of smart beam conformation and estimation of the direction multichannel arrival. | Assessment |
| CO-3 | Design in array processing algorithms that solve specific problems in the field of communications. | Assessment |
| CO-4 | Evaluate the advantages of using multiple antennas for the reception and/or transmission of radio navigation. | Assessment |
| CO-5 | Analyze the implications at system level of the use of antenna arrays in different applications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Array Processing, Applications, Uniform Linear Array, Array Steering, Array Performance Measures, Linear Aperture, Broadband Arrays, Uniform Rectangular Arrays. | 6 |
| 2 | Optimum Waveform Estimation: Optimum Beamformers, Discrete Interference, Spatially Spread Interference, Beamforming for Correlated Signal and Interferences, Broadband Beamformers | 8 |
| 3 | Adaptive Beamformers: Estimation of Spatial Spectral Matrices, Recursive Least Squares (RLS), Gradient Algorithms, LMS Algorithms, Eigenspace and DMR Beamformers. | 9 |
| 4 | Parameter Estimation: Maximum Likelihood (ML) Estimator, Parameter Estimation Model, Cramer-Rao Bounds, Maximum Likelihood Estimation, Quadratic Algorithms, Subspace Algorithms, Sensitivity, Robustness, and Calibration. | 10 |
| 5 | Optimum Detection: Classic Binary Detection, Matched Subspace Detector, Spatially Spread Gaussian Signal Processes, Adaptive Detection. | 9 |
| Total lectures | | 42 |

Suggested Text Book(s):

1. Harry L. Van Trees: Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory, 1st Edition, Wiley-Interscience, 2002.
2. Simon Haykin: Array Signal Processing, 1st Edition, Prentice Hall, 1984.

Suggested Reference Book(s):

1. Jacob Benesty, Israel Cohen, Jingdong Chen: Fundamentals of Signal Enhancement and Array Signal Processing, 1st Edition, Wiley-IEEE Press, 2017.
2. Steven M. Kay: Fundamentals of Statistical Signal Processing, 1st Edition, Prentice Hall, 1993.

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Other useful resource(s):

1. Link to NPTEL course contents: Array Processing and Array Gain with Uniform Linear Arrays_ https://nptel.ac.in/courses/117104117/16
2. Link to MITOPENCOURESEWARE: Adaptive Antennas and Phased Arrays_ https://ocw.mit.edu/resources/res-ll-002-adaptive-antennas-and-phased-arrays-spring-2010/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (3) - 10<br>Quizzes (3) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Optimum Array Processing) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1.67 |
| CO-2 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 1.92 |
| CO-3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2.17 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 2.50 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2.50 |
| Average | 3.00 | 2.80 | 2.60 | 2.40 | 2.20 | 1.60 | 1.20 | 1.00 | 1.20 | 2.40 | 2.40 | 3.00 | |

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# Antenna and Wave Propagation

COURSE CODE: 18B1WEC742

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To make students understand the fundamental theory and concepts of antenna and propagation of waves.
2. Make them aware to the radiation characteristics of different types of antennas, their measurement and applications of various antennas.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Comprehend the fundamental theory and concepts of radiation, antenna and significance of antenna parameters. | Familiarity |
| CO-2 | Assess the power and usefulness of UHF, VHF and Microwave Antennas, microstrip patch antennas their requirements, specifications, characteristics and design relations. | Assessment |
| CO-3 | To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved. | Assessment |
| CO-4 | Reveal different applications of the various types of antenna to solve engineering and other problems | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – single wire, 2 wire, dipoles, Current Distribution on a thin wire antenna. Antenna Parameters - Radiation Patterns, Beamwidths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency Antenna temperature and signal to noise ratio. | 7 |
| 2 | RADIATION OF ELECTRIC DIPOLE: Potential functions and the electromagnetic field, Oscillating electric dipole derivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quarter wave monopole and half wave dipoles, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas, antenna feeding methods. | 8 |
| 3 | ANTENNAS FOR SPECIAL APPLICATIONS: Broadband antenna, Frequency-independent antenna, log periodic antennas, Antennas design consideration for satellite communication, antenna for terrestrial mobile communication systems, GPR, Embedded antennas, UWB, Plasma | 6 |
| 4 | ANTENNA MEASUREMENTS: Radiation Pattern measurement, Distance requirement for uniform phase, uniform field amplitude requirement, Introduction to phase measurement; Gain Measurement: Comparison method, Near field method, Introduction to current distribution measurement, Measurement of antenna efficiency, measurement of Noise figure and noise temperature of an antenna polarization measurement, Anechoic Chamber measurement. | 7 |

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| | | |
|---|---|---|
| 5 | WAVE PROPAGATION - I: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations. Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF & Skip Distance – Calculations for flat and spherical earth cases, Optimum Frequency, LUHF, Virtual Height, Ionospheric Abnormalities, Ionospheric Absorption. | 7 |
| 6 | WAVE PROPAGATION – II: Fundamental Equation for Free-Space Propagation, Basic Transmission Loss Calculations. Space Wave Propagation – Mechanism, LOS and Radio Horizon. Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations, M-curves and Duct Propagation, Tropospheric Scattering. | 7 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. E.C.Jordan and Balmain: Electromagnetic waves and Radiating Systems, 2nd Edition, PHI, 2006
2. Constantine A. Balanis: Antenna Theory Analysis and Desin, John Wiley, 2nd Edition,2007.


Suggested Reference Book(s):


1. John D.Kraus, Ronald J Marhefka and Ahmad S Khan: Antennas for all Applications, Tata McGraw-Hill Book Company, 3rd Edition, 2007.
2. G.S.N.Raju: Antenna Wave Propagation, Pearson Education, 1st Edition,2004.
3. R.E.Collins, "Antenna and Radiowave propagation", 3rd Edition, Mc Graw Hill, 2005.


Other resources/ learning website:

www.nptel.ac.in
www.antenna-theory.com

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Antenna and Wave Propagation) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 2.17 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 2.25 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 2.25 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2.92 |
| Average | 3 | 3 | 2.75 | 2.75 | 3 | 2.25 | 1.5 | 1.25 | 1.5 | 2.25 | 2.5 | 3 | 2.40 |

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# OFDM and Applications

COURSE CODE: 18B1WEC736

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. Learn the fundamental concepts of high rate OFDM communication system focusing on the physical layer.
2. Analyze the design requirements of various OFDM standards.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Learn the fundamentals of OFDM communication system. | Familiarity |
| CO-2 | Performance analysis of OFDM signals over AWGN and wideband channels. | Assessment |
| CO-3 | Demonstrate the challenging issues in OFDM system. | Assessment |
| CO-4 | Apply OFDM to the practical communication systems. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction and Basics of OFDM: High rate wireless applications; Wireless channel; Interference and noise; OFDM concept and system model- block diagram, design of the OFDM signal, OFDM system model, FFT implementation, cyclic extension, power spectrum and spectrum efficiency, synchronization errors; Channel capacity and OFDM; Comparison with single-carrier; Design example; Performance of an uncoded OFDM system. | 10 |
| 2 | Impairments of Wireless Channels to OFDM Signals: Time varying impairments; Effect of sampling clock offset; Effect of timing offset; Effect of delay spread; System Non Linearity.<br>Other Multicarrier Modulation; Mathematical modeling and analytical evaluation of the BER of OFDM System. | 8 |
| 3 | OFDM Transmission over Gaussian channels and wideband channels.<br>Synchronization: Overview of synchronization schemes- timing offset estimation, frequency offset estimation, acquisition versus tracking; Timing offset estimation-pilot based methods, non-pilot based methods; Frequency offset estimation- pilot based methods, non-pilot based methods; Joint time and frequency offset estimation and correction. | 8 |
| 4 | OFDM versus-MC-CDMA<br>Peak Power Ratio: The peak power problem; Distribution of PAP ratio; Maximum PAPR of an N subcarrier OFDM signal; PAPR reduction with signal distortion; Limits for distortion-less PAPR-reduction; Techniques for distortion-less PAPR reduction-selective mapping, optimization techniques, modified signal constellation; PAPR reduction effect on the system performance; PAPR reduction for multicarrier CDMA. | 8 |
| 5 | OFDM applications: MIMO OFDM- synchronization for MIMO OFDM, A practical OFDM system: Fixed broadband wireless access, system requirements, parameter selection, communication protocol, frame structure, MAC consideration and conformance. | 8 |
| Total lectures | | 42 |

Suggested Text Book(s):

1. Ye Li and Gordon L. Stuber: Orthogonal Frequency Division Multiplexing for Wireless Communications,

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1st Edition, Springer, 2006.
2. Ramjee Prasad: OFDM for Wireless Communications Systems, 1st Edition, Artech House Publishers, 2004.
3. Lazos Hanzo: OFDM and MC-CDMA: A primer, 1st Edition, Wiley-IEEE Press, 2006

Suggested Reference Book(s):

1. Richard Van Nee: OFDM for Wireless Multi-Media Communication, 1st Edition, Artech, House Publishers, 2000.
2. Hui Liu: OFDM based Broadband Wireless Networks: Design and Optimization, 1st Edition, John Wiley & Sons, 2006.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/117104099/
2. Link to topics related to course:
   https://nptel.ac.in/courses/117104099 /27
   https://nptel.ac.in/courses/117104099 /28
   https://nptel.ac.in/courses/117104099 /29
   https://nptel.ac.in/courses/117104099 /30
   https://nptel.ac.in/courses/117104099 /31
   https://nptel.ac.in/courses/117104099 /34

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (OFDM and its Applications ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 1.92 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2.25 |
| CO-3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 1.83 |
| CO-4 | 2 | 1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1.75 |
| Average | 2.5 | 2 | 3 | 2.5 | 2.75 | 1.5 | 1 | 1 | 1.75 | 1.5 | 1 | 2.75 | |

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# Robotic Systems and Control

COURSE CODE: 18B1WEC737

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Differential equations and Linear algebra, knowledge of Control Systems

Course Objectives:

1. The Robotics' chief objective has always been associated with working for new and updated technologies for example embedded systems, microcontrollers and VLSI.
2. To use the robotic system for logic building & programming and to solve many engineering problems.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will be equipped with the automation and brief history of robot and applications. | Familiarity |
| CO-2 | Students will be equipped with the principles of various sensors, actuators and their applications in robots. | Assessment |
| CO-3 | Be able to analyze any physical system using mathematical model. | Assessment |
| CO-4 | Be able to do the path planning on robotic systems using various control strategies. | Assessment |
| CO-5 | Students will be equipped with the simulation and hands on robotic kits | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Robotics: Introduction – brief history, types, classification and usage, Science and Technology of robots, textbooks and research journals, introduction to simulation environment. | 3 |
| 2 | Elements of Robots -- joints, links, actuators, and sensors: Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force- torque sensors, proximity and distance measuring sensors, and vision. | 10 |
| 3 | Robot Arm Kinematics and Dynamics: forward kinematics, Inverse kinematics, Lagrange formulation of dynamics | 8 |
| 4 | Motion Planning and Control: Joint and Cartesian space trajectory planning and generation. Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators | 10 |
| 5 | Modeling and Control of Flexible Robot Manipulators: Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations studies | 6 |
| 6 | Robot Programming: MATLAB and other simulation platforms, Hands on experiment on robotic kits, working and implementing various Ad-on modules. | 5 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. J. J. Craig, "Introduction to Robotics- Mechanics and Control", Pearson, 3rd Edition, 2009.
2. Spong and Vidyasagar, "Robot Dynamics and Control", Wiley Student Edition, John Wiley and Sons, 2013.

Suggested Reference Book(s):

1. Sciavicco and Siciliano, "Modeling and Control of Robot Manipulators", Springer, 2nd Edition, 2002.
2. D.K. Pratihar, "Fundamentals of Robotics", Narosa Publishing House, 1st Edition, 2017.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/112101099/
2. Other links to course material: https://nptel.ac.in/downloads/112101098/
3. Material provided by IIT Bomaby under eLSI project

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignments (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Robotic Systems and Control) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 1.9 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 2.6 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 2.5 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 2.4 |
| Average | 3 | 3 | 2.8 | 2.6 | 2.8 | 2.6 | 1.6 | 1 | 1.8 | 1.6 | 3 | 3 | |

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# Time-Frequency Analysis and Applications

COURSE CODE: 18B1WEC738

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

Pre-requisite: Signals and Systems

Course Objectives:

1. Study and analyze various spectral analysis and time-frequency analysis tools.
2. Study the time-frequency analysis tools based algorithm for different applications.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the concept of the spectral analysis. | Familiarity |
| CO-2 | Familiar with the basics concept of the short time Fourier transform /continuous wavelet transform. | Assessment |
| CO-3 | Understand the basic concept of the distribution based Time-Frequency Analysis tools. | Assessment |
| CO-4 | Develop the TFA based algorithms for various applications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1. | Introduction to spectral analysis: Parametric and Non-Parametric methods. | 6 |
| 2. | Basics of Time Frequency Analysis: Basic Concepts & Definition, Duration-Bandwidth Principle, Joint Energy Density, Short-time FT, its Properties & Applications, MATLAB based implementation of STFT | 6 |
| 3. | Wavelet transforms: Continuous Wavelet Transform and its Computational aspects, Scale to Frequency conversion, Scalogram, Scaling Function and Wavelets, Applications of CWT, MATLAB based implementation of wavelet transform. | 8 |
| 4 | Distributions based time-frequency tools: Wigner-Ville Distributions, Interference in WVD, its Applications, Cohen's class, Smoothed WVD, Ambiguity Functions, Affine Class, and MATLAB based implementation of distribution based time-frequency analysis tools. | 8 |
| 5. | Case studies: Radar and Sonar, Economic Data Analysis with the Gabor Spectrogram, Gabor Spectrogram in Ultrasonic Nondestructive Materials testing, Applications of Time-Frequency Analysis in spectrum sensing, Biomedical signal processing, Genomics data analysis. | 14 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Hayes MH. Statistical digital signal processing and modeling. John Wiley & Sons; 2009.
2. Boashah B. Time-frequency signal analysis and processing: a comprehensive reference. Academic Press; 2015.


Suggested Reference Book(s):


1. S. Mallat, A Wavelet Tour of Signal Processing - The Sparse Way. Elsevier, Third Edition, 2009.
2. Cohen, Leon, Time-frequency analysis. Vol. 778. Prentice hall, 1995.
3. Chen, Victor C., and Hao Ling. Time-frequency transforms for radar imaging and signal analysis. Artech house, 2002.



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Other useful resource(s):

1. http://nptel.ac.in/courses/117101001/: The lecture series on Wavelets and Multi-rate Digital Signal Processing

created by Prof. Vikram M. Gadre in NPTEL.

2. Time-frequency toolbox (MATLAB) is available for download from http://tftb.nongnu.org/
3. http://nptel.ac.in/courses/117101001/1

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Time-Frequency Analysis and its Applications) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.3 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2.4 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Average | 2.5 | 3 | 2.75 | 2.75 | 2.75 | 1.5 | 1.5 | 1.5 | 2 | 3 | 3 | 3 | |

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# Design of Modern Antennas

COURSE CODE: 18B1WEC852

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: Transmission lines and E.M waves.

Course Objectives:

The main objective of the course is to

1. Learn the mechanism of antenna, antenna performance parameters.
2. Design and analysis of various antennas for different applications.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To define overall needs and constraints of RF systems and antennas. | Familiarity |
| CO-2 | To understand the mechanism of antenna radiation. | Familiarity |
| CO-3 | To design and analyze various antennas for specific application. | Usage |
| CO-4 | Size reduction techniques, Broad banding and multi band operation techniques in antenna design. | Usage |
| CO-5 | Evaluate the opportunities involving technology, a product or a service required for developing a startup idea. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1. | Introduction: antenna types, radiation mechanism, use of potential functions, radiated field, far field, antenna parameters, radiation pattern, directivity, numerical evaluation of directivity, gain, efficiency, impedance, loss resistance, polarization, linear polarization, circular and elliptic polarization, equivalent area, Friss equation. | 6 |
| 2. | Dipole Antennas: Potential functions for analysis of radiated fields, Duality theorem, Reciprocity theorem for antennas, Radiation from current element, infinitesimal dipole, finite length dipole, half wave dipole | 6 |
| 3. | Antenna Arrays: Analysis and Synthesis Review of antenna array basics, Linear arrays, circular array, planar (2D) arrays, sum and difference patterns, Effect of mutual couplings, Phased array antennas, scan Principles, Non uniform arrays, Dolph Chebyshev Arrays Binomial Arrays. | 6 |
| 4 | Broadband and Frequency Independent Antennas Helical antenna: Normal mode and axial mode helix Spiral antennas, Log Periodic antennas. | 5 |
| 5. | Aperture Antennas Radiation from an aperture in an infinite ground plane, Radiation from rectangular and circular apertures, Radiation from a slotted rectangular waveguide Horn antenna: E plane and H plane sectoral horns, Pyramidal horn, Conical horn Reflector antennas parabolic reflector, methods of analysis, dual reflector antennas, offset reflector antenna, gain and efficiency calculations, scanning properties and cross polarization Lens antennas and their applications | 7 |
| 6 | Microstrip Antennas Rectangular patch antenna: cavity and transmission line models, Circular patch antenna Coupling mechanisms, circular polarization, Microstrip arrays, Broadband and Multi band microstrip antennas, Compact Microstrip Antennas. | 7 |
| 7 | Dielectric Resonator Antennas Introduction, radiation mechanism, advantages of DRA, types of DRA, feeding techniques, design method, modes. | 5 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Constantine A. Balanis: Antenna Theory Analysis and Desin, John Wiley, 3rd Edition, 2009.
2. Antennas for All Applications, J. D. Kraus and R. J. Marhefka, McGraw-Hill, Inc, 3rd Ed., 2007.



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3. Rectangular Dielectric Resonator Antennas, Rajveer S. Yaduvanshi Harish Parthasarathy, Springer, 1st Ed, 2016.

Suggested Reference Book(s):

1. Antennas and Radio wave Propagation, R. E. Collin, McGraw-Hill, Inc, 3rd Ed, 2005.
2. Modern Antenna Design, T. A. Milligan, John Wiley & Sons, 2nd Ed., 2005.
3. Antenna Arrays, R. L. Haupt, John Wiley & Sons, Inc., 1st Ed., 2010.
4. Antenna Theory and Microstrip Antennas, D. G. Fang, CRC Press, 1st Ed., 2009.

Other useful resource(s):

Link to NPTEL course contents

1. https://nptel.ac.in/courses/108101092/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered up to T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered up to T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Design of Modern Antennas) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2.2 |
| CO-2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1.9 |
| CO-3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 1.8 |
| CO-4 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO-5 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| Average | 2.2 | 2.4 | 2.8 | 3 | 2.4 | 1.8 | 1 | 1.2 | 1.6 | 1.6 | 1.4 | 2.2 | |

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# Soft Computing Techniques

COURSE CODE: 18B1WEC851

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Comprehend the fuzzy logic and the concept of fuzziness and concepts of neural networks | Familiarity |
| CO-2 | Demonstrate knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic | Assessment |
| CO-3 | Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications | Assessment |
| CO-4 | Apply fuzzy rules and neural network learning rules and design paradigms to solve engineering and other Problems. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to fuzzy set theory: Probabilistic reasoning, Fuzzy sets, mathematics of fuzzy set theory, operations on fuzzy sets, comparison of fuzzy and crisp set theory. | 4 |
| 2 | Fuzzy mapping: one to one mapping, max-min principle, extension principle, implication rules – mamdani implications. Membership functions: Universe of discourse, mapping inside fuzzy domain, fuzzy membership mapping methods, and application to real world problems. | 10 |
| 3 | Artificial Neural Networks (ANN) and their biological roots and motivations. Comparison Between Artificial and Biological Neural Networks, Applications of Neural network. Network Architecture ,Taxonomy of neural networks: feed forward and recurrent networks with. Merits and limitations of neurocomputing. | 8 |
| 4 | Types of learning, supervised and unsupervised learning laws . Learnig Laws : Hebb's rule, Delta rule, Widrow - Hoff (The Least-Mean-Square ) learning rule, correlation learning rule, instar and outstar learning rules, Competitive learning, Credit Assignment Problem, Error Correction learning, Memory based learning. | 9 |
| 5 | The Perceptron and its learning law, Classification of linearly separable patterns, Multi-Layer Perceptron, Supervised Learning, Back-Propagation Learning law. Feed forward networks, Recurrent Networks. | 6 |
| 6 | Winner takes-all Networks, Competitive Learning, Kohonen's Self organizing Maps, Introduction to Adaptive Resonance Theory. | 5 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Simon Haykin: Artificial Neutral Networks, 2nd Edition, Pearson, 2008.
2. Yegna Narayanan: Artificial Neural Networks, 2nd Edition, Prentice-Hall of India, 2010.
3. S.N. Sivanandam, S.N Deepa: Principles of Soft Computing, 3rd Edition, Wiley, 2019.



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Suggested Reference Book(s):


1. Bart Kosko: Neural Network and Fuzzy Systems: A Dynamic System Approach to Machine, Prentice-Hall 1998
2. L. Fausett: Fundamentals of Neural Networks: Architectures, Algorithms, and Applications, Prentice-Hall, Reprint 2013
3. Jack M. Zurada: Introduction to Artificial Neural Systems, PWS Publishing Co., 2nd Edition, 2002.


Other useful resource(s):

Link to NPTEL course contents

1. http://nptel.ac.in/courses/117105084/
2. http://nptel.ac.in/courses/108104049/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes( POs)

| Course outcomes (Soft Computing Techniques ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1.92 |
| CO-2 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2.00 |
| CO-3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2.08 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 2.58 |
| Average | 3 | 2.25 | 2.75 | 2.75 | 3 | 1.75 | 1.5 | 1 | 1 | 2.25 | 2.25 | 2.25 | 2.15 |

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# Fault-Tolerant Communication Systems

COURSE CODE: 18B1WEC850

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Computer Communication Network

Course Objectives:

1. Apply the concepts of reliability and fault-tolerance for the communication systems.
2. Propose the communication system design approach for the service predictability.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Historical background and basic approaches of fault-tolerance in communication system. | Familiarity |
| CO-2 | Integration of integrity, survivability, availability, protection & restoration. | Familiarity |
| CO-3 | Routing schemes used for fault-tolerance. | Assessment |
| CO-4 | Planning and testing of fault-tolerant architectures. | Assessment |
| CO-5 | Fault-tolerant planning for the development of mission-critical communication and systems. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Historical perspective, best-effort service, guaranteed service, QoS. Fault, Failure and Error, reliability engineering in network design. Performance failure, breakdown failure, reliability, resiliency and performability. | 6 |
| 2 | Network availability, protection & restoration. Continuity and availability in communication network, Concepts and methodology of protection and restoration. | 9 |
| 3 | Fault-tolerant planning for MPLS based network, Optical networks and SONET/SDH network. | 8 |
| 4 | Fault-tolerant schemes for ad-hoc networks, sensor network and IoT. | 8 |
| 5 | Development routing schemes for handling proactive and passive faults. | 6 |
| 6 | Mission-critical network planning considering faults failure and recovery. | 5 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Jean-Philippe Vasseur, Mario Pickavet, Piet Demeester, Network Recovery: Protection and Restoration of Optical, SONET-SDH, IP, and MPLS, Elsevier, 1st edition, 2004.
2. Mathew Liotine, Mission-Critical Network Planning, Artech House, 1st edition, 2003.
3. Dhiraj K. Pradhan, Fault-tolerant Computer System Design, Prentice-Hall, 1st edition, 1996.


Suggested Reference Book(s):


1. Martin L. Shooman, Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design, John Wiley & Sons, 1st edition, 2002.
2. Arun K. Somani, Survivability and Traffic Grooming in WDM Optical Networks, Cambridge University Press,1st edition,2006.


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Other useful resource(s):

1. Link to NPTEL course contents:

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i. https://nptel.ac.in/courses/107106009/13,
ii. https://nptel.ac.in/courses/106106168/12

2. Link to topics related tocourse:
   i. http://www.staff.city.ac.uk/~sm377/FTcourse.html
   ii. http://www2.cs.uidaho.edu/~krings/CS449/index.html
   iii. http://euler.ecs.umass.edu/ece655/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) – 10<br>Quizzes(2) -10<br>Attendance – 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Fault Tolerant Communication Systems ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.08 |
| CO-2 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 1 | 1 | 2.16 |
| CO-3 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 1.91 |
| CO-4 | 3 | 1 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 2.08 |
| CO-5 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 2.33 |
| Average | 2.6 | 2 | 2.6 | 2.6 | 1.8 | 1.6 | 2 | 2.2 | 2 | 2.2 | 1.6 | 2.2 | |

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# Cognitive Radio Networks

COURSE CODE: 18B1WEC849

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To understand the principles, applications and challenges of cognitive radio technology.
2. Analyze the design of wireless networks based on cognitive radio technology.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the fundamental issues regarding dynamic spectrum access and radio-resource management. | Familiarity |
| CO-2 | Analyze the emerging issues in cognitive radio network. | Assessment |
| CO-3 | Apply different spectrum sharing models in the Cognitive Radio Network. | Assessment |
| CO-4 | Apply efficient sharing of the unutilized spectrum among cognitive and licensed users while avoiding interference to the licensed user due to cognitive user's transmission | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Cognitive Radio: Spectrum scarcity, Spectrum white space, Fixed spectrum allocation, Software defined radio (SDR), Limitations of SDR, Evolution of cognitive radio, Dynamic spectrum access, Introduction to cognitive radio concept, Cognitive cycle, Functions of cognitive radio; spectrum sensing, spectrum management, spectrum mobility, Cognitive radio architecture, Interference temperature and its models. | 8 |
| 2 | Spectrum Sensing and Challenges in Cognitive Radio Network: Hypothesis model for spectrum sensing, Types of spectrum sensing; Non-cooperative sensing, Cooperative sensing, Interference-based sensing, Matched filter detection, Energy detection, Cyclostationary feature detection, advantages and disadvantages of various spectrum sensing techniques, False alarm, Miss detection, Optimal sensing framework for infrastructure based cognitive radio network. Research challenges in spectrum sensing, spectrum management and spectrum mobility, potential applications of cognitive radio, IEEE 802.22 for WRANs | 8 |
| 3 | Spectrum Sharing and Management: Dynamic spectrum Access (DSA): models and architectures, Opportunistic spectrum access (OSA), Antenna Systems, MIMO systems, Smart antenna and beamforming.<br>SDR architecture, Software tunable analog radio components, Reconfigurable digital radio technologies. | 8 |
| 4 | Cross Layer Adaptation and Security in Cognitive Radio: Why we need cross-layer design, adaptation and optimization, Cognitive radio cross layer design, security challenges in cognitive radio.<br>OFDM for Cognitive Radio: OFDM based cognitive radio, Why OFDM is a good fit for Cognitive radio, Challenges to cognitive OFDM systems, Multiband OFDM, A step toward cognitive-OFDM: standards and technologies. | 9 |
| 5 | Cognitive Radio Regulation and Standardization: regulatory issues and new spectrum management regimes, spectrum planning, Spectrum authorization, Standards and international activities.<br>UWB Cognitive Radio: Introduction, Fundamentals of impulse radio Ultra Wideband, Cognitive radio requirements versus IR-UWB, Merging impulse radio with cognitive radio. | 9 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. Ekram Hossain, Dusit Niyato and Zhu Han: Dynamic Spectrum Access and Spectrum Management in Cognitive Radio Networks, 1st Edition, Cambridge University Press, 2009.
2. Huseyin Arslan: Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, 1st Edition, Springer, 2007.
3. Bruce A. Fette: Cognitive Radio Technology, 2nd Edition, Academic Press, April 6, 2009.

Suggested Reference Book(s):

1. Yang Xiao and Fei Hu: Cognitive Radio Networks, 1st Edition, CRC Press, 2008.
2. Linda E. Doyle: Essentials of Cognitive Radio, 1st Edition, Cambridge University Press, 2009.

Other useful resource(s):

Link to GIAN IIT Kanpur course contents (10 lecture series):
https://www.youtube.com/watch?v=SljXFf0vgvw&list=PL48UwQJyfW3SmrjLgl5LrVciqfWz9XazY

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Cognitive Radio Networks ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2.08 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 2.17 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2.25 |
| Average | 3 | 3 | 2.75 | 2.5 | 2 | 1.5 | 1 | 1.5 | 1.75 | 2.25 | 1.5 | 2.75 | |

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# RF Engineering

COURSE CODE: 18B1WEC848

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Basic knowledge of Electromagnetic Engineering

Course Objectives:

1. To lay strong foundations in RF and microwave engineering.
2. To apply the theoretical knowledge acquired in the design of different components in microwave systems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To have a thorough knowledge of RF and microwave components | Familiarity |
| CO-2 | To have a thorough knowledge about different parameters involved in microwave receiver and their significance | Assessment |
| CO-3 | To have a thorough knowledge about different parameters involved in microwave receiver and their significance | Assessment |
| CO-4 | To design different RF filters according to certain specifications | Usage |
| CO-5 | To understand active microwave components and their use in different applications | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Review of Waves and Transmission Lines: Wave Propagation, Transmission Line Equations, Reflection, Transmission, and impedance for a Terminated Transmission Line, Voltage Standing-Wave Ratio, Decibels, insertion Loss, Return Loss, Smith Charts, S-Parameters, Impedance Matching Networks. | 5 |
| 2 | Receiver System Parameters: Typical Receivers, System Considerations, Natural Sources of Receiver Noise, receiver Noise Figure and Equivalent Noise Temperature, Compression Points, Minimum detectable Signal and Dynamic Range, Third-Order Intercept Point and Intermodulation, spurious Responses, Spurious-Free Dynamic Range | 8 |
| 3 | Transmitter and Oscillator Systems: Transmitter Parameters, Transmitter Noise, Frequency Stability and Spurious Signals, Frequency Tuning, Output Power, and Efficiency, Intermodulation, Crystal Reference Oscillators, Phase-Locked Oscillators, frequency Synthesizers | 6 |
| 4 | Design of RF filters: Periodic Structures, Filter Design by the Image Parameter Method, Filter Design by the Insertion Loss Method, Characterization by Power Loss Ratio Filter transformations, Filter Implementation, Stepped-Impedance Low-Pass | 9 |
| 5 | Fabrication Technologies: Lumped Elements for RF circuits: Basic Design of Lumped elements, Lumped element modeling, printed inductors, MIM capacitor and Interdigital capacitor, Monolithic Integrated circuit technology (MIC), Monolithic microwave integrated circuit (MMIC) technology, material, RF printed circuit boards. | 9 |
| 6 | Wireless Communication Systems: Friis Transmission Equation, Space Loss, Link Equation and Link budget, Effective Isotropic Radiated Power and G/T Parameters, Radio/Microwave Links, Satellite Communication Systems, Mobile Communication Systems and Wireless cellular phones, Personal Communication Systems | 5 |
| | Total lectures | 42 |

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Suggested Text Book(s):

1. Kai Chang, "RF and Microwave Wireless Systems",1st Edition, John Wiley & Sons, 2002.
2. Pozar, David M. "Microwave engineering", 4th Edition, John Wiley & Sons, 2013.
3. Bahl I.J "Lumped Elements for RF and Microwave Circuits"1st Edition, Artech House,2003.

Suggested Reference Book(s):

1. R.E.Collin, "Foundations for microwave Engineering", 2nd Edition, John Wiley & Sons, 2007.
2. Annapurna Das, Sisir.K.Das, "Microwave Engineering",1st Edition, Tata McGraw Hill, 2000.

Other useful resource(s):

Link to NPTEL course contents:

https://nptel.ac.in/courses/117101119/

https://nptel.ac.in/courses/117105138/

Link to topics related to course:

https://nptel.ac.in/courses/117105138/ 1 to 18

https://nptel.ac.in/courses/117101119/ 1 to 14

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (RF Engineering ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.7 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2.1 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| Average | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.0 | 1.0 | 1.0 | 1.0 | 2.2 | 1.0 | 2.0 | |

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# Medical Image Processing

COURSE CODE: 18B1WEC847

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To introduce various medical imaging modalities.
2. To teach the requirement and development of different blocks of computer aided diagnosis for medical images.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand different types of medical imaging modalities and would be able to differentiate them with respect to their advantages and limitations. | Familiarity |
| CO-2 | Acquire an ability to analyze and process medical images. | Usage |
| CO-3 | Understand different feature extraction techniques and classifiers used for image classification. | Usage |
| CO-4 | Understand the role of computer aided diagnosis for medical images. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Image Processing:- Acquisition of Images, Image Sampling and quantization; Spatial and histogram based enhancement; Noise modeling, Image restoration. Image transformation. | 8 |
| 2 | Edge Detection and Image Segmentation: Gradient based edge detectors. Intensity thresholding based image segmentation; Region growing and region splitting algorithm; watershed segmentation. | 8 |
| 3 | Medical Imaging Modalities: Working principle, applications and limitations of Computed tomography , X-ray, Magnetic resonance imaging, Ultrasound imaging, and Positron emission tomography; Various Artifacts. | 6 |
| 4 | Image Texture: Types of texture parameters: Statistical analysis of texture (First order statistics and Second order statistics), Grey level co-occurrence matrix, grey-level run length matrix. | 8 |
| 5 | Pattern classification: Supervised and Unsupervised pattern classification, Neural Network classifier, Support Vector Machines. | 6 |
| 6 | Case Studies: Pre-processing, Segmentation, Feature extraction, and Classification of medical images. | 6 |
| | Total lectures | 42 |

Suggested Text Book(s):


1. Chris Solomon, Toby Breckon: Fundamental of Digital Image Processing, 1st Ed., John Wiley & Sons, 2011.
2. Rangaraj M. Rangayyan: Biomedical Image Analysis, 1st Ed., CRC Press, New York , 2004.


Suggested Reference Book(s):


1. RC Gonzalez, RE Woods, Digital Image Processing, 3rd Ed., Pearson Publisher, 2008.
2. Kayvan Najarian, Robert Splinter: Biomedical Signal and Image Processing, 2nd Ed., CRC Press, 2012


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3. Tamal Bose: Digital Signal and Image Processing, 1st Ed., John Wiley & Sons, 2003.

Other useful resource(s):

http://www.nptelvideos.in/2012/12/digital-image-processing.html (Prof P.K. Biswas, IIT Kharagpur)

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Medical Image Processing) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 2.42 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 0 | 0 | 1 | 2 | 3 | 1 | 1 | 1.83 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1.92 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2.75 |
| Average | 3.00 | 3.00 | 3.00 | 3.00 | 2.75 | 1.75 | 1.25 | 2.00 | 1.50 | 2.25 | 1.50 | 1.75 | |

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# Design of Dependable Systems

COURSE CODE: 18B1WEC846

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: Graph Theory and Computer Communication Network

Course Objectives:

1. Incorporate the concepts of dependability in the design of critical systems.
2. Propose an architectural framework for the design of systems based on information and communication technologies.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introduction to dependability attributes such as availability, reliability, safety, QoS, SLA in systems. | Familiarity |
| CO-2 | Familiarization with dependability analysis approaches. | Familiarity |
| CO-3 | Application of methodologies used dependability modeling. | Usage |
| CO-4 | Design of dependability schemes on practical systems. | Usage |
| CO-5 | Evaluation of survivability of networks, dependability evaluation of networks. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Dependability attributes: availability, reliability, safety, QoS, SLA. | 5 |
| 2 | Analysis Approach of Dependability: The failure process, failure semantics, fault handling and maintenance, failure rate, probability distributions, series/parallel systems, Markov models. | 6 |
| 3 | Dependability modeling: Block diagrams and state diagrams - discrete and continuous time Markov models. Fault Trees and Fault Injection. Modeling of software failure, prediction of software failure rates, and impact of software failures on systems behavior. | 8 |
| 4 | Design of Dependability: Fault tolerance, types of redundancy, design principles and mechanisms. Fault detection, tolerance and recovery, Lifetime improvement. | 8 |
| 5 | Prediction of hardware failure rates: Software/hardware and architectural approaches space, information and time redundancy. Design for testability. Model-driven approaches Diagnosis. | 7 |
| 6 | Internet QoS, survivability of networks, dependability evaluation of networks taking the traffic carrying (QoS) requirements into account. QoS guarantee analysis. Some applications of dependability in IT related services. | 8 |
| | Total lectures | 42 |

Suggested Text Book(s):


1. Ajit Kumar Verma, Srividya Ajit, Dependability of Networked Computer-based Systems, Springer Series in Reliability Engineering, 1st edition, 2013.
2. J.C. Geffroy, G. Motet, Design of Dependable Computing Systems, Springer-Science-Business Media B.V., 1st edition, 2002.


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3. J.C. Laprie, Dependability: Basic Concepts and Terminology, Springer-Verlag, 1st edition, 1992.

Suggested Reference Book(s):

1. Dhiraj K. Pradhan, Fault-tolerant computer system design, Prentice-Hall, 1st edition, 1996.
2. M.L. Shooman, Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design, Wiley, 1st edition, 2002.
3. Krishna B. Misra, Handbook of Performability Engineering, Springer, 1st edition, 2008.

Other useful resource(s):

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc16_oe01/preview
2. Link to topics related to course: https://www.mdh.se/utbildning/livslangtlarande/prompt/design-of-dependable-and-fault-tolerant-embedded-systems-1.120193?l=en_UK

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Design of Dependable Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO-2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 2 | 2 |
| CO-3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2.33 |
| CO-4 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2.6 |
| CO-5 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2.16 |
| Average | 2.4 | 2.2 | 2.2 | 2 | 2.4 | 2.4 | 2.6 | 1.6 | 2 | 2.4 | 2.2 | 2 | |

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# Artificial Intelligence Techniques

COURSE CODE: 18B1WEC838

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: Prerequisites are good programming skills, basic data structures and algorithms, and some university level mathematics.

Course Objectives:

1. Learn to create expert systems which exhibit intelligent behavior.
2. Learn to create expert systems which exhibit the capability to learn, demonstrate, explain and advice its users.
3. Learn to help machines finding solutions to the complex problems.
4. Learn to design human like machines in a computer friendly manner.
5. To study State of the Art algorithms with engineering applications.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Analyze the need and foundation of Artificial Intelligence | Familiarity |
| CO-2 | Study the Intelligent agents that receive percepts from the environment and perform actions | Assessment |
| CO-3 | Analysis of problem solving, knowledge and reasoning | Assessment |
| CO-4 | Study of application domains. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Artificial Intelligence (AI): The History and foundations of AI, Philosophy of AI, Intelligent Agents and Knowledge based Systems, AI Problem Solving, AI Learning and AI Perception, Real World AI. | 8 |
| 2 | Intelligent Agents: Agents and Environments, The concept of Rationality, Performance Measures, The structure of Agents, Agent Programs, Simple reflex Agents, Model based reflex Agents, Goal based Agents, Utility based Agents, Learning Agents. | 8 |
| 3 | Problem Solving: Problem solving Agents, Formulating Problems, Searching for Solutions, Uninformed Search Strategies, Breadth first search, Depth first search, Depth limited Search, Bidirectional search, Informed Search Exploration, Constraint Satisfaction Problems. | 7 |
| 4 | Knowledge and Reasoning: Knowledge based agents, Reasoning Patterns in Propositional Logic, Forward and Backward Chaining, Back tracking Algorithm, First Order Logic, Knowledge Representation, Uncertain Knowledge and Reasoning | 7 |
| 5 | Learning, Perception and Action: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees, Ensemble Learning, Knowledge in Learning, Statistical Learning, Reinforcement Learning, Perceptional Analysis, Communication as Action | 6 |
| 6 | Applications of AI Techniques: Semantic Interpretation, Probabilistic Language Processing, Robotic Hardware and Software Architectures, Probabilistic Inference, Planning and Search, Localization, Tracking and Control. | 6 |
| Total lectures | | 42 |

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Suggested Text Book(s):

1. Stuart J. Russel and Peter Norvig: Artificial Intelligence: A Modern Approach, Third Edition, Pearson Education Limited, 2014.
2. E. Rich and K. Knight: Artificial Intelligence and Applications, Third Edition, Tata McGraw Hill, 2012.

Suggested Reference Book(s):

1. P. Kulkarni and P. Joshi: Artificial Intelligence, Second Edition, PHI Learning Private Limited, 2015.
2. P. H. Winston: Artificial Intelligence and Applications, Third Edition, PHI Learning Private Limited, 2017.

Other useful resource(s):

Link to topics related to course:

https://nptel.ac.in/courses/106105077/
https://nptel.ac.in/courses/106105079/
https://www.tutorialspoint.com/artificial_intelligence/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Artificial Intelligence Techniques ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.91 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 2.33 |
| CO-3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2.00 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2.25 |
| Average | 2.50 | 2.75 | 2.75 | 2.75 | 2.25 | 1.50 | 1.25 | 1.25 | 2.25 | 2.25 | 1.50 | 2.50 | |

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# Radar Principles and Applications

COURSE CODE: 18B1WEC839

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Basic Knowledge of Electromagnetic Engineering

Course Objectives:

1. To acquire fundamentals of radar systems.
2. To identify different components used in radar system and analyze different types of radar systems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To know the basic building blocks of a radar system. | Familiarity |
| CO-2 | To have an in-depth knowledge on different types of signals that are used in radar systems. | Familiarity |
| CO-3 | To know about the ambiguity function and its significance in radar signal processing. | Assessment |
| CO-4 | To know the principle of operation of sonar and sound propagation in water. | Assessment |
| CO-5 | To apply the knowledge acquired in this course in real time applications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Introduction to radar and radar equation, radar wave propagation. Radar block diagram, resolutions in range velocity, radar equation, types of radars. Atmospheric effects on radar wave propagation. Radar cross section, radar displays. | 6 |
| 2 | CW,FM and MTI radar systems: Doppler radar, CW radar, FMCW radar, multiple frequencies CW radar, MTI radar, delay line cancellers, staggered pulse repetitive frequencies, pulse Doppler radar, limitations of MTI radar. | 8 |
| 3 | Radar waveforms: Matched filter, Pulse compression, ambiguity function, LFMCW, HFM waveforms, Doppler invariant waveforms. | 8 |
| 4 | Radar antennas and radar tracking: Radar antennas and radar tracking Antenna basics, antenna arrays, analysis and synthesis of antenna arrays. Buttler's matrix, tracking of radar. Synthetic aperture radar. | 9 |
| 5 | Radar transmitters and receivers: Noise figure, amplifiers, mixers, power dividers and phase shifters. | 8 |
| 6 | Introduction to sonar: Under water propagation, types of sonar, sonar transducers. | 3 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Peebles, Peyton Z. "Radar principles" ,Wiley India Edition, John Wiley & Sons, 2007.
2. Skolnik, Merrill I. " Introduction to radar systems", 3rd Edition, McGraw-Hill Education,2002.
3. Elliot, Robert S. "Antenna theory and design", Wiley India Edition, John Wiley & Sons, 2007.
4. Lawrence J.Ziomek, "An introduction to Sonar Systems Engineering", 1st Edition, CRC Press,2017.


Suggested Reference Book(s):


1. Stutzman, Warren L., and Gary A. Thiele. "Antenna theory and design". Wiley India Edition, John Wiley & Sons, 2012.


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2. Pozar, David M. "Microwave engineering", 4th Edition, John Wiley & Sons, 2013.
3. Cheng, David Keun. "Field and wave electromagnetics", 2nd Edition, Pearson Education India, 1989.
4. Mark. A Richards, "Fundamentals of Radar Signal Processing", 2nd Edition, McGraw-Hill Professional Engineering, 2014.

Other useful resource(s):

1. Link to NPTEL course contents:https://nptel.ac.in/courses/101108056/
2. Link to topics related to course:
   https://nptel.ac.in/courses/101108056/1 to 7
   https://ocw.mit.edu/resources/res-ll-001-introduction-to-radar-systems-spring-2007/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Radar Principles and Applications) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.5 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.6 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1.5 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.6 |
| Average | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.0 | 1.0 | 1.0 | 1.0 | 2.2 | 1.0 | 2.0 | |

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# Industrial Automation and Control

COURSE CODE: 18B1WEC840

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: Electrical Networks, Control Systems

Course Objectives:

1. Overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing.
2. To explain the general architecture of Industrial Automation Systems and develop automation systems using PLC programming.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will be able to handle any kind of process by framing it in block diagram, mathematical model and different process variables. | Familiarity |
| CO-2 | Students will be able to handle different types of controller like electronic, pneumatic and hydraulic. | Assessment |
| CO-3 | Understand principle of working of various signal conditioners used with Temperature, Displacement, Optical and various miscellaneous other sensors. | Assessment |
| CO-4 | Students will be able to implement different control schemes to various processes. | Assessment |
| CO-5 | Students will be able to design relay logic for various processes. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to industrial automation and Control, Architecture of industrial automation systems | 2 |
| 2 | Sensors and Measurement Systems: Temperature measurement; Pressure and force measurements; Displacement and speed measurement; Flow measurement techniques; Measurement of level, humidity, pH etc | 8 |
| 3 | Signal conditioning and processing: Estimation of errors and calibration | 4 |
| 4 | Motion Actuators: Types of motion and motion conversion, Electric linear actuators, Electric rotary actuators, Fluid-power linear actuators, Fluid-power rotating actuators | 4 |
| 5 | Process Control: PID control, Controller tuning, Implementation of PID controllers, Special control structures : Feed-forward and ratio control, Predictive control, Cascade control, Overriding control, Selective control, Split range control | 8 |
| 6 | Sequence Control, PLCs and Relay Ladder Logic: Scan cycle, RLL syntax; Structured design approach; Advanced RLL programming; Hardware environment | 8 |
| 7 | Robotics and Numerical Control : Basic robot definitions, Basic manipulator configurations, Numerical control systems, Robot kinematics, Robot grippers, Robot sensors, Robot programming, General considerations for robot applications | 8 |
| Total lectures | | 42 |

Suggested Text Book(s):

1. S. Mukhopadhyay, S. Sen and A. K. Deb, "Industrial Instrumentation, Control and Automation", Jaico

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Publishing House, 2013.
2. George Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", 1st edition, Prentice Hall India, 2012.

Suggested Reference Book(s):

1. R. Krishnan, "Electric Motor Drives, Modelling, Analysis and Control", Prentice Hall India, 2002.
2. Herbert E. Merritt, "Hydraulic Control Systems", Wiley, 1991.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/108105062/
2. Link to SWAYAM course contents: https://swayam.gov.in/course/4440-industrial-automation-and-control

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignments (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Industrial Automation and Control) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2.2 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2.8 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2.8 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2.8 |
| Average | 3 | 3 | 2.8 | 2.6 | 2.8 | 2.6 | 2 | 1 | 2.2 | 5 | 3 | 3 | |

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# Bio Electronic Sensors

COURSE CODE: 18B1WEC841

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To learn about transducers, bio-sensors, bio-potentials electrodes and bio-signal amplifiers.
2. To understand the various bio-potentials generated in human body and the instrumentation used to acquire it.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Gain knowledge on sensors, actuators and transducers | Familiarity |
| CO-2 | Learn to design circuits of bio-sensor for electrical and nonelectrical signals | Usage |
| CO-3 | Acquaint with different types of amplifiers used for biosensors | Familiarity |
| CO-4 | Learn about bio-potential and bio-potential amplifiers | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Introduction to Sensor, Bio electronics, Bioelectronics Sensor, Systems biology and Synthetic biology | 4 |
| 2 | Electrodes, Sensors and transducers: Sensor/Actuators, Active v/s passive sensors, sensor error sources, sensor terminology, Types of Sensors, Bio sensor, Block diagram of Bio-sensor for electrical and non electrical signals, electrodes for biophysical sensing, transducers, performance parameters of sensors, complete circuit diagram of bio sensor. | 8 |
| 3 | Bio-potential Electrodes: The electrode-electrolyte interface, polarization, polarizable and non-polarizable electrodes, Electrode behavior and circuit models, body surface recording electrodes, internal electrodes, micro electrode, macro electrode | 4 |
| 4 | Bio-electric Amplifiers: Voltage, current, power amplifiers, Low gain, medium gain, high gain amplifiers | 6 |
| 5 | Bio-potentials: ECG, EEG, EMG, ERG, EOG, its amplitude and bandwidth, Electrodes for Bio-potential Recordings, Electrical Interference Reduction. | 6 |
| 6 | Bio-potential Amplifiers: Operational amplifiers, basic amplifier configurations, multiple input circuits, differential amplifiers, signal processing circuits, isolation amplifiers, IMRR, ECG Amplifier, functional block, interference from electric devices, transient protection, common mode and other interference reduction circuits, Driven right leg circuit, amplifiers for other bio-potential signals, pre amplifier. | 8 |
| 7 | Bio-signal Amplifiers : Instrumentation amplifier, Chopper Amplifier, Carrier Amplifier | 6 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Carr, J.J., Brown, J.M., "Introduction to Biomedical Equipment Technology," 4th Ed., Pearson, 2001.
5. Reddy, D.D., Hussian, O.M., Gopal, D.V. R., Rao, D. M., Sastry, K.S. "Biosensors and Bioelectronics," I.K. International Pub., 2012


Suggested Reference Book(s):


1. Webster JG (Ed.), "Medical Instrumentation, Application and Design," 4th Ed., John Wiley & Sons, 2016.
2. Chatterjee S and Miller A, "Biomedical Instrumentation Systems," Cengage Learning, 2018.
3. Gayakwad, R. A., "Op-amps and Linear Integarted Circuits," 4th Ed., PHI, 2000.


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Other useful resource(s):

NPTEL Online Courses: Biomedical Signal Processing - https://nptel.ac.in/courses/108105101/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered up to T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered up to T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| CO/PO (Bio electronic Sensor) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 1 | 2 | X | X | X | X | X | 2 | 1.17 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | X | X | 1 | 2 | 2 | 3 | 1.92 |
| CO3 | 3 | 3 | 2 | 1 | 1 | 2 | X | X | X | 1 | 1 | 3 | 1.42 |
| CO4 | 3 | 3 | 2 | 2 | 1 | 2 | X | X | X | 1 | 1 | 3 | 1.50 |
| Average | 3.00 | 3.00 | 2.25 | 1.50 | 1.25 | 2.00 | 0.00 | 0.00 | 0.25 | 1.00 | 1.00 | 2.75 | |

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# Optical Networks

COURSE CODE: 18B1WEC842

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Mathematical Physics

Course Objectives:

1. To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
2. To make the students aware of the hardware used for practical purposes.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Recognize and classify the structures of Optical fiber and types. | Familiarity |
| CO-2 | Discuss single hop and multihop fibers. | Assessment |
| CO-3 | Analyze various coupling losses. | Assessment |
| CO-4 | Get acquainted with optical switching. | Usage |
| CO-5 | Get familiar with the recent optical networks used for practical purposes. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Optical Networking-Introduction and Challenges: Advantages of optical network, telecom network overview and architecture, WDM optical networks, WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network. | 7 |
| 2 | Optical Networking Components/Building Blocks : Optical transmitters, semiconductor laser diode, tunable and fixed laser, laser characteristics, photodectors, tunable and fixed optical filters, channel equalizers, optical amplifiers and its characteristics, semiconductor laser amplifier, Raman amplifier, doped fiber amplifier, various switching elements. | 8 |
| 3 | Single and Multi-hop Networks: Introduction to single and multi-hop networks, Characteristics of single and multi-hop networks, experimental single hop networks: LAMBDANET, STARNET, SONATA, Rainbow, experimental multi-hop networks: Shufflenet, De Bruijn Graph, Hypercube. | 8 |
| 4 | Optical switching: Optical packet switching basics, slotted and unslotted networks, header and packet format, contention resolution in OPS networks, self routing, examples on OPS node architecture. | 8 |
| 5 | Optical Access and Metro Network: Introduction to access network, PON, EPON and WDN EPON: overview, principal of operation, architecture; dynamic wavelength allocation, STARGATE: overview, need, architecture, operation and application, gigabit Ethernet, radio over fiber network. Introduction to metro network, overview of traffic grooming in SONET ring, traffic grooming in WDM ring, Interconnected WDM networks, packet communication using tunable WADM. | 11 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Optical Network Series: Biswanath Mukherjee, Springer, 2006.
2. Optical Networks: R.Ramaswami and K.Sivarajan, A Morgan Kaufmann Publishers, 2nd Edition, 2002.
3. Optical Switching Networks: Mayer & Martin, Cambridge University Press, 2008.
4. Optical Fiber Communications- Principles and Practice by John M Senior, 3rd Edition, Pearson Education India.


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Suggested Reference Book(s):

1. Data Communication by Behrouz Â, A Forouzan, Mc Graw Hill, 4th Edition.
2. Optical Switching: Tarek S. El. Bawab, Springer.

Other useful resource(s):

1. http://www.iec.org/online/tutorials/acrobat/opt_net.pdf
2. http://www.pdf-search-engine.com/optical-networking-pdf.html
3. http://www.networktutorials.info/networkhowto/what_is_optical_networking.html
4. http://www.urec.fr/hd/DWDM/ALCATEL/optical_network.pdf

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Optical Networks ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.75 |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.75 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| CO-5 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2.08 |
| Average | 2 | 2.6 | 2.6 | 2.6 | 2.4 | 1 | 1 | 1 | 2 | 2.4 | 1.6 | 2 | |

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# Principles of Communication Systems

COURSE CODE: 18B1WEC635 COURSE

CREDITS: 2 CORE/ELECTIVE: ELECTIVE

L-T-P: 2-0-0

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Pre-requisite: Signals & Systems. Course

Objectives:

1. To make the students familiar with the constituent elements of the communication systems such as transmitter, receiver and channel with their features.
2. To make students understand the various modulation techniques.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To be familiar with the need of modulation and various types of modulation. | Familiarity |
| CO-2 | Assess and evaluate different analog and angle modulation and demodulation techniques. | Assessment |
| CO-3 | Develop an ability to compare and contrast the strengths and weaknesses of various communication systems. | Assessment |
| CO-4 | To understand the need of sampling and sampling theorem. | Assessment |
| CO-5 | To understand the basics of various digitization techniques like PCM, DPCM, DM, ADM. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Basic elements of communication system; Analog and digital signals, bandlimited signals and systems, bandwidth. | 3 |
| 2 | Amplitude Modulation: AM Signal and Spectra, AM Current and Power Relation, AM generation and Demodulation, Double Side-Band Suppressed Carrier System (DSB-SC)'s Need, Generation and Demodulation, Single Side-Band Suppressed Carrier System (SSB-SC)'s Need, Generation and Demodulation. | 9 |
| 3 | Angle Modulation: Concept of Frequency and Phase modulation, Narrowband and Wideband FM, Carson's Rule of bandwidth, FM Generation and Detection, Comparison of AM and FM. . | 8 |
| 4 | Receivers and Multiplexing Techniques: TRF Receiver, Superheterodyne Receiver, Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM). | 2 |
| 5 | Sampling and Pulse Modulation Techniques: Sampling Theorem with proof, Reconstruction of Signal from Sampled Signal, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). | 5 |
| 6 | Digitization Techniques and Line Coding: Basics of Quantization, Pulse Code Modulation (PCM), Differential PCM, Delta Modulation (DM), Adaptive Delta Modulation (DM). | 3 |
| | Total lectures | 30 |

Suggested Text Book(s):


1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication", 4th Ed., Oxford University Press, 2010.
2. R P Singh and S D Sapre, "Communication Systems: Analog and Digital", 3nd Ed., Tata McGraw-Hill Publishing Company Ltd., 2012.


Suggested Reference Book(s)


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1. Simon Haykin, "Communication Systems", 4th Ed., John Wiley, 2001.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/108104091/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (1) - 5<br>Quizzes (2) - 15<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course Outcomes (Principles of Communication Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2.17 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 2.25 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2.58 |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2.08 |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2.33 |
| Average | 3.00 | 3.00 | 3.00 | 2.60 | 2.20 | 2.00 | 1.60 | 1.80 | 1.00 | 1.80 | 2.40 | 3.00 | |

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# Principles of Communication Systems Lab

COURSE CODE: 18B1WEC672

COURSE CREDITS: 1

CORE/ELECTIVE: ELECTIVE

L-T-P: 0-0-2

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Pre-requisite: None.

Course Objectives:

To enhance the understanding of communication systems and devices.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand the fundamentals of designing of a filter. | Familiarity |
| CO2 | To design a laboratory set up for the understanding of Amplitude modulation and Angle modulation. | Usage |
| CO3 | To design and understand the importance of Sampling. | Usage |
| CO4 | To understand the practical implementation of PAM, PWM, PPM. | Usage |
| CO5 | To understand transmission line encoding. | Usage |
| CO6 | To practically design digitization techniques like PCM, DM. | Usage |

List of Experiments:

| S. No | Description | Hours |
|---|---|---|
| 1 | To design and obtain the frequency response of Low pass filter of cut- off frequency 1 KHz. | 2 |
| 2 | To design and obtain the frequency response of High pass filter of cut- off frequency 1 KHz. | 2 |
| 3 | To perform Amplitude modulation and its demodulation using Envelope detector. Measure the modulation index. | 2 |
| 4 | To perform Frequency modulation and its demodulation. Measure the modulation index. | 2 |
| 5 | To design Sample and Hold circuit. | 2 |
| 6 | To perform Pulse Amplitude modulation (PAM). | 2 |
| 7 | To perform Pulse Width modulation (PWM). | 2 |
| 8 | To perform Pulse Position modulation (PPM). | 2 |
| 9 | To perform Line coding techniques. | 2 |
| 10 | To perform Delta modulation. | 2 |
| 11 | To perform Time division multiplexing. | 2 |
| 12 | To perform Pulse code modulation and its demodulation. | 2 |
| Total Lab hours | | 24 |

Suggested/Resources:

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1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication", 4th Ed., Oxford University Press, 2010.
2. R P Singh and S D Sapre, "Communication Systems: Analog and Digital", 3nd Ed., Tata McGraw-Hill Publishing Company Ltd., 2012.

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2.17 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 2.25 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2.58 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2.08 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2.33 |
| CO6 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2.25 |
| Average | 3 | 3.00 | 3.00 | 2.50 | 2.17 | 2.0 | 1.5 | 1.83 | 1.00 | 1.83 | 2.50 | 3.00 | |

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# Fundamentals of Digital Signal Processing & Applications

COURSE CODE: 18B1WEC636

COURSE CREDITS: 2

CORE/ELECTIVE: ELECTIVE

L-T-P: 2-0-0

Pre-requisite: Prerequisites are Higher Engineering Mathematics, Different Transforms (Fourier, Laplace & Z - transforms), Basic knowledge of Signals and Systems.

Course Objectives:

1. Learn to represent signal in time domain.
2. Learn to analyze the representation of signal in frequency domain.
3. Learn to study the signal transformation tools like Fourier transform, Laplace transform and Z – transform.
4. To study the architectural features of DSP processor.
5. Learn to design a signal processor (digital filter) for a given problem.

Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Analyze the interpretation of discrete/digital signals | Familiarity |
| CO-2 | Study the frequency domain behavior of discrete / digital signals | Assessment |
| CO-3 | Analysis and design of DSP filters | Assessment |
| CO-4 | Study of application domains. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Digital Signal Processing (DSP): Discrete-time sequences and systems, Properties of discrete time sequences and systems, Frequency domain representation of discrete time sequences and its analysis, Sampling theorem and reconstruction of band limited signals. | 5 |
| 2 | Linear Time Invariant (LTI) System: Discrete time LTI system and its analysis, Impulse Response and Convolution Sum, Properties of LTI system, Correlation of Discrete time sequences, LTI system defined by Linear Constant Coefficient Difference Equations. | 5 |
| 3 | Review of Z - transform: Z Transform and its properties, Region of Convergence (ROC) and Pole-Zero Plot, Analysis of discrete LTI systems using Z Transform, Causality and Stability Criterion. | 5 |
| 4 | Discrete Fourier Transform (DFT) & Fast Fourier Transform (FFT): Sampling in frequency domain and origin of DFT, Properties of DFT, Linear Convolution using DFT, Analysis of discrete LTI systems using DFT, FFT-Efficient Computation of DFT, Goertzel Algorithm, radix - 2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms. | 6 |
| 5 | DSP Filter Design and Realization: Structures for the Realization of Discrete time systems, Structures for FIR and IIR systems, Design of FIR filters, Design of IIR filters from analog filters, Frequency Transformations. | 6 |
| 6 | Applications of DSP: Applications of DSP in Speech Processing, RADAR systems, Image Processing and Biomedical Engineering. | 3 |
| | Total lectures | 30 |

Suggested Text Book(s):

1. A. V. Oppenheim, R. W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 2nd Edition, Pearson Education, 2008.

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2. S. K. Mitra and Yonghong Kuo, Digital Signal Processing: A Computer- based Approach, 2nd Edition, Tata McGraw-Hill, 2011.

Suggested Reference Book(s):

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications. Pearson Education India, 2011.

Other useful resource(s):

Link to topics related to course:

i. https://nptel.ac.in/courses/117102060/
ii. https://www.tutorialspoint.com/digital_signal_processing/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Fundamentals of DSP & Applications) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2.08 |
| CO-2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 1 | 1.58 |
| CO-3 | 1 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 2.08 |
| CO-4 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 1 | 1.83 |
| Average | 1.5 | 2.5 | 2.5 | 2 | 1.5 | 1.5 | 1.75 | 1.5 | 2.5 | 2.5 | 1.5 | 1.5 | |

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# Fundamentals of Digital Signal Processing Lab

COURSE CODE: 18B1WEC673

COURSE CREDITS: 1

CORE/ELECTIVE: ELECTIVE

L-T-P: 0-0-2

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Pre-requisite: Basic knowledge of MATLAB Programming for generation of signals and system analysis.

Course Objectives:

The objective of this course is to provide a thorough understanding and analysis of digital signal processing systems using MATLAB and LabVIEW.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand the basics of Lab VIEW Programming and code compressor studio. | Familiarity |
| CO2 | Generate the discrete time signals using sampling and conversion of analog signals in to digital signals. | Familiarity |
| CO3 | Analyze the FFT Algorithm based frequency domain representation. | Usage |
| CO4 | Design the FIR and IIR filter for specified parameters. | Usage |
| CO5 | Apply the adaptive filtering for systems identification. | Assessment |
| CO6 | Perform the linear and circular convolution using DSP kit to get the LTI system response.. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Getting Familiar with LabVIEW. | 1 |
| 2 | Generate a discrete signal by sampling a sinusoidal signal and I investigate the aliasing effect. | 1 |
| 3 | Convert analog signal to digital signal (A/D) and digital signal to analog signal (D/A) using LabVIEW | 1 |
| 4 | Design FIR filter using LabVIEW to meet specifications on their frequency response using window design. | 1 |
| 5 | Design IIR Filter using LabVIEW to meet specifications on their frequency response using the bilinear transformation. | 1 |
| 6 | Use LabVIEW to analyze and display signals in the frequency- domain using the FFT algorithm. | 1 |
| 7 | Design an adaptive filter for system identification using LabVIEW. | 1 |
| 8 | Getting familiar with code compressor studio. | 1 |
| 9 | Perform and verify linear convolution of two signals using DSP Kit. | 1 |
| 10 | Perform and verify circular convolution of two signals using DSP Kit. | 1 |
| Total Lab hours | | 10 |

Suggested/Resources:


1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.



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3. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007
4. https://nptel.ac.in/courses/106104019/26
5. https://nptel.ac.in/courses/106104019/2Ev

Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation (P-1) | 20 Marks |
| 2 | End Sem. Evaluation (P-2) | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| C06 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Principles of Wireless Communication

COURSE CODE: 18B1WEC637

COURSE CREDITS: 2

CORE/ELECTIVE: ELECTIVE

L-T-P: 2-0-0

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Pre-requisite: None

Course Objectives:

1. To understand the fundamentals of wireless communication system.
2. Analyze the design criterion of recent mobile generations.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basic blocks of wireless communication system design. | Familiarity |
| CO-2 | Understand the concept of cellular communication. | Familiarity |
| CO-3 | Analyze the effect of various parameters on the performance of communication system. | Assessment |
| CO-4 | Demonstrate recent wireless communication standards. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Wireless Communication: Block diagram of communication system: source coding & channel coding, base band & band pass signal representation; 1G, 2G, 2.5G, 3G, 4G and 5G wireless standards and their Comparison; Multiplexing and multiple access techniques: FDD, TDD, FDMA,TDMA,CDMA, SDMA. | 8 |
| 2 | Cellular Concept: System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity: co-channel interference, adjacent channel interference, Trunking and Grade of Services, Improving Coverage & Capacity in Cellular System: cell splitting, sectoring and microcell concept, Near-far Problem, Hidden node problem. | 9 |
| 3 | Wireless channel characteristics: Friss equation, Path loss model, Multipath propagation, Doppler shift, Parameters of wireless Multipath Channel; Small-scale and large-scale fading; Shadowing, Types of fading: flat fading, frequency selective fading, slow fading and fast fading. | 7 |
| 4 | 3G and 4G Networks: UMTS Network, UMTS Radio Interface, UTRAN, Handover, LTE Network, 802.16 WiMAX. | 6 |
| Total lectures | | 30 |

Suggested Text Book(s):


1. T.S. Rappaport: Wireless Communication, 2nd Edition, Prentice Hall., 2002.
2. A.Goldsmith: Wireless Communication, 1st Edition , Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath: Fundamentals of Wireless Communication, 1st Edition, Cambridge University Press, 2005.


Suggested Reference Book(s):


1. Jochen Schiller : Mobile Communication, 2nd edition, Pearson, 2003.
2. Martin Sauter: Beyond 3G Bringing Networks, Terminals and the Web Together, 1st Edition, John Wiley & Sons, 2008.


Other useful resource(s):

Link to NPTEL course contents: https://nptel.ac.in/courses/117102062/

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Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Principles of Wireless Communication ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2.18 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 2.17 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2.25 |
| Average | 3 | 3 | 3 | 2.5 | 2 | 1.5 | 1 | 1.5 | 1.75 | 2.25 | 1.5 | 2.75 | |

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# Principles of Wireless Communication Lab

COURSE CODE: 18B1WEC674

COURSE CREDITS: 1

CORE/ELECTIVE: ELECTIVE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. Understand the various techniques of practical wireless communication system.
2. To get familiar with the implementation of various blocks of practical wireless system.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of LabView, MATLab and WiCOMM-T kit | Familiarity |
| CO-2 | Understand basics of various analog and digital modulation techniques. | Usage |
| CO-3 | Gain practical experience of the functioning of wireless systems. | Usage |
| CO-4 | Analyze the performance of practical wireless communication systems. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to various equipments of the lab. | 2 |
| 2 | Design, implementation and study of amplitude modulator. | 2 |
| 3 | Design, implementation and study of amplitude demodulator. | 2 |
| 4 | Design, implementation and study of amplitude shift keying modulator. | 2 |
| 5 | Design, implementation and study of amplitude shift keying demodulator. | 2 |
| 6 | Design of basic Direct Sequence- Code Division Multiple Access (DS-CDMA) system. | 2 |
| 7. | Modeling and simulation of multipath fading channel. | 2 |
| 8. | Bit error rate (BER) analysis of fading channel. | 2 |
| 9 | Analysis of Viterbi equalizer for cellular mobile communication system. | 2 |
| 10 | Analysis of adaptive equalization techniques. | 2 |
| 11 | Implementation of data compression technique for digital communication system | 2 |
| 12 | Mini project | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. S. Haykin: Digital Communication Systems, Student Edition, Wiley,2013.
2. J.H. Reed: Software Radio: A Modern Approach to Radio Engineering, 1st Edition, Prentice Hall, 2002.


Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |


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Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 2.00 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1.92 |
| Average | 3.00 | 3.00 | 2.75 | 2.50 | 2.50 | 1.25 | 1.00 | 1.25 | 1.00 | 1.50 | 1.00 | 3.00 | |

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# Software Defined Radio and Applications

COURSE CODE: 18B1WEC639

COURSE CREDITS: 2

CORE/ELECTIVE: ELECTIVE

L-T-P: 2-0-0

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Pre-requisite: None

Course Objectives:

1. To know software defined radio technology and its challenges.
2. Analyze the design considerations of software defined radio.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the terminology of software defined radio. | Familiarity |
| CO-2 | Understand the need of software defined radio system in next generation communication system. | Familiarity |
| CO-3 | Analyze the design considerations for software defined radio system. | Assessment |
| CO-4 | Demonstrate application areas of software defined radio technology. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to SDR: The need for Software Radios, What is a Software Radio, Characteristics, benefits and design principles of of a Software Radio. | 6 |
| 2 | Radio frequency implementation issues: Purpose of RF Front-End, Dynamic range: The principal challenge of receiver design, RF receiver front-end topologies, Enhanced flexibility of the RF chain with software radios, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC and DAC distortion. | 7 |
| 3 | Multirate signal processing: Introduction, Sample Rate Conversion Principles, Polyshase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters. | 4 |
| 4 | Analog to digital and digital to analog conversion: Parameters of ideal data converters, Parameters of practical data converters, Techniques to improve data converter performance; Common ADC and DAC architectures | 6 |
| 5 | Digital hardware choices: Introduction, Key hardware elements; DSP Processors, Field programmable gate arrays, Trade-offs in using DSPs, FPGAs, and ASICs, Power management issues, Using a combination of DSPs, FPGAs, and ASICs | 5 |
| 6 | Case studies in software radio design. | 2 |
| Total lectures | | 30 |

Suggested Text Book(s):


1. J.H. Reed: Software Radio: A Modern Approach to Radio Engineering, 1st Edition, Prentice Hall, 2002.
2. P.B. Kenington: RF and Baseband Techniques for Software Defined Radio, 1st Edition, Norwood, MA, USA: Artech House, 2005.


Suggested Reference Book(s):


1. S. Haykin: Digital Communication Systems, Student Edition, Wiley, 2013.
2. H. Arslan: Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, 1st Edition, Springer, 2007


Other useful resource(s):

Link to NPTEL course contents : https://nptel.ac.in/courses/108107107/


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Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Software Defined Radio and Applications ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 2.17 |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2.17 |
| Average | 2.75 | 3 | 2.75 | 2.5 | 2 | 1.5 | 1 | 1.5 | 1.75 | 2.25 | 1.5 | 2. 5 | |

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# Software Defined Radio Lab

COURSE CODE: 18B1WEC676

COURSE CREDITS: 1

CORE/ELECTIVE: ELECTIVE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. Understand the basic building blocks of software defined radio.
2. To achieve reconfigurability of communication system through software controlled parameters.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of MATLab and WiCOMM-T kit | Familiarity |
| CO-2 | Attain flexibility in design and implementation of communication system. | Usage |
| CO-3 | Gain practical experience of the functioning of next generation communication systems through SDR technology. | Usage |
| CO-4 | Analyze the performance of reconfigurable software controlled digital communication systems. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to WiComm-T (SDR) kit and MATLab.<br>Interfacing of WiComm-T kit with MATLlab<br>Basic commands of MATLab. | 2 |
| 2 | Demonstration of baseband digital communication system and observe effect of filter roll-off factor on eye pattern. | 2 |
| 3 | Implementation of BPSK Modulation and Demodulation system. | 2 |
| 4 | Implementation of Quadrature Phase Shift Keying Modulation and Demodulation system. | 2 |
| 5 | Implementation of Amplitude Shift Keying Modulation and Demodulation system. | 2 |
| 6 | Implementation of Quadrature Amplitude Modulation and Demodulation (QAM). | 2 |
| 7 | Implementation of Gaussian Minimum Shift Keying (GMSK) modulation and demodulation system. | 2 |
| 8 | To demonstrate GSM communication system. | 2 |
| 9 | To demonstrate Time Division Multiplexing and Demultiplexing. | 2 |
| 10 | To demonstrate Frequency Division Multiplexing and Demultiplexing. | 2 |
| 11 | Implementation of source coding techniques. | 2 |
| 12 | Implementation of channel coding and error control coding techniques. | 2 |
| | Total Lab hours | 24 |

Suggested/Resources:


1. S. Haykin: Digital Communication Systems, Student Edition, Wiley, 2013.
2. J.H. Reed: Software Radio: A Modern Approach to Radio Engineering, 1st Edition, Prentice Hall, 2002.



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Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 2.08 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 2.00 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1.92 |
| Average | 3.00 | 3.00 | 2.75 | 2.75 | 2.50 | 1.25 | 1.00 | 1.25 | 1.00 | 1.50 | 1.00 | 3.00 | |

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# Optimization Techniques in Engineering

COURSE CODE: 18B1WEC739

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To understand the need and origin of the optimization methods.
2. To get a broad picture of the various applications of optimization methods used in engineering.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Cast engineering minima/maxima problems into optimization framework. | Familiarity |
| CO-2 | Learn efficient computational procedures to solve optimization problems. | Familiarity |
| CO-3 | To design algorithms, the repetitive use of which will lead reliably to finding an approximate solution. | Assessment |
| CO-4 | Analyze and appreciate variety of performance measures for various optimization problems. | Assessment |
| CO-5 | Understand importance of optimization of industrial process management. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Functions and Continuity, Optimization and Optimality, Optimization Problem Formulation, Engineering Optimization Problems, Classification of Optimization Algorithms, Order and Notations, Convergence Rate, Computational Complexity, Convexity, Stochastic Nature in Algorithms | 6 |
| 2 | Optimization Techniques and Algorithms: Unconstrained Optimization, Gradient-Based Methods, Newton's Method, Convergence Analysis, Steepest Descent Method, Line Search, Conjugate Gradient Method, Stochastic Gradient Descent, Subgradient Method, Gradient-Free Nelder–Mead Method | 7 |
| 3 | Constrained Optimization: Mathematical Formulation, Lagrange Multipliers, Slack Variables, Generalized Reduced Gradient Method, KKT Conditions, Penalty Method. | 7 |
| 4 | Approximation Optimization Methods: BFGS Method, Trust-Region Method, Sequential Quadratic Programming, Convex Optimization, Equality Constrained Optimization, Barrier Functions, Interior-Point Methods, Stochastic and Robust Optimization. | 7 |
| 5 | Modern Methods of Optimization: Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization. | 7 |
| 6 | Multi-Objective Optimization: Pareto Front and Pareto Optimality, Choice and Challenges, Weighted Sum Method, Utility Function Method, Multi-objective Genetic Algorithms, Multi-objective Particle Swarm Optimization | 8 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Parkinson, A.R., Balling, R., and J.D. Hedengren: Optimization Methods for Engineering Design, 2nd Edition, Brigham Young University, 2018.
2. Deb K: Optimization for Engineering Design: Algorithms and Examples, 2nd Edition, Prentice Hall India Learning Private Limited, 2012.
3. Xin-She Yang: Optimization Techniques and Applications with Examples, 1st Edition, Wiley, 2018.



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Suggested Reference Book(s):


1. A. D. Belegundu and T. R. Chandrupatla: Optimization Concepts and Applications in Engineering, 2nd Edition, Cambridge University Press, 2011.
2. Xin-She Yang: Engineering Optimization: An Introduction with Metaheuristic Applications, 1st Edition, Wiley, 2010.


Other useful resource(s):

Link to NPTEL course contents:Optimization Methods: https://nptel.ac.in/courses/105108127/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (3) - 10<br>Quizzes(3) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the ProgrammeOutcomes (POs)

| Course outcomes (Optimization Techniques in Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1.67 |
| CO-2 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 1.75 |
| CO-3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 3 | 2.25 |
| CO-4 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 3 | 2.25 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 | 2.50 |
| Average | 3 | 2.6 | 2.2 | 1.8 | 2.6 | 1.6 | 2.8 | 1 | 1.2 | 1 | 2.6 | 2.6 | |

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# Electrical Machines

COURSE CODE: 18B1WEC740

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

To prepare students to perform the analysis of any electromechanical system and empower them to understand the working of electrical equipment used in daily life.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions. | Familiarity |
| CO-2 | The skill to analyze the response of any electrical machine. | Usage |
| CO-3 | The ability to troubleshoot the operation of an electrical machine. | Usage |
| CO-4 | The ability to select a suitable measuring instrument for a given application. | Assessment |
| CO-5 | The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Basics of electrical machines: Electromagnetism; magnetic field; torque; electromechanical energy conversion principle, Review of magnetic circuits: Magnetic materials, BH characteristics, Magnetomotive Force (MMF); Magnetic Field Strength; Permeability, Reluctance, Permeance; Analogy between Electric and Magnetic Circuits. | 2 |
| 2 | Transformers: Principle of Operation, EMF Equation; Ideal Transformer, Conditions for Ideal Transformer, Transformation Ratio, Volt-Amperes, Impedance Transformation.<br>Practical Transformer at No Load, Effect of Magnetization, Effect of Core Losses: (i) Hysteresis Loss, (ii) Eddy-Current Loss; Construction of Transformer, Core of Transformer: (ii) Core Type Transformer; (ii) Shell Type Transformer.<br>Ideal Transformer on Load; Practical Transformer on Load : Effect of Winding Resistance, Effect of Flux Leakage; Equivalent Circuit of a Transformer, Phasor Diagram, Simplified Equivalent Circuit, Approximate Equivalent Circuit.<br>Voltage Regulation of a Transformer, Approximate Voltage Drop, Exact Voltage Drop; Condition for Zero Regulation, Condition for Maximum Regulation.<br>Efficiency of a Transformer; All-day Efficiency. | 7 |
| 3 | Synchronous Machines: Electro-Mechanical Energy-Conversion Machines: Power Considerations for a Generator and Motor; How a Generator Differs from a Motor; Type of Rotary Machines.<br>General Characteristics of the Synchronous Machine; Synchronous Speed; Rotating Magnetic Flux due to Three-Phase Currents; EMF Equation.<br>Synchronous Motors; Phasor Diagrams for Generator and Motor; Constant Speed Operation; Operation of a Synchronous Motor; Effect of Change in Mechanical Load, Effect of Change in Excitation, Synchronous Condenser. | 7 |

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| | | |
|---|---|---|
| 4 | Induction Motor : Principle of Working; Slip of Induction Motor; Construction of Induction Motor; Rotor EMF, Current and Power Factor.<br>Torque-Slip Characteristics; Condition for Maximum Torque; Maximum Torque; Effect of Rotor Resistance on the Starting Torque. | 4 |
| 5 | DC Machines : Construction of a DC Machine; Armature Winding; EMF Equation for a DC Generator .<br>Types of DC Machines; A DC Machine as Generator or Motor; Types of DC Generators; Losses in a DC Machine; Efficiency of a DC Generator; Condition for Maximum Efficiency.<br>Characteristics of DC Generators; Open-Circuit Characteristic (OCC).<br>DC Motors; Equivalent Circuit of a DC Motor; Speed Regulation of a DC Motor; Torque Developed by a DC Motor; Torque and Speed Characteristics of a DC Motor. | 8 |
| 6 | Fractional Horse Power Motors: Introduction; Single-Phase Motors, Double-Field Revolving Theory; Types of Single-Phase Motors.<br>Stepper Motors: Types of Stepper Motors; Variable reactance (VR) stepper motors, Permanent magnet stepper motor, Hybrid motor. one-phase on Mode, two-phase on mode, half step mode, microstepping mode. | 5 |
| 7 | Measurement and Error: Definitions; Accuracy and Precision; Significant Figures; Gross errors; Limiting Errors. | 1 |
| 8 | Electrical Instruments: Essentials of an Instrument: (1) Deflecting Torque; (2) Controlling Torque; (3) Damping Torque.<br>Permanent Magnet Moving Coil (PMMC) Instruments; Ammeters; (*Multi-Range Ammeter*); Universal Shunt for Extending Current Ranges; Voltmeters; (*Multi-Range Voltmeter, AC Voltage Measurement).*<br>The Series-Type Ohmmeter; Meter Sensitivity; Loading Effect; Multimeter; Dynamometer Wattmeter; Single-Phase Induction Type Energy Meter. | 4 |
| 9 | Measurement of Non-electrical Quantities: Sensors and transducers, Strain gauge, LVDT, piezoelectric, inductive and capacitive transducers, Hall Effect transducer, light and temperature sensors, proximity sensors. | 4 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. D C Kulshreshtha: Basic Electrical Engineering, 1st Edition, McGraw Hill Education, 2011.
2. Helfrick and Cooper: Modern Electronic Instrumentation and Measurement Techniques, 1st Edition, PHI, 1992.


Suggested Reference Book(s):


1. B.L. Theraja, A.K. Theraja: A Textbook of Electrical Technology: Basic Electrical Engineering Vol- I, 23rd Edition, S Chand and Company Ltd, 2015.
2. B.L. Theraja, A.K. Theraja: A Textbook of Electrical Technology Vol II: AC and DC Machines, 23rd Edition, S Chand and Company Ltd, 2015
3. V.N. Mittle, Arvind Mittal: Basic Electrical Engineering, 2nd Edition Tata McGraw Hill Publishing Co, 2015.


Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/108106071/
2. Link to topics related to course:
   https://nptel.ac.in/courses/108106071/1-24
   https://nptel.ac.in/courses/108105017/6
   https://nptel.ac.in/courses/108105017/21
   https://nptel.ac.in/courses/108105017/24

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Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Electrical Machines) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1.73 |
| CO-2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.00 |
| CO-3 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2.60 |
| CO-4 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2.58 |
| CO-5 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.56 |
| Average | 2.00 | 2.20 | 2.20 | 2.00 | 2.00 | 2.00 | 2.40 | 2.20 | 2.20 | 2.60 | 2.60 | 2.60 | |

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# Biomedical Signal Processing

COURSE CODE: 18B1WEC741

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To introduce different biomedical signals.
2. To apply different methods to analyze and filter the signals.
3. To detect events in signals used for diagnosis.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the origin of different biomedical signals. | Familiarity |
| CO-2 | Able to filter out the noise and artifacts from the medical signals. | Usage |
| CO-3 | Able to extract different events from the signals. | Usage |
| CO-4 | Understand different waveform analyzing methods for medical signals. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Biomedical Signals:- Action potential of neurons, Electrocardiography, Electroencephalogram, Electromyography, Electroretinogram and Electrooculography. | 10 |
| 2 | Filtering for Removal of artefacts: Types of Noise, Power Line and high frequency noise interference, motion artefacts, Filters for removal of interference, Illustration of the Problem with Case Studies. | 8 |
| 3 | Detection of Events: Illustration of the Problem with Case Studies, Derivative based Approaches for QRS detection; Autocorrelation function and Cross- correlation functions for the detection of events in EEG. | 8 |
| 4 | Waveform Analysis: Morphological Analysis of waves, Envelope detection and Analysis; Analysis of activity using Root Mean Square value, Zero-crossing rate, Turns Count, and Form factor. | 8 |
| 5 | Frequency-domain Analysis: Spectral Analysis of biomedical signals, Estimation of PSD; Measures Derived from PSDs. | 8 |
| | Total lectures | 42 |

Suggested Text Book(s):


1. R. S Khandpur and Raghbir Khandpur: Biomedical Instrumentation, 2nd Ed., McGraw-Hill Education; , 2003.
2. Rangaraj M. Rangayyan, Biomedical Signal Analysis, 2nd Ed., Wiley,2015.


Suggested Reference Book(s):


1. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A: Biomedical Instrumentation and Measurements, Prentice-Hall India, 2nd Edition, 1997.
2. John G. Webster: Medical Instrumentation application and design, John Wiley, 3rd Edition, 1997.


Other useful resource(s):

Link to NPTEL course contents: https://nptel.ac.in/courses/108105101/


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Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Biomedical Signal Processing ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2.28 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 2.25 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 2.25 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 2.25 |
| Average | 2.75 | 2.5 | 3 | 2.75 | 3 | 1.25 | 1.25 | 1.25 | 2 | 2 | 1 | 3 | |

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# Industrial Internet of Things

COURSE CODE: 18B1WEC839

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To understand the concepts of Internet of Things.
2. To automate the industrial process through IoT applications.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To Understand the Characteristics of IoT. | Familiarity |
| CO-2 | To provide the basic knowledge of Network & Communication Aspects of IoT. | Familiarity |
| CO-3 | To Design IoT applications in different domain and be able to analyze their performance. | Usage |
| CO-4 | To Implement basic IoT applications on embedded platform. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1. | Introduction to IoT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & Application Programming Interfaces (APIs). | 6 |
| 2. | IoT & M2M: Machine to Machine, Difference between IoT and M2M, Software defined Network. | 8 |
| 3 | Network & Communication Aspects: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. | 8 |
| 4 | Challenges in IoT: Design challenges, Development challenges, Security challenges, Other challenges. | 8 |
| 6 | Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT applications. | 6 |
| 7 | Developing IoTs: Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts. | 6 |
| | Total Lectures | 42 |

Suggested Text Book(s):


1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach",Universities Press, 1st Edition, 2015.
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 1st Edition, 2017.


Suggested Reference Book(s):


1. Antonio Capasso and Giacomo Veneri, "Hands-On Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0", Pact Publishing Ltd, UK, 1st edition, 2018.
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley-Blackwell, 1st Edition, 2010.



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Other useful resource(s):

Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc17_cs22/preview

Link to topics related to course: https://onlinecourses.nptel.ac.in/noc19_cs32/preview

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Industrial Internet of Things) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2.6 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2.9 |
| Average | 3 | 3 | 3 | 3 | 3 | 2.75 | 3 | 2.75 | 2.75 | 2.75 | 2.75 | 2.75 | |

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# Wireless Ad Hoc and Sensor Networks

COURSE CODE: 18B1WEC844

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: None

Course Objectives:

1. To understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology.
2. Learn key routing and transport layer protocols for sensor networks, and design requirements.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basics of wireless sensor and ad-hoc network. | Familiarity |
| CO-2 | To identify communication protocols employed in wireless sensor and ad hoc network. | Assessment |
| CO-3 | To select the appropriate technology to implement a WSN. | Assessment |
| CO-4 | To assess different communication protocols and their usefulness in different applications | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Wireless sensor and Ad Hoc Networks, Architecture, Self-organizing Behaviour, Practical Implementation Issues, Power Management. | 8 |
| 2 | Layered Protocols Architecture, Physical layer, WSN Coverage & Placement of wireless sensor nodes, Topology Management in Wireless Sensor | 8 |
| 3 | Data link layer, Network layer, Congestion and Flow Control | 8 |
| 4 | MAC and Routing Protocols, Application of MAC and Routing protocols, Cooperation in Ad Hoc Network, MANETs. | 9 |
| 5 | Multicasting in MANETs, Mobility Models, Transport Protocols for MANETs, Opportunistic Mobile Networks, UAV Networks | 9 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. Savo G Glisic, "Advanced Wireless Networks 4G Technologies", 2nd Edition, John Wiley & Sons, 2006.
2. Yingshu Li, My T. Thai, "Wireless Sensor Networks and Applications". 1st Edition, Springer,2008.
3. Jonathan Loo et.al. , "Mobile Ad Hoc Networks current status and future trends" 1st Edition, CRC Press, 2016.


Suggested Reference Book(s):


1. Stefano Basagni , "Mobile Ad Hoc Networking" 2nd Edition, John Wiley & Sons, 2015,
2. Driss Benhaddou, "Wireless Sensor and Mobile Ad-Hoc Networks", 1st Edition, Springer,2015.
3. A.Goldsmith, "Wireless communication" 1St Edition, Cambridge University Press,2005.


Other useful resource(s):


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Link to NPTEL course contents: https://swayam.gov.in/courses/4408-wireless-adhoc-and-sensor-networks

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programmed Outcomes (POs)

| Course outcomes (Wireless Ad Hoc and Sensor Networks) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 1 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 1.75 |
| CO-2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| CO-3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1.83 |
| CO-4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 1.91 |
| Average | 2.5 | 2.25 | 2 | 1.75 | 2.25 | 1.75 | 1.5 | 1.5 | 1.5 | 2.25 | 1.5 | 1.75 | |

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# Satellite Communication

COURSE CODE: 18B1WEC841 COURSE

CREDITS: 3 CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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Pre-requisite: Basic knowledge of communications Course Objectives:

1. To acquire good knowledge about the components of a satellite communication system.
2. To analyze different methods of satellite access and the applications of satellites.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To obtain basic knowledge of satellite communication principles. | Familiarity |
| CO-2 | To have a thorough understanding of orbital mechanics and launches for the satellite communication. | Familiarity |
| CO-3 | To understand the basic knowledge of link design of a satellite system. | Assessment |
| CO-4 | To provide better understanding of multiple access systems and earth station technology. | Assessment |
| CO-5 | To prepare students with knowledge in satellite navigation and GPS and satellite packet communications. | Usage |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction : Origin of Satellite Communication, Historical Back-ground, Basic Concepts of Satellite Communication, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communication. | 2 |
| 2 | Orbital mechanics and launchers: Kepler's laws, Newton's law, Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance. | 7 |
| 3 | Satellite systems: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification. | 6 |
| 4 | Earth station technology and Link design: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods. Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example. | 6 |
| 5 | Multiple Access: Frequency Division Multiple Access (FDMA) – Intermodulation Calculation of C/N, Time Division Multiple Access (TDMA) – Frame Structure, Burst Structure, Satellite Switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) — Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception. | 9 |
| 6 | Low earth orbit and geo-stationary satellite systems: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs | 6 |
| 7 | Satellite navigation and the global positioning system: Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS. | 6 |
| | Total lectures | 42 |

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Suggested Text Book(s):

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "Satellite Communications", 2nd Edition , John Wiley & Sons, 2002.
2. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.

Suggested Reference Book(s):

1. M.Richharia, "Satellite Communication Systems-Design Principles", 1st Edition, Palgrave, Macmillan 2003.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, "Satellite Communications Engineering", 2nd Edition, Pearson Publications, 2003.

Other useful resource(s):

Link to NPTEL course contents: https://nptel.ac.in/syllabus/117105131/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Satellite Communications ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.7 |
| CO-2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 2.0 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2.3 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 3 | 2 | 2 | 2.0 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1.8 |
| Average | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 2.2 | 1.4 | 1.0 | 1.2 | 2.2 | 4 | 2.20 | |

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# English and Technical Communication

## Course Goal

This course is aimed to equip students of engineering with effective oral and written communication. The course develops the verbal skills of the students with emphasis on learning grammatical concepts and syntactical strategies. The course emphasis in grooming the students and their personality by focusing on written and spoken English and Communication.

## Course Objectives

- The Student will be able to analyze communication situations and audiences to make choices about the most effective and efficient way to communicate and deliver messages
- The student will learn to deliver effective presentations in contexts that may require power point, extemporaneous or impromptu oral presentations
- The student will learn to write grammatically correct business documents using appropriate business style.
- The student will learn to speak and write grammatically correct sentences with the ability to express thoughts with clarity and accuracy.
- Students will develop command over their language and synchronize their thoughts into written form

## Detailed Syllabi
### Lecture-wise Breakup

| | | | |
|---|---|---|---|
| **Subject Code** | 18B11HS111 | **Semester** | 1 |
| **Subject Name** | English and Technical Communication | | |
| **Credits** | 02 | **Contact Hours** | 28 |

| | | |
|---|---|---|
| **Faculty (Names)** | **Coordinator(s)** | 1. Dr Tanu Sharma<br>2. Dr. Papiya Lahiri |
| | **Teacher(s) (Alphabetically)** | |

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| Module No. | Subtitle of the Module | Topics | No. of Lectures |
|---|---|---|---|
| 1 | Concept and Nature of Communication | What is communication?<br>Stages of communication<br>Ideation, encoding, transmission, decoding & response<br>Channels of communication<br>Communication in organizational settings<br>Etiquettes in social and Office settings<br>Work culture in Jobs<br>Barriers to effective communication<br>Guidelines to overcome communication barriers | 4 |
| 2 | Self Development and Assessment | Self Assessment,Awareness, Perception and Attitude and Values.<br>Personal goal Setting , | 2 |
| 3 | Effective presentation | Pre- presentation jitters<br>Preparation and practice<br>Delivering the presentation<br>Qualities of a skilful presenter<br>Capturing and maintaining attention<br>Handling questions<br>Power point presentations | 4 |
| 4 | Nature and Mechanics of Writing(Basic Writing Skills ) | Techniques for writing precisely:<br>Defining<br>Describing<br>Classifying<br>Use of Phrases and Clauses in sentences<br>Importance of Proper Punctuation<br>Organizing Principles of Paragraphs in documents | 5 |
| 5 | Technical Writing | Importance ,structure and drafting and revising of Reports<br>Technical writing style and Language<br>Business writing: Letters, Preparing | 6 |

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| | | | |
|---|---|---|---|
| | | resume, notices, agenda and minutes of meeting | |
| 6 | Vocabulary Development | Word Formation<br>Derivatives: Prefixes & Suffixes<br>Root words<br>Synonyms, Antonyms<br>Homophones and Homonyms<br>One word substitution | 2 |
| 7 | Grammar and Usage | Subject-Verb Agreement<br>Noun-Pronoun Agreement<br>Prepositions, Articles | 3 |
| 8 | Identifying Common errors in writing | Redundancies, Clichés , Misplace modifiers, words often confused and misused | 2 |
| | | Total number of Lectures | 28 |

**Methodology**

The course will follow an interactive teaching-learning method with classroom discussions and activities on fundamental concepts of grammar with a strong emphasis on skill development of students with regard to speaking, writing, logically interpreting ideas into words and reasoning in the classroom. Both lab and tutorial activities are run on student –teacher individual and group interactions.

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**Evaluation**

| Sr. No. | Components | Total Marks |
|---|---|---|
| 1 | **Test 1** | 15 |
| 2 | **Test 2** | 25 |
| 3 | **Test 3** | 35 |
| 4 | **Internal Assessment** | 25 |

| **Recommended Reading** (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format) | |
|---|---|
| **1.** | *Practical English Usage. Michael Swan. OUP.1995.* |
| **2.** | *Remedial English Grammar. F.T. Wood. Macmillan. 2007* |
| **3.** | *On Writing Well. William Zinsser. Harper Resource Book. 2001.* |
| **5.** | *Study Writing.Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006* |
| **6.** | *Communication Skills. Sanjay Kumar and Pushp Lata. OUP. 2011.* |
| **7.** | *Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. OUP* |
| **8.** | *A Communicative Grammar of English. 3rd Edn. G. Leech and J. Svartvik. 2012* |
| **9.** | *Williams, K., Krizan, A. C., Logan, J. & Merrier, P. (2011) Business Communicating in Business 8th Ed. New Delhi: Cengage Learning.* |
| **10.** | *Murphy, Herta A., Herbert Hildebrandt, Jane Thomas (2008) Effective Business Communication 7th Ed. New Delhi:Tata Mcgraw Hill Education Private Limited.* |
| **11.** | *Guffey, M. A. (2000) Business Communication: Product & Process South-Western College Publishing.* |
| **12.** | *Lesikar, R. V., Flatley, M.E., Rentz, K. & Pande, N. (2009) Business communication 11th Ed. New Delhi: Mc Graw Hill.* |
| **13.** | *Business correspondence and Report Writing: by R. C. Sharma & Krishna Mohan* |

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# Engineering Mathematics I

COURSE CODE: 18B11MA111

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

**Pre-requisite:** Basic concepts of calculus and algebra

**Course Objectives:**

1. Various techniques of Multivariate Calculus and Integral Calculus.
2. The fundamental concepts of Vector Calculus.
3. The fundamentals of Laplace transforms and their applications.
4. To develop the essential tool of Matrices and Linear Algebra in a comprehensive manner.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Evaluate partial derivatives with its physical significance and expand functions of several variables. | Familiarity & Usage |
| CO-2 | Find maxima and minima of functions of several variables with / without constraints. | Assessment |
| CO-3 | Find areas and volumes of solids using multiple integration | Assessment |
| CO-4 | Understand the calculus of vectors and vector valued functions with their physical significance | Familiarity & Usage |
| CO-5 | Use Laplace transforms and inverse Laplace transforms to solve IVP | Usage |
| CO-6 | Solve linear systems of equations and perform diagonalization of matrices | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Differential Calculus:** Limits and continuity of function, Partial Differentiation, Chain rule, Total Derivative; Maxima, Minima and Saddle points; Method of Lagrange's multipliers, Taylor's series for two or more variables | 10 |
| 2 | **Integral Calculus:** Improper integrals; Beta and Gamma functions and their properties; Double integrals, Change of order and Change of variables, Applications to areas and volumes. | 10 |
| 3 | **Vector Calculus:** Equations to a line and a plane, Tangent plane and Normal line, Gradient, Curl and divergence and their physical significance, Directional derivatives, Line and surface integrals. | 6 |
| 4 | **Laplace Transform:** Laplace Transform, Inverse Laplace transform, Convolution, Dirac delta and Unit Step function, Solution of initial value problems. | 6 |
| 5 | **Matrices:** Algebra of matrices, Row Echelon form, Inverse and Rank of a matrix, Symmetric, Skew- symmetric and Orthogonal matrices; Determinants; Solution of systems of linear equations (Gauss's elimination, Rank method), Linear Independence and Dependence of vectors. Eigen values and Eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices and Orthogonal transformation. | 10 |
| **Total lectures** | | 42 |

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**Suggested Text Book(s):**

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Jain and Iyengar, Advanced Engineering Mathematics, Narosa Publishing House.

**Suggested Reference Book(s):**

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

**Other useful resource(s):**

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18_ma05/preview
2. Link to topics related to course:
   i. https://www.whitman.edu/mathematics/calculus_online/chapter14.html
   ii. https://nptel.ac.in/courses/103103037/5
   iii. https://nptel.ac.in/courses/111106051
   iv. https://nptel.ac.in/courses/111107108/25
   v. https://nptel.ac.in/courses/117101056/16

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1. | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2. | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (1) - 5<br>Quizzes (2) - 15<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Engineering Mathematics I ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 1 |
| CO-2 | 3 | 2 | 3 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 2 | 2 | 1.5 |
| CO-3 | 2 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 2 | 1 |
| CO-4 | 3 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 1.5 |
| CO-5 | 2 | 2 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 3 | 1.5 |
| CO-6 | 3 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 3 | 1.5 |
| Average | 2.67 | 1.5 | 1.17 | 1 | 1.5 | 1.5 | 0 | 0 | 0 | 1.67 | 1.5 | 2.17 | |

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# Engineering Physics-I

COURSE CODE: 18B11PH111

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** None

**Course Objectives:**

1. To enable the students to get better understanding about physical optics and its applications in engineering.
2. To familiarize students about modern physics and its applications in engineering.
3. To enable the students to get better understanding about thermal physics and its applications in engineering.
4. To familiarize students with relativistic mechanics.
5. At the conclusion of the course, the ability of students should have enhanced to think logically about the problems of science and technology and obtain their solutions

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the fundamental of physical optics | Familiarity |
| CO-2 | To implement the concepts and theory for solving the application related problems of physical optics | Assessment |
| CO-3 | To learn the basic and mathematical methods for relativity and related fields | Familiarity and Assessment |
| CO-4 | To learn the basic concepts of modern , laser and thermal physics | Familiarity |
| CO-5 | To implement the concept of modern and thermal physics ; analyzing and solving the related problems | Assessment and Implementation |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Interference:** Introduction, Young's double slit experiment, Phase difference and Path Difference, Coherence, Analytical treatment of interference, Methods of interference (division of wave front & division of amplitude) Applications of interference in the field of engineering, Scientific applications of interference. | 8 |
| 2 | **Diffrection:** Introduction, Difference between interference and diffraction, Fresnel and Fraunhoffer class of diffraction, Diffraction grating, Applications of diffraction grating, Resolving and dispersive power of an optical instrument. | 6 |
| 3 | **Polarization:** Introduction, Difference between unpolarized and polarized light, Means of production of polarized light, Optical activity, specific rotation, Lorentz half shade and biquartz polarimeter. | 4 |
| 4 | **Atomic Physics:** Introduction, Quantum numbers, spin and orbital angular momentum, Atoms in magnetic field, Zeeman effect, Atoms in electric field, | 4 |

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| | | |
|---|---|---|
| | Stark effect. | |
| 5 | **Quantum Physics:** Wave particle duality, uncertainty principle and its applications, wave function, Schrodinger equation and its solutions, Particle in a box, Harmonic Oscillator | 6 |
| 6 | **Lasers:** Principle and working of laser, Different types of lasers (Three level and four level lasers). | 2 |
| 7 | **Thermal Physics:** Introduction, Zeroth law of Thermodynamics. First law of thermodynamics, Specific heat relation, Work done during an isothermal and adiabatic process. Second law of thermodynamics, concept of entropy, entropy for an ideal gas, Third law of thermodynamics, Principle of increase of entropy or degradation of energy, Reversible and irreversible processes. Carnot cycle and Carnot engine, Refrigerator, Clausius-Cleyperon equation, Thermodynamic Potentials, Maxwell's equations. | 8 |
| 8 | **Relativistic Mechanics**: Inertial & non-inertial frames, Michelson- Morley experiment, Einstein's postulates. Lorentz transformation, equations. Length contraction & Time dilation, Addition of velocities; Variation of mass with velocity Mass energy equivalence. | 4 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson Pub. 2018.
2. N. Subrahmanayam, Brij Lal and M.N. Avadhanulu, A Text Book of Optics, S. Chand (2012).
3. Brij Lal, N Subrahmanyam and P.S. Hemne, Heat Thermodynamics and Statistical Physics, S. Chand, 3rd edition 2012.
4. Arthur Beiser, Concepts of Modern Physics, McGraw Hill, 6th edition (1994).

**Suggested Reference Book(s):**

1. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill (1981).
2. R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons, 2nd edition (1985).
3. Ajoy Ghatak, Optics, Tata McGraw Hill, 5th addition, (2012)

**Other useful resource(s):**

1. Link to topics related to course:

i. https://nptel.ac.in/courses/122107035/
ii. https://nptel.ac.in/courses/122103011/
iii. https://nptel.ac.in/courses/122101002/28
iv. https://nptel.ac.in/courses/122105023/

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |

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| | | | | |
|---|---|---|---|---|
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Parallel and Distributed Algorithms ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | | | | 2 | | | | 2 | | 2 | **1.25** |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | 2 | **2** |
| CO-3 | 3 | 2 | | | | 2 | | | | 2 | | 2 | **1.4** |
| CO-4 | 3 | 3 | | | | 2 | | | | 2 | | 2 | **1.5** |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | | | | 3 | | 3 | **3** |
| Average | **2.6** | **2.4** | **2.5** | **2.5** | **2.5** | **2.2** | | | | **2.2** | | **2.2** | |

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# Programming for Problem Solving-II

COURSE CODE: 19B11CI111

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 2-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs (in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. To use arrays, pointers and structures to formulate algorithms and programs.
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
8. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

**Course outcomes:**

| S.NO | Course outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To formulate simple algorithms for arithmetic and logical problems. | Familiarity |
| CO-2 | To translate the algorithms to programs (in C language). | Familiarity |
| CO-3 | To test and execute the programs and correct syntax and logical errors. | Usage |
| CO-4 | To implement conditional branching, iteration and recursion. | Usage |
| CO-5 | To decompose a problem into functions and synthesize a complete program using divide and conquer approach. | Usage |
| CO-6 | To use arrays, pointers and structures to formulate algorithms and programs. | Usage |
| CO-7 | To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. | Assessment |
| CO-8 | To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Programming (4 lectures)**<br>Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture).<br><br>**Idea of Algorithm:** steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. (1 lecture)<br><br>From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable | 4 |



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| | | |
|---|---|---|
| | code- (2 lectures) | |
| 2 | **Arithmetic expressions and precedence** | 2 |
| 3 | **Loops:**<br>Conditional Branching and Loops (6 lectures)<br><br>Writing and evaluation of conditionals and consequent branching (3 lectures)<br>Iteration and loops (3 lectures) | 6 |
| 4 | **Arrays:**<br>Arrays (1-D, 2-D), Character arrays and Strings | 6 |
| 5 | **Basic Algorithms:**<br>Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required. | 6 |
| 6 | **Function:**<br>Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference<br><br>**Recursion:**<br>Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort. | 5<br><br>4 |
| 7 | **Structure:**<br>Structures, Defining structures and Array of Structures | 4 |
| 8 | **Pointers:**<br>Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)<br><br>**File handling** | 3<br><br>2 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Byron Gottfried, Schaum's Outline of Prokli[gramming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

**Suggested Reference Book(s):**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

**Other useful resource(s):**

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18-cs10

2. Link to topics related to course:
   a. **https://www.learn-c.org/**
   b. **https://www.programiz.com/c-programming**
   c. **https://www.codechef.com/ide**

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |

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| | | | | |
|---|---|---|---|---|
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Programming for Problem Solving ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2.5 |
| CO-2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.6 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2.4 |
| CO-4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2.5 |
| CO-5 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2.4 |
| CO-6 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2.6 |
| CO-7 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2.4 |
| CO-8 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2.5 |
| Average | 2.6 | 2.1 | 2.6 | 2.1 | 2.4 | 2.6 | 2.5 | 2.6 | 2.1 | 2.5 | 2.9 | 2.8 | |

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# Workshop Practices

COURSE CODE: 18B17GE171

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

L-T-P: 0-0-3

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**Pre-requisite: Nil**

**Course Objectives:**

1. To learn the basics of different workshop practices by understanding and implementing used in different shops of workshop.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Study of various carpentry processes and its applications in carpentry | Familiarity |
| CO2 | Study and practice the use of various carpentry tools for different carpentry processes | Familiarity |
| CO3 | Study and manufacturing of different wood working joints | Assessment |
| CO4 | Study the principles, classification and application of different welding processes | Usage |
| CO5 | Study and Manufacturing of various welding joints using electric arc welding and gas welding | Usage |

**List of Experiments**

| S.NO. | Subtitle | Topics |
|---|---|---|
| 1. | Carpentry | To Study the carpentry processes |
| | | To study and identify carpentry tools |
| | | To prepare a T-Lap Joint |
| | | To prepare Motise-tenon joint |
| | | To prepare corner joint |
| 2. | Welding | To study the different welding processes with mechanism |
| | | To prepare lap welding joint |
| | | To prepare butt welding joint |
| 3. | Sheet Metal work | To cut and prepare V-joint from metal using hexablade |
| 4. | Turning | To study the lathe machine and its operation with one turning job |

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**Suggested/Resources:**

1. Workshop Practices by S.K. Hajra and Chaudhary

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| Average | 2.80 | 2.80 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Engineering Graphics

COURSE CODE: 18B17GE173

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

: 0-0-3

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**Pre-requisite: None**

**Course Objectives:**

1. To introduce the students to the "universal language of Engineers" for effective communication through drafting exercises of geometrical solids.
2. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.
3. To impart knowledge to students about creating a sheet and software aided layout of required dimensions in 2-D and 3-D view.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To impart and inculcate proper understanding of the theory of projection. | Familiarity |
| CO2 | To improve the visualization skills | Assessment |
| CO3 | To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient | Usage |
| CO4 | To impart the knowledge on understanding and drawing of simple residential/office buildings. | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to Lettering | 3 |
| 2 | Scales and their types | 2 |
| 3 | Construction of Polygons | 4 |
| 4 | Projection of points | 2 |
| 5 | Projection of lines | 4 |
| 6 | Projection of planes | 3 |
| 7 | Drawing of building plan | 6 |
| 8 | Introduction to Basic Commands in Auto-CAD | 3 |
| 9 | Orthographic projections in Auto-CAD | 3 |
| 10 | Isometric Projection in Auto-CAD | 4 |
| 11 | Projections of solids in Auto-CAD | 1 |
| 12 | Section of solids in Auto-CAD | 1 |

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| | |
|---|---|
| **Total Lab hours** | **36** |



**Suggested/Resources:**

1. Engineering Drawing & Graphics with AutoCAD by K.Venugopal, New Age International Pvt. Ltd., New Delhi (India)
2. Engineering Drawing by N.D.Bhatt, V.M.Panchal and Pramod R. Ingle, Charotar Publishing House, Anand, Gujarat (India)
3. Engineering Drawing [With Introduction to Auto-CAD] by Roop Lal and Ramakant Rana, IK International Publishing House Pvt. Ltd.

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 10 Marks |
| 4 | Lab Assessment | 50 Marks |
| | **Total** | **100 marks** |

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## Engineering Physics Lab-I

COURSE CODE: 18B17PH171

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | To determine the wavelength of sodium light by measuring the diameters of Newton's Rings | 4 |
| 2 | To find the wavelength of sodium light using Fresnel's biprism. | 2 |
| 3 | To determine the distance between two virtual source using biprism. | 2 |
| 4 | To measure the wavelengths of certain lines in the spectrum of the mercury lamp using plane transmission grating. | 2 |
| 5 | To determine the dispersive power of the material of prism with the help of a spectrometer. | 2 |
| 6 | To measure the angle of prism with the help of a spectrometer. | 2 |
| 7 | To determine the magnetic susceptibility of a given paramagnetic liquid using Quinck's method. | 4 |
| 8 | To find the specific rotation of sugar solution by using a half shade polarimeter. | 4 |
| 9 | To find the specific rotation of sugar solution by using a biquartz polarimeter. | 4 |
| 10 | To verify the Malus's law for a given light using polarizer and analyzer. | 2 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**


1. S. P. Singh, Advanced Practical Physics,Pragati Prakashan, Vol. 1 (2013).
2. C. L. Arora, Practical Physics, S. Chand Company Limited, 20th edition (2004).
3. N. Subrahmanayam, Brij Lal and M.N. Avadhanulu, A Text Book of Optics, S. Chand (2012)
4. Ajoy Ghatak, Optics, Tata McGraw Hill, 5th addition, (2012)
5. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill (1981).
6. Dabir S. Viswanath, Tushar Ghosh, Dasika H.L. Prasad, Nidamarty V.K. Dutt, Kalipatnapu Y. Rani , Viscosity of Liquids: Theory, Estimation, Experiment, and Data , Springer (2007).


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# Programming for Problem Solving Lab-II

COURSE CODE: 19B17CI171

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

**Pre-requisite:** No prior programming experience is expected however, mathematical maturity level of science or engineering undergraduate is assumed.

**Course Objectives:**

1. Develop problem solving ability using programming.
2. To impart adequate knowledge on the need of programming languages and problem solving techniques.
3. To develop a methodological way of problem solving
4. Analyze and construct effective algorithms
5. Employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines
6. Learn a programming approach to solve problems

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the Typical C Program Development Environment, compiling, debugging, Linking and executing. | Familiarity |
| CO-2 | Introduction to C Programming using Control Statements and Repetition Statement | Usage |
| CO-3 | Apply and practice logical formulations to solve some simple problems leading to specific applications. | Assessment and Usage |
| CO-4 | Design effectively the required programming components that efficiently solve computing problems in real world. | Assessment & Usage |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | Getting acquainted with the C program Structure and basic I/O.<br>Getting acquainted with the various data types and arithmetic operator used in C. | 2 |
| 2 | Write a program to obtain the reversed number and to determine whether the original and reversed numbers are equal or not. | 2 |
| | Write a program to check whether a triangle is valid or not, when the three angles of triangle are entered through the keyboard. A triangle is valid if the sum of all three angles is equal to 180 degrees.<br>Check a given I/P is character, number or special symbol. | |
| 3 | WAP to check a given number is Armstrong or not. Calculate factorial of a number<br>Given number is prime or not. | 2 |
| 4 | Write a program to add first seven terms of the following series using any loop: 1/1! + 2/2! + 3/3! +…..<br>Any five pattern program. | 2 |
| 5 | WAP to swap two numbers with function using 3rd variable or without using (call by value & reference). | 2 |

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| | | |
|---|---|---|
| | Write a function to find out the roots of quadratic equation. | |
| 6 | Factorial using recursion<br>Fibonacci series using recursion. | 2 |
| 7 | WAP to sort N elements of an array using bubble sort.<br>WAP for Binary search & linear search. | 2 |
| 8 | Find Max, Min, 2nd Max, Standard Deviation.<br>Reverse elements of an array. | 2 |
| 9 | Matrix addition, Multiplication and Transpose. | 2 |
| 10 | WAP to handle pointer variables and access the elements of an array using pointers.<br>WAP to insert a string and perform operations: string length, copy, concatenation, compare, lower to upper, etc. | 2 |
| 11 | Write a program to find whether the string is palindrome or not using pointers<br>Write a program to delete all vowels from sentence, assume that sentence is not more than 80 character long using pointers. | 2 |
| 12 | Enter the detail of 5 students using structure and print the details of all students including pointers and also sort the detail of students using DOB. | 2 |
| 13 | Dynamic allocation function and random function with string and integer array. | 2 |
| 14 | Perform operation on files: open, read, write, close etc. | 2 |
| | **Total Lab hours** | **28** |

**Suggested/Resources:**


1. Yale N. Patt and Sanjay J. Patel, Introduction to Computing Systems, from bits & gates to C & beyond, 2nd Edition, 2004.
2. Deitel and Deitel, C How to Program, 7th Edition, 2013.
3. Venugopal Prasad, Mastering C, Tata McGraw Hill.
4. Complete Reference with C, Tata McGraw Hill.
5. Drmey, How to solve it by Computer, PHI.
6. Kerninghan and Ritchie, The C Programming Language.
7. http://www.acm.uiuc.edu/webmonkeys/book/c_guide/
8. http://msdn.microsoft.com/en-us/library/25db87se.aspx


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | **1.7** |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | **1.8** |
| **CO3** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | **2.1** |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | **2.2** |
| **Average** | **3** | **3** | **2** | **1.8** | **2.5** | **2** | **1.3** | **1** | **1** | **2** | **1.3** | **2.3** | |

## Data Structure and Algorithms

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COURSE CODE: 18B11CI211

COURSE CREDIT: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisites:** C/C++

**Course Objectives:**

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures
5. Introduce students to data abstraction and fundamental data structures.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To gain knowledge on the notions of data structure, Abstract Data Type. | Familiarity |
| CO-2 | For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness. | Assessment |
| CO-3 | For a given Search problem (Linear Search and Binary Search) student will able to implement it. | Assessment |
| CO-4 | For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity. | Assessment |
| CO-5 | Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity. | Assessment |
| CO-6 | Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|

## English and Technical Communication Lab

### Course Goal

The Presentation and Communication (Language Lab) aims at developing the verbal/written skills of the students with emphasis on learning grammatical concepts and syntactical strategies. The lab based softwares particularly focus on sharpening language skills of the students and grooming their personality. This would include expressing thoughts in the written form logically, precisely and appropriately; understanding the essentials of successful job applications with command over language and using economy of words; help in making communication stronger, facilitating working faster and better.

### Course Objectives

1. The students will learn to speak and write grammatically correct sentences with the ability to express thoughts with clarity and accuracy.

2. The students will learn the rules of grammar in writing. It will enhance their ability to use logical sequencing while writing any business letter or document.

3. The students will learn using new words and build their vocabulary steadily and systematically by following the exercises.

4. Students will develop command over their language and synchronize their thoughts while writing different types and kinds of Business letters.

5. Students will be groomed to develop the art of speaking logically, confidently and pragmatically, involving understanding work ethics, manners and correct use of body language.

### Detailed Syllabi
### Lab class-wise Breakup

| | | | |
|---|---|---|---|
| **Subject Code** | 18B17HS171 | **Semester** | 1 |
| **Subject Name** | English and Technical Communication Lab | | |

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| Credits | 01 | Contact Hours | 28 |
|---|---|---|---|

| Faculty (Names) | Coordinator(s) | 1. Dr. Papiya Lahiri |
|---|---|---|
| | Teacher(s) (Alphabetically) | |

| Lab Exercise No. | Subtitle of the Module | Topics | No. of Lab Exercises |
|---|---|---|---|
| | **The Writing Process** | Key vocabulary for writing<br>How do you write<br>Vocabulary: What is a document<br>The Writing process<br>Prepositions<br>The Writing process: some thoughts | 1 |
| | **Linking Ideas (I)** | Linking by time<br>Linking by contrast and logic<br>Test yourself (learn about sequencing, exemplifying, highlighting and logic) | 1 |
| | **Linking Ideas (I)** | Referencing Words (1)<br>Practice linking ideas (using connectors)<br>Grammatical focus (Agreement) | 1 |
| | **Applying for a Job** | Online Application (Spell Check)<br>Use action words | 1 |

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|---|---|---|---|
| | | Resumes- the basics<br>Look at a Resume<br>Applying for a Job: a thought<br>The Covering letter | |
| | **Business Letters** | Grammar focus: contractions<br>A letter of complaint<br>A letter of apology<br>Words: formal or informal? (Writing clearly and appropriately) | 1 |
| | **Writing letters** | Successful emails: the basics (Alternatives to gender- specific words)<br>Marketing emails: some thoughts<br>Perfecting your document (Spell checking)<br>Emails and letters: case studies (Analyze a formal response)<br>Emails and Letters (Grammar Focus: Modals) | 1 |
| | **Use of Body Language** | This exercise will include showing a couple of videos to the students on the use of Body Language in communication and also how to interpret other people's body language when they communicate. This will include studying facial expressions, gestures, non- verbal cues and eye contact. | 1 |
| | **Use of Power point** | This exercise will comprise of two videos on the specifics of preparing | 1 |

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| | | | |
|---|---|---|---|
| | **presentation** | power- point presentations; the Do's and don'ts; examples from successful business entrepreneurs' presentations. | |
| | **Vocabulary Development** | Synonyms, Antonyms, Standard Abbreviations<br>One word Substitution<br>Homophones, Homonyms, Paronyms, Words often confused and misused<br>Word Functioning Idiomatically<br>Foreign Words<br>Prefixes Suffixes | 2 |
| | **Reports: Organizing Information** | What will I learn?<br>Organizing information<br>Why is organization important?<br>Finding information<br>Other Report types (Only reading)<br>Write a report<br>Grammar focus: past or present? (1)<br>Grammar Focus: past or present? (2) | 1 |
| | **Reported Speech** | Introduction<br>The Rule<br>Practice: Pronouns<br>Practice: Verbal Actions<br>Pronunciation: Stress and Rhythm<br>Do you understand | 1 |

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|---|---|---|---|
| | | Vocab: reporting verb<br>Your test | |
| | **Perfecting your Document (I)** | What will I learn?<br>The elements of formatting<br>Format a document<br>British or North American? | 1 |
| | **Perfecting your Document (II)** | Proofreading: grammar mistakes<br>Practice Proofreading<br>Spell Checking<br>Common Misspellings<br>Final thought: the golden rules | 1 |
| | | Total | 14 |

**Methodology**

The course will follow a lab based teaching-learning method with classroom discussions and activities on fundamental concepts of grammar with a strong emphasis on skill development of students with regard to speaking, writing, logically interpreting ideas into words and reasoning in the classroom. Both lab and tutorial activities are run on student –teacher individual and group interactions.

**List of English and Technical Communication Tutorial Classes**

| Sr No | Tutorial | Hr | Week |
|---|---|---|---|
| 1 | Introduction | 1 | 1 |
| 2 | Extempore Speaking | 2 | 2 & 3 |
| 3 | Extempore Speaking | | |
| 4 | Prepared Speech | 2 | 4 & 5 |
| 5 | Prepared Speech | | |
| 6 | Group Presentation | 3 | 6,7, & 8 |
| 7 | Group Presentation | | |
| 8 | Group Presentation | | |
| 9 | Group discussions | 2 | 10 & 11 |
| 10 | Group discussions | | |
| 11 | Conversations, Debates and Dialogues | 2 | 11 & 12 |
| 12 | Conversations, Debates and Dialogues | | |

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| | | | |
|---|---|---|---|
| 13 | Summary, Precis writing, Essay writing | 2 | 13 & 14 |
| 14 | Summary, Precis writing, Essay writing | | |

**Evaluation Scheme**

| | |
|---|---|
| 1. Mid Sem Evaluation | 20 Marks |
| 2. End Sem Evaluation | 20 Marks |
| 3. Attendance | 15 Marks |
| 4. Class response | 30 Marks |
| 5. File | 15 Marks |
| Total Marks | 100 Marks |

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| **Recommended Reading** (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format) | |
|---|---|
| **1.** | *Practical English Usage*. Michael Swan. OUP.1995. |
| **2.** | *Remedial English Grammar*. F.T. Wood. Macmillan. 2007 |
| **3.** | *On Writing Well.* William Zinsser. Harper Resource Book. 2001. |
| **5.** | *Study Writing.*Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006 |
| **6.** | *Communication Skills.* Sanjay Kumar and Pushp Lata. OUP. 2011. |
| **7.** | *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. OUP |
| **8.** | *A Communicative Grammar of English.* 3rd Edn. G. Leech and J. Svartvik. 2012 |

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# Engineering Mathematics II

COURSE CODE: 18B11MA211

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** Engineering Mathematics I

**Course Objectives:**

1. The various methods of solving the second order differential equations with variable coefficients, to study the basic properties of Bessel Functions, Legendre polynomials, Chebyshev polynomials and their Applications.
2. To obtain solutions of Wave, Diffusion and Laplace Equation.
3. To study calculus of complex variables.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Solve problems related to convergence of series | Familiarity & Usage |
| CO-2 | Understand basics of Ordinary Differential equation | Assessment |
| CO-3 | Comprehend series solution with certain special functions e.g. Bessel, Legendre Eqn. | Usage |
| CO-4 | understand partial differential Eqn and Solve Heat, wave & Laplace equation | Usage |
| CO-5 | Understand Functions of a complex variable, Analytic functions, Mobius Transformation | Usage |
| CO-6 | Solve Contour integration and find Taylor's and Laurent's series | Familiarity & Usage |
| CO-7 | Evaluate certain real definite and improper integrals. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Sequences and Series:** Convergence of sequence and series, tests for convergence; Power series, Fourier series: Half range sine and cosine series, Parseval's theorem. | 7 |
| 2 | **Differential Equations Part I:** Basics of first order Differential Equations, Second and Higher order differential equations with constant coefficients. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; | 7 |
| 3 | **Differential Equations Part II:** Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties. Introduction to Partial Differential Equations, Solutions of One dimensional Wave, Heat Equation & Laplace Equation. | 12 |
| 4 | **Complex Variable – Differentiation:** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. | 8 |



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| | | |
|---|---|---|
| 5 | **Complex Variable – Integration:** Contour integrals, Cauchy Theorem, Cauchy Integral formula, Liouville's theorem and Maximum-Modulus theorem; Taylor's series, zeros of analytic functions, singularities, Laurent's series; **[CO-6]** Residues, Cauchy Residue theorem, Evaluation of definite integral involving sine and cosine, improper integrals. | 8 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. Jain and Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

**Suggested Reference Book(s):**

1. Simmons, G.F., Differential Equations with Applications, 2nd Ed, McGraw-Hill, 1991.
2. Brown, J.W., Churchill, R.V. , Complex Variables and Applications, 6th Ed., McGrawHill, 1996.
3. Spiegel, Murray R, Theory and Problems of Complex variables Schaum's series.
4. Sneddon I. N., Introduction to Partial Differential Equations, Dover Publications, 2006

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/122101003/2
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/111104031/
   ii. https://nptel.ac.in/courses/111104031/8
   iii. https://nptel.ac.in/courses/122107037/29
   iv. https://nptel.ac.in/courses/111107056/
   v. https://nptel.ac.in/courses/117101055/14

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1. | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2. | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (1) - 5<br>Quizzes (2) - 15<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Engineering Mathematics II ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 1 |
| CO-2 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 2 | 1.5 |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-3 | 3 | 2 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 1.5 |
| CO-4 | 3 | 1 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 1.5 |
| CO-5 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 2 | 1.5 |
| CO-6 | 3 | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 1.5 |
| CO-7 | 3 | 1 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 1.5 |
| Average | 2.71 | 1.57 | 1.14 | 1 | 1.71 | 1.42 | 0 | 0 | 0 | 1.57 | 1.42 | 1.85 | |

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# Engineering Physics-II

COURSE CODE: 18B11PH211

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To offer a broad aspect of those areas of Physics which are specifically required as an essential background to engineering students for their studies in higher semesters.
2. To enable the students to get better understanding about solid state physics and its applications in engineering.
3. To familiarize students about electromagnetism and its applications in engineering.
4. To enable the students to get better understanding about statistical physics and its applications in engineering.
5. To familiarize students with optical fibers communication.
6. At the conclusion of the course, the ability of students should have enhanced to think logically about the problems of science and technology and obtain their solutions.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the fundamentals of vector calculus and its applications in electrostatics | Familiarity |
| CO-2 | Knowledge of, physical interpretation, and ability to apply Maxwell's equations to determine field waves, potential waves, energy ,charge conservation conditions and other diverse engineering problems. | Familiarity/Assesment |
| CO-3 | Able to distinguish Step Index, Graded index fibers and compute mode volume and Implementation of numerical methods for calculating the design parameters of optical fiber. | Familiarity/Problem Solving |
| CO-4 | To understand the basics of statistical distributions and use Maxwell-Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems | Familiarity/Problem Solving |
| CO-5 | To analyze atomic structure, Crystal structure, Crystal axes and planes, X-ray diffraction data and effect of energy bands on electronic behavior of solids. | Analytical Skills/ Familiarity |
| CO-6 | To understand the concepts of modern solid state physics ,various properties of semiconductors and apply Hall effect to calculate allied parameters of semiconductors | Familiarity/ Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Electromagnetism:** Basic knowledge of fields, gradient, divergence and curl, Coulomb's law and related numerical, electric flux, Gauss's law for the charge inside and outside the Gaussian surface, applications of Gauss law: spherical and cylindrical symmetries, electric field due to charged conductor, force per unit area on the surface of the charged conductor, treatment of electrostatic problems by solution of Laplace and Poisson's equations, Biot Savart law, | 12 |

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| | | |
|---|---|---|
| | Ampere's law, Maxwell's equations in free space and dielectric media, energy in electromagnetic waves (Poynting vector and Poynting theorem), plane electromagnetic waves in free space, transverse nature, wave impedance and energy flow, energy density and energy flux (Poynting vector) in an electromagnetic field, radiation pressure. | |
| 2 | **Statistical Physics & Applications:** Introduction, macrostates, microstates, thermodynamic probability, distribution of n-particles in k-cells, phase space, minimum volume, classical and quantum statistics: common approach to three statistics, Maxwell-Boltzmann (ideal gas), Bose-Einstein (photon gas), Fermi-Dirac distributions<br>(electron gas), Compton effect. | 10 |
| 3 | **Optical Fiber Communication:** Light propagation in fibers, Step index and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode fibers and their propagation characteristics, Fiber losses and optical fiber applications. | 4 |
| 4 | **Solid State Physics:** Basic ideas of bonding, ionic bonding, covalent bonding (hybridization), metallic bonding, dispersion bonds, dipole bonds, hydrogen bonds, Lattice points and space lattice, basis and crystal structure, unit cell and primitive cell, seven crystal systems and fourteen Bravais space lattice, coordination number, nearest neighbour distance, atomic radius, atomic packing factor in crystal structure, calculation of lattice constant, lattice planes and Miller indices, separation between lattice planes.<br>X-ray diffraction, Bragg's law of X-ray diffraction, Bragg's x-ray spectrometer, powder crystal method, rotating crystal method.<br>Electronic conduction in metals, classical free electron theory, quantum theory of free electrons, band theory of solids, distinction between metals, semiconductors and insulators, intrinsic and extrinsic semiconductors, carrier concentration in thermal equilibrium in intrinsic semiconductor, Fermi level and energy band diagram in intrinsic semiconductor, energy band diagram and Fermi level in extrinsic semiconductors, effect of temperature on extrinsic semiconductor,<br>electrical conductivity of intrinsic semiconductor and extrinsic semiconductor, Hall effect, allied parameters and its applications. | 16 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**


1. David J Griffiths, Introduction to Electrodynamics, Eastern Economy Editions, PHI, 4th edition (2012).
2. Brij Lal, N Subrahmanyam and P.S. Hemne, Heat Thermodynamics and Statistical Physics, S. Chand, 3rd edition (2012).
3. Gerd Keiser, Optical Fiber Communication, Tata McGraw-Hill Education Pvt. Ltd., 5th edition (2013).
4. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016).


**Suggested Reference Book(s):**


1. Charles Kittel, Introduction to Solid State Physics. John Wiley & Sons, 8th edition (2005).
2. Ghatak Ajoy, Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (2006).
3. Silvio R A, Salinass, Introduction to Statistical Physics. Springer Verlag (2004).
4. Lakhanpal R C, Modern Approach to Statistical Physics and Thermodynamics, Modern Publishers (2003).



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**Other useful resource(s):**

1. Link to topics related to course:
   i. https://nptel.ac.in/courses/115101004/
   ii. https://nptel.ac.in/courses/115101005/
   iii. https://nptel.ac.in/courses/115105099/
   iv. https://nptel.ac.in/courses/122101002/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Engineering Physics-II ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | 2 | **2** |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 2 | | | | 2 | | 2 | **2.5** |
| CO-3 | 3 | 3 | 3 | 2 | 3 | 2 | | | | 2 | | 2 | **2.5** |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 2 | | | | 3 | | 3 | **2.6** |
| CO-5 | 3 | 3 | 3 | 3 | 2 | 1 | | | | 3 | | 3 | **2.6** |
| CO-6 | 3 | 3 | 3 | 3 | 2 | 1 | | | | 3 | | 3 | **2.6** |
| Average | **2.5** | **2.8** | **2.8** | **2.7** | **2.3** | **1.7** | | | | **2.5** | | **2.5** | |

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## Engineering Physics Lab-II

COURSE CODE: 18B17PH271

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. The Art of Experimentation: The introductory laboratory engages each student in significant experiences with experimental processes, including some experience in investigation.
2. Experimental and Analytical Skills: The laboratory help the student develop a broad array of basic skills and tools of experimental physics and data analysis.
3. Conceptual Learning: The laboratory help student's to understand basic physics concepts.
4. Understanding the Basis of Knowledge in Physics: The laboratory help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
5. Developing Collaborative Learning Skills: The laboratory helps students to develop collaborative learning skills that are vital to success in many lifelong endeavors.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To Understand different aspects of magnetism and semi conductive properties of materials and their use in design of various devices. | Familiarity |
| CO2 | To helps the students to understand the concepts of light propagation in optical fiber and introduce them to various losses in optical fiber communication. | Familiarity and Assessment |
| CO3 | To demonstrate the scientific results based on observation. | Assessment and usage |
| CO4 | Scientific discussion for clear and concise conclusion on particular scientific results. | Assessment and usage |
| CO5 | To develop collaborative learning skills | Assessment and usage |

**List of Experiments**:

| S.No | Description | Hours |
|---|---|---|
| 1 | To determine the numerical aperture, of an optical fibre using LED as a light source. | 2 |
| 2 | To determine the attenuation coefficient, losses of an optical fiber | 2 |
| 3 | To measure resistivity of semiconductor using four probe methods. | 2 |

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|---|---|---|
| 4 | To measure energy band gap of the Ge crystal using four probe methods and compare with optical band gap. | 2 |
| 5 | To study Hall effect in semiconductor and determination of its allied parameters. | 2 |
| 6 | To determine the carrier concentration and type of doping using hall coefficient. | 2 |
| 7 | To calculate the e/m ratio for an electron using Thomson method/Bar magnet method | 4 |
| 8 | To study magnetostriction in magnetic materials using He-Ne laser. | 4 |
| 9 | To study the coercivity, saturation magnetization, retentivity of given materials. | 4 |
| 10 | Experimental Determination of Planck's constant using Light Emitting Diodes (LEDs) and Photoelectric Effect. | 4 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**


1. S. P. Singh, Advanced Practical Physics,Pragati Prakashan, Vol. 1 (2013).
2. C. L. Arora, Practical Physics, S. Chand Company Limited, 20th edition (2004).
3. N. Subrahmanayam, Brij Lal and M.N. Avadhanulu, A Text Book of Optics, S. Chand (2012)
4. Ajoy Ghatak, Optics, Tata McGraw Hill, 5th addition, (2012)
5. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill (1981).
6. Dabir S. Viswanath, Tushar Ghosh, Dasika H.L. Prasad, Nidamarty V.K. Dutt, Kalipatnapu Y. Rani , Viscosity of Liquids: Theory, Estimation, Experiment, and Data , Springer (2007).


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2.00 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2.00 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2.00 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.5 |
| CO5 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.5 |
| **Average** | **2.6** | **2.6** | **2.6** | **2.6** | **2.0** | **2.0** | **1.0** | **1.00** | **2.2** | **1.00** | **1.0** | **1.0** | |

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# Electrical Science

COURSE CODE: 18B11EC211

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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Pre-requisite: None

Course Objectives:

1. To introduce various circuit elements.
2. To analyze different DC and AC circuits using various circuittheorems.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basic parameters related to DC and AC circuit. | Familiarity |
| CO-2 | Understanding electrical principle, laws, and working of electrical machines. | Familiarity |
| CO-3 | Understanding different theorems to analyze DC and AC circuits. | Usage |
| CO-4 | Understanding sinusoidal steady state analysis of various AC circuits. | Usage |
| CO-5 | Demonstrate knowledge of and apply the theory of transformers and induction motors. | Assessment |

Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | DC Circuits: Electrical circuit elements (R, L and C), Voltage and current sources, series and parallel combination of elements, star and delta connections, Kirchhoff current and voltage laws, analysis of simple circuits and dc excitation using Node and Mesh analysis. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits | 9 |
| 2 | AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RLC combinations (series and parallel), resonance. | 9 |
| 3 | Sinusoidal steady state analysis: Representation of sine function, Phasor diagrams, Impedance and admittances, AC circuit analysis, Effective or RMS values, Average power and Complex power. | 8 |
| 4 | Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. | 5 |
| 5 | Electrical Installations: Types of wires and cables, earthling, types of batteries, important characteristics for batteries, elementary calculations for energy consumption, power factor improvement and battery backup. | 5 |
| 6 | Electrical Machines: Introduction to machines, single-phase induction motor, construction, working, loss components and efficiency, staring and speed control of induction motor. | 6 |
| Total lectures | | 42 |

Suggested Text Book(s):


1. W.H. Hayt, J. E. Kemerlay & S.M. Durbin: Engineering Circuit Analysis, 6th Ed., TATA McGraw Hill, 2006.
2. J. Hiley, K. Brown, & I.M. Smith: Electrical and Electronic Technology, 10th Ed., Pearson, 2019.
3. D.C. Kulshreshtha: Basic Electrical Engineering, 1st Ed., McGraw Hill Education, 2011.


Suggested Reference Book(s):


1. Ozgur Ergul: Introduction to Electrical Circuit Analysis, 1st Ed., Wiley , 2017.
2. V.N. Mittle and Arvind Mittal: Basic Electrical Engineering, 2nd Ed., Tata McGraw Hill, 2015.




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Other useful resource(s):

Link to NPTEL course contents: https://nptel.ac.in/courses/108102097/3 (Prof. S.C. Dutta Roy, IIT Delhi)

Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Electrical Science) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| CO-2 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 1.92 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2.17 |
| Average | 3 | 2.8 | 2.8 | 2.8 | 2.4 | 2 | 1 | 1 | 1 | 1 | 1.4 | 3 | |

# Electrical Science Lab

COURSE CODE: 18B17EC271

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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Pre-requisite: None

Course Objectives:

1. The primary objective of this course is to provide a thorough understanding of circuit analysis and measurement of various electrical parameters.
2. Analysis of a given circuit depending on types of elements - DC analysis, Transient analysis and Frequency analysis.
3. To acquire hands on experience of conducting various experiments on electrical machines.

Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understanding basic electrical sources and measuring devices: Power supply, Multimeter, CRO/DSO and Function Generator. | Familiarity |
| CO2 | Understand the basic working principle of a transformer and the operation of electrical machines. | Usages |
| CO3 | Practical implementation of the fundamental electrical theorems and modeling of simple electrical systems. | Usages |
| CO4 | Accurate measurement of voltage, current, power and impedance of any circuit. | Usages |
| CO5 | DC analysis, Transient analysis and Frequency analysis of a given circuit depending on types of elements. | Assessment |
| CO6 | Teamwork skills for working effectively in groups and develop analytical skills to compare experimental results with theoretical concepts. | Assessment |

List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to Power supply & Multimeter. | 2 |
| 2 | To determine the equivalent resistance of a circuit using color code and to verify it using a multimeter. To verify Voltage divider and Current divider. | 2 |
| 3 | To verify Delta to Star and Star to Delta conversion. | 2 |
| 4 | Introduction to CRO & Function Generator | 2 |
| 5 | To verify Kirchoff's voltage law (KVL) and Kirchoff's Current Law (KCL) | 2 |
| 6 | To verify Superposition Theorem | 2 |
| 7 | To verify Norton's Theorem | 2 |
| 8 | To verify Thevenin's Theorem and Maximum Power Transfer Theorem | 2 |
| 9 | To study the transient response of series RC circuits using different values and R and C | 2 |
| 10 | Determination of frequency response of current in RLC circuit with sinusoidal ac input | 2 |
| 11 | To determine the turns ratio and polarities of transformer windings. | 2 |
| 12 | To obtain the equivalent circuit parameters from OC and SC tests, and to estimate efficiency & regulation at various loads. | 2 |
| | Total Lab hours | 24 |

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Suggested Resources:


1. W.H. Hayt, J. E. Kemerlay & S.M. Durbin, "Engineering Circuit Analysis", Eighth Edition, McGraw Hill, 2012.
2. Van Valkenburg, "Network Analysis", Prentice-Hall India, 2001.
3. D.C. Kulshreshtha, "Basic Electrical Engineering", First Edition, McGraw Hill, 2011.


Evaluation Scheme:

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

Course Outcomes (COs) contribution to the Program Outcomes (POs)

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1.92 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| C06 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2.42 |
| Average | 3.00 | 2.83 | 2.83 | 2.50 | 2.50 | 2.17 | 1.67 | 1.33 | 1.17 | 1.17 | 1.33 | 1.17 | |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | **2.2** |
| **Average** | **3** | **3** | **2** | **1.8** | **2.5** | **2** | **1.3** | **1** | **1** | **2** | **1.3** | **2.3** | |

## Data Structure and Algorithms

COURSE CODE: 18B11CI211

COURSE CREDIT: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisites:** C/C++

**Course Objectives:**

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures
5. Introduce students to data abstraction and fundamental data structures.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To gain knowledge on the notions of data structure, Abstract Data Type. | Familiarity |
| CO-2 | For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness. | Assessment |
| CO-3 | For a given Search problem (Linear Search and Binary Search) student will able to implement it. | Assessment |
| CO-4 | For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity. | Assessment |
| CO-5 | Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity. | Assessment |
| CO-6 | Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|

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| | | |
|---|---|---|
| 1 | **Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis. | 7 |
| 2 | **Stacks:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. | 5 |
| 3 | **Queues:** ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis. | 5 |
| 4 | **Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. | 8 |
| 5 | **Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis. | 6 |
| 6 | **Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. | 6 |
| 7 | **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press

**Suggested Reference Book(s):**

1. "Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
3. "Data structures and Algorithms Made Easy" 5th edition by Narasimha Karumanchi, Career monk publications
4. "Data Structure and Algorithms in C" 2nd edition by Mark Allen Weiss (2002), Pearson Education

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106102064/
2. Link to topics related to course:
   a. https://onlinecourses.nptel.ac.in/noc18_cs25/preview
   b. https://nptel.ac.in/courses/106103069/

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c. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course Outcomes (Data Structure and Algorithms) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.4** |
| **CO-2** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **CO-3** | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | **2.4** |
| **CO-4** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-5** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-6** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **Average** | **3** | **3** | **3** | **2** | **2.7** | **2.8** | **2** | **2** | **2.5** | **3** | **1** | **3** | |

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# Data Structure and Algorithms Lab

COURSE CODE: 18B17CI271

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisites:** None

**Course Objectives:**

1. Develop problem solving ability using Programming
2. Develop ability to design and analyze algorithms
3. Introduce students to data abstraction and fundamental data structures
4. Develop ability to design and evaluate Abstract Data Types and data structures
5. Apply data structure concepts to various examples and real life applications

**Course outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To gain knowledge on the notions of data structure, Abstract Data Type | Familiarity |
| CO-2 | To have hands on skills to evaluate different kinds of linked lists and their applications in day to day problem solving. | Usage |
| CO-3 | To have hands on skills to evaluate different kinds stacks and their applications and implementations in day to day problem solving | Assessment |
| CO-4 | To have hands on skills to evaluate different kinds queues and their applications and implementations in simulations. | Assessment |
| CO-5 | To acquire knowledge of various sorting algorithms | Usage |
| CO-6 | To learn Searching: Balanced tree, red-black tree, lower bounds for searching | Usage |
| CO-7 | To learn to code for operations on Tree or BST (Creation; Traversing like pre-order,post-order and in-order; Searching element; finding height etc.) | Usage |
| CO-8 | Introduction to Heaps | Usage |
| CO-9 | To learn to code for operations on Graphs (Creation; entering info, printing output and deleting; traversal of BFS and DFS algorithm ) | Assessment |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | **Getting acquainted with** | |
| | a) Arrays and Strings, Structures, | 2 |
| | b) Recursion, Pointers | 4 |
| | c) Dynamic memory allocation | 4 |
| 2 | **Operations on: (Creation, insertion, deletion, sorting, traversing, reversing etc)** | |
| | a) Linear Linked List, | |
| | b) Doubly and | 4 |
| | c) Circular Linked List | 4 |
| | | 2 |

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| | | |
|---|---|---|
| 3 | **Operations on Stacks:**<br>a) Creation; pushing; popping;<br>b) testing underflow, overflow;<br>c) prefix and postfix | <br>4<br>2<br>2 |
| 4 | **Operations on Queues:**<br>a) Creation;<br>b) enqueue; dequeue;<br>c) testing underflow, overflow | <br>4<br>2<br>2 |
| 5 | **Operations on Tree or BST:**<br>Creation;<br>a) Traversing like preorder, post-order and in-order;<br>b) Searching element; finding height etc. | <br><br>4<br>2 |
| 6 | **Implementation of sorting algorithms 1:**<br>Insertion Sort and Selection Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 7 | **Implementation of sorting algorithms 2:**<br>Bubble Sort and Merge Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 8 | **Implementation of sorting algorithms 3:**<br>Implementation of Radix Sort and Quick Sort Algorithm with arrays using dynamic memory allocation. | 2 |
| 9 | **Operation on Heaps:**<br>a) Heaps,<br>b) Heap Sort | <br>2<br>2 |
| 10 | **Implementation of Searching algorithms:**<br>Linear Search Algorithm and Binary Search Algorithm using dynamic memory allocation. | 2 |
| 11 | **Operations on Graphs :**<br>(Creation; entering info; printing Output and deleting;<br>traversal of BFS and DFS algorithm etc.) | 2 |
| **Total Lab hours** | | **56** |

**Minor Project(s) – (*Only for 2 credit lab)***

- Design GUI based program to solve any binary equation.
- Design GUI based program to find the roots of quadratic equation.

- Design a program that picks the characters at equal interval from the given text/paragraph and generate a new paragraph in which each set of word can't have more than 4 characters. Last word of the paragraph can have <=4 characters.
- Program to input following data into disk file. Code, name, department and salary of employee in a firm. After creating file read the file and find following-

Methodology
algorithms
Code execution
Future scope
Count number of employees as per department
Search record of employee
Display record of employee
Display list of employee in alphabetical order as per department
Read record from file

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# Python Programming Essentials

COURSE CODE: 18B11CI314

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. Provide an understanding of the role computation can play in solving problems.
2. Help students, including those who do not plan to major in Computer Science and Electrical Engineering (like BI and BT), feel confident of their ability to write small programs that allow them to accomplish useful goals.
3. Position students so that they can compete for research projects and excel in subjects with programming components.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Familiarity about concepts of Python Programming. Broaden the knowledge about Variables, expressions and Functions in Python. | Familiarity |
| CO-2 | Broaden the knowledge about Branching and Iteration. To have hands on skills on String Manipulation, Guess and Check, Approximations, Bisection | Assessment |
| CO-3 | To learn about Decomposition Abstractions, Tuples, Lists, Dictionaries and Illustrative programs: | Assessment |
| CO-4 | Files, Modules, Packages and Testing, Debugging, Exceptions, Assertions: | Usage |
| CO-5 | Understanding and analyzing Object Oriented Programming: | Familiarity |
| CO-6 | To have hands on skills on Illustrative programs(examples Sorting and Searching, Regular expressions) and GUI | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Informal introduction to Python programming language:** What is a program?, What is debugging?, Formal and natural languages, Downloading and installing Python., The first program, Debugging **Variables, expressions and Functions in Python** Values and types, Variables, Variable names and keywords, Operators and operands, Expressions and statements, Interactive mode and script mode, Order of operations, String operations, Function calls, Type conversion functions, Math functions, Composition, Adding new functions, Definitions and uses, Flow of execution **Parameters and arguments** | 5 |
| 2 | **Branching and Iteration:** Loops, Multiple assignment, Updating variables, The while statement, Break **String Manipulation, Guess and Check, Approximations, Bisection:** String manipulation, Guess and check algorithms(e.g: find Square Root etc), Approximate solutions(e.g | 8 |

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| | | |
|---|---|---|
| | Successive approximation), Bisection method. | |
| 3 | **Decomposition, Abstractions:** divide and conquer (modules), Abstraction<br>**Tuples, Lists, Dictionaries, Illustrative programs:**<br>- Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;<br>- Tuples: tuple assignment, tuple as return value;<br>- Dictionaries: operations and methods; advanced list processing – list comprehension;<br>Illustrative programs: selection sort, insertion sort, mergesort, histogram | 7 |
| 4 | **Files, Modules, Packages**: Files and exception: text files, reading and writing files, format operator, Packages, Illustrative programs: word count, copy file.<br>**Testing, Debugging, Exceptions, Assertions:** Unit testing framework(unit test), debugger for Python program(pdb), Handling an exception | 7 |
| 5 | **Object Oriented Programming:**<br>-Classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects<br>-OOP, continued: inheritance, polymorphism, operator overloading, abstract classes. | 7 |
| 6 | **Illustrative programs(examples):**<br>• Sorting and Searching<br>• Regular expressions<br>o Match function<br>o Search function<br>o Matching vs. Searching<br>o Modifiers<br>o Patterns<br>**GUI :**<br>Introduction, Tkinter programming, Tkinter widgets | 8 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705

**Suggested Reference Book(s):**

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.
2. Chun, Wesley. Core python programming. Vol. 1. Prentice Hall Professional, 2001.
3. Zelle, John M. Python programming: an introduction to computer science. Franklin, Beedle & Associates, Inc., 2004.
4. Gold, Steve. "Python: Python Programming Learn Python Programming In A Day-A Comprehensive Introduction To The Basics Of Python & Computer Programming." (2016).

**Other useful resource(s):**

1. https://onlinecourses.nptel.ac.in/noc18_cs35/preview
2. https://nptel.ac.in/courses/106106145/

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3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/index.htm
4. https://docs.python.org/3/tutorial/index.html

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | *T-1 | 15 | 1 Hour. | Syllabus covered up to T-1 |
| 2 | #T-2 | 25 | 1.5 Hours | Syllabus covered up to T-2 |
| 3. | $T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | ~Internal Assessment | 25 | Entire Semester | Assignment<br>Quizzes<br>Attendance |

*In Test-I Paper the 20% of 15 Marks will be allocated to Introduction to Computers portion and 80% of 15 Marks will be allocated to Introduction to Programming portion.

#In Test-II Paper the 20% of 25 Marks will be allocated to syllabus of Test-I and 80% of 25 Marks will be allocated to further covered portion.

$In Test-III Paper the 40% of 30 Marks will be allocated to syllabus of Test-I+ Test-II and 60% of 30 Marks will be allocated to further covered portion.

~Internal Assessment will purely be focused on the assignments and quizzes based on Python Programming.

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Python Programming Essentials) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 2.1 |
| CO-2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2.3 |
| CO-3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 2.3 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2.5 |
| CO-5 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2.4 |
| CO-6 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2.3 |
| Average | 3 | 2.8 | 3 | 1.7 | 2.3 | 2.8 | 2.8 | 2.5 | 1.8 | 1 | 1 | 3 | |

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# Object-Oriented Systems and Programming

COURSE CODE: 18B11CI311

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To use object modelling technique to analyze problem requirements, design a solution to the problem and then implement the solution in Object-Oriented Programming Language(s) or database.
2. To strengthen their problem solving ability by applying the characteristics of an object-oriented approach.
3. To strengthen ability to design and represent solutions to problems using UML notations
4. To introduce object oriented concepts in C++ and Java.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the concepts of Objects, Classes, Methods, Constructors and Destructors | Usage |
| CO-2 | To learn the designing of complex classes: Friend Functions and Static member functions, Inline functions, constant functions. | Usage |
| CO-3 | To learn Inheritance: Single Inheritance, Multiple Inheritance, Multi-levelInheritance, Hierarchical Inheritance and Hybrid Inheritance. | Usage |
| CO-4 | To learn the concept of Abstract classes and interfaces | Usage |
| CO-5 | To learn the concepts of Operator overloading and conversion function | Usage |
| CO-6 | To learn File Handling. Writing and reading data from the file, reading and writing the objects into the file. | Usage |
| CO-7 | To learn the Exception Handling: try --catch and finally block, making user-defined exceptions. | Usage |
| CO-8 | To learn the Unified Modeling Language (UML): Use Case Diagrams, State Diagrams, Sequence Diagrams, Communication Diagrams, and Activity Diagrams. | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Structured versus Object-Oriented programming, Object-Oriented paradigm. Defining Objects, Classes, Data members, Member functions, Constructors and Destructors in C++. Inline Functions, Friend Functions, Constant member functions, and Static members (static data and static member functions). Function overloading, Operator overloading and Conversion functions. Using the concepts of File handling | 12 |
| 2 | Polymorphism and Inheritance in C++. Abstract classes, virtual function, pure virtual functions, and virtual base classes in C++. | 6 |
| 3 | Function templates and Class templates | 3 |
| 4 | Introduction to Java and its features. Defining Classes in Java, Wrapper classes, Packages and Exception handling in Java | 7 |
| 5 | Inheritance and Interfaces in Java. Abstract class, abstract methods, | 5 |

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|---|---|---|
| | final class and final method in Java | |
| 6 | Basic principles of Software engineering. System analysis, design, testing and debugging. Unified Modeling Language (Class Diagram, Use Case Diagram, State Diagram, Sequenced Diagram, Communication Diagram, Activity Diagram) | 9 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Lafore R., Object oriented programming in C++, Waite Group
2. Java 2: The Complete Reference, Fifth Edition -- by Herbert Schildt
3. Satzinger, Jackson, Burd, Object-Oriented Analysis & Design

**Suggested Reference Book(s):**

1. Stroustrap B., The C++ Programming Language, Addison Wesley
2. Bruce Eckel, Thinking in C++
3. Bruce Eckel, Thinking in Java

**Other useful resource(s):**

1. Link to NPTEL course contents:
    a. https://onlinecourses.nptel.ac.in/noc16_cs17/preview
    b. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
    c. https://onlinecourses.nptel.ac.in/noc17_cs25/announcements
2. Link to topics related to course:
    a. https://www.tutorialspoint.com/cplusplus/
    b. http://www.cplusplus.com/doc/tutorial

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Internal Assessment | 25 | Entire Semester | Assignment<br>Quizzes<br>Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Object-Oriented Systems and Programming) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2.8 |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-2** | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | **2.4** |
| **CO-3** | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | **2.3** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | **2.5** |
| **CO-5** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 3 | 3 | **2.4** |
| **CO-6** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | **2.7** |
| **CO-7** | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | **2.6** |
| **CO-8** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 1 | **2.5** |
| **Average** | **3** | **3** | **2.8** | **2.5** | **2** | **1.8** | **2.4** | **2.8** | **2** | **2.4** | **3** | **2.8** | |

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# Database Management Systems

COURSE CODE: 18B11CI313

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisite:** Introduction to Computer Programming, Discrete Mathematics, Data Structures

**Course Objectives:**

1. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
2. To understand and use data manipulation language to query, update, and manage a database.
3. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
4. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Explain the characteristics, architecture of database approach, its components, different data models and the examples of their usage. | Familiarity |
| CO-2 | For a given query write relational algebra expressions for that query and optimize the developed expressions. | Usage |
| CO-3 | For a given specification of the requirement, design the databases using E-R method and normalization. | Usage |
| CO-4 | Determine the functional dependency between two or more attributes, compute the closure of a set of attributes, evaluate a proposed decomposition | Assessment |
| CO-5 | Give examples of the application of primary, secondary, and clustering indexes, explain the theory and application of internal and external hashing techniques. | Assessment |
| CO-6 | Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling. | Assessment |
| CO-7 | Familiarize with the security in databases and gaining familiarity with other popular databases used in the industry | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).<br><br>**Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations. | 5 |
| 2 | **Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - | 15 |



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|---|---|---|
| | MYSQL, ORACLE, DB2, SQL server.<br><br>**Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.<br><br>**Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. | |
| **3** | **Storage strategies:** Indices, B-trees, hashing. | **6** |
| **4** | **Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic<br><br>Concurrency Control schemes, Database recovery. | **9** |
| **5** | **Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. | **5** |
| **6** | **Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining. | **3** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. "Fundamentals of Database Systems" Elmasri, Navathe, Pearson Education.
2. "Database system concepts" Henry F Korth, Abraham Silberschatz, S. Sudurshan, McGraw-Hill Ellis

**Suggested Reference Book(s):**

1. "Database Systems: A Practical Approach to design, Implementation and Management". Thomas Connolly, Carolyn Begg; Third Edition, Pearson Education.
2. Bipin C Desai, ?An Introduction to Database Systems?, Galgotia. Publications Pvt Limited, 2001
3. "An Introduction to Database Systems", C.J.Date, Pearson Education.
4. "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson, Education.
5. "Data Management: databases and organization", Richard T. Watson, Wiley.
6. " Data Modeling Essentials", Graeme C. Simxion, Dreamtech.

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**Other useful resource(s):**

1. Link to NPTEL course contents:
   https://www.youtube.com/watch?v=EUzsy3W4I0g&list=PL9426FE14B809CC41
2. Link to topics related to course:
   a. https://www.tutorialspoint.com/dbms/database_normalization.htm
   b. https://www.igi-global.com/journal/journal-database-management/1072
   c. https://www.tutorialspoint.com/dbms/dbms_hashing.htm

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |

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| | | | | |
|---|---|---|---|---|
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Internal Assessment | 25 | Entire Semester | Assignment<br>Quizzes<br>Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Database Management Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | **2.2** |
| **CO-2** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **2.3** |
| **CO-3** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | **2.3** |
| **CO-4** | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | **1.9** |
| **CO-5** | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.1** |
| **CO-6** | 3 | 2 | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | **1.9** |
| **CO-7** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | **2.3** |
| **Average** | **3** | **2.6** | **2.4** | **1.1** | **1.6** | **2.6** | **2.6** | **1.7** | **1.9** | **2.6** | **2** | **1.4** | |

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# Python Programming Lab

COURSE CODE: 18B17CI374

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Learn syntax, semantics and create Functions in Python.
2. Understand the usage of Lists, Dictionaries, and arrays in Python.
3. Learn the Implementation of object oriented programming concepts in Python
4. Learn different data structure in Python.
5. Understand file handling in Python
6. Implement GUI applications and browser.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Familiarity about concepts of Python Programming. Broaden the knowledge about Variables, expressions and Functions in Python. | Familiarity |
| CO2 | Broaden the knowledge about Branching and Iteration. To have hands on skills on String Manipulation, Guess and Check, Approximations, Bisection | Assessment |
| CO3 | To learn about Decomposition Abstractions, Tuples, Lists, Dictionaries and Illustrative programs: | Assessment |
| CO4 | Files, Modules, Packages and Testing, Debugging, Exceptions, Assertions: | Usage |
| CO5 | Understanding and analyzing Object Oriented Programming: | Familiarity |
| CO6 | To have hands on skills on Illustrative programs(examples Sorting and Searching, Regular expressions) and GUI | Usage |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | 1. Write a Python program to get the Python version you are using.<br>2. Write a Python program which accepts the radius of a circle from the user and compute the area. | **2** |
| 2 | 1. Write a Python program to display the current date and time.<br>2. Write a Python program which accepts the radius of a circle from the user and compute the area. | 2 |
| 3 | 1. Write a Python program which accepts the user's first and last name and print them in reverse order with a space between them.<br>2. Write a Python program to display the first and last colors from the following list.<br>color_list = ["Red","Green","White" ,"Black"]. | 2 |
| 4 | 1. Write a Python program to print the documents (syntax, description etc.) of Python built-in function(s).<br>Samplefunction :abs()<br>ExpectedResult :<br>abs(number)->number<br>Return the absolute value of the argument. | 2 |
| 5 | Write a Python program to get the difference between a given number and 17, if the | 2 |



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|---|---|---|
| | number is greater than 17 return double the absolute difference. Write a Python program to test whether a number is within 100 of 1000 or 2000.<br>Write a Python program to check whether a specified value is contained in a group of values. Test Data :<br>3 -> [1, 5, 8, 3] : True<br>-1 -> [1, 5, 8, 3] : False | |
| 6 | Write a Python program to print all even numbers from a given numbers list in the same order and stop the printing if any numbers that come after 237 in the sequence.<br>Sample numbers list :<br>numbers = [<br>386, 462, 47, 418, 907, 344, 236, 375, 823, 566, 597, 978, 328, 615,<br>953, 345, 399, 162, 758, 219, 918, 237, 412, 566, 826, 248, 866, 950,<br>626, 949, 687, 217, 815, 67, 104, 58, 512, 24, 892, 894, 767, 553, 81,<br>379, 843, 831, 445, 742, 717, 958,743, 527]<br>Now do it using file as input. | 2 |
| 7 | Write a Python program that accepts a single integer value entered by the user. If the value entered is less than one, the program prints nothing. If the user enters a positive integer, n, the program prints an n×n box drawn with * characters. If the users enters 1, for example, the program prints * If the user enters a 2, it prints ** ** An entry of three<br>yields. | 2 |
| 8 | Write a Python program to sum of two given integers. However, if the sum is between 15 to 20 it will return 20. Write a Python program to compute the future value of a specified principal amount, rate of interest, and a number of years.<br>Test Data : amt = 10000, int = 3.5, years = 7 Expected Output : 12722.79 | 2 |
| 9 | Write a Python program to create an array of 5 integers and display the array items. Access individual element through indexes. Write a Python program to convert an array to an ordinary list with the same items. | 2 |
| 10 | Write a Python program to display all the member name of an enum class ordered by their values. Expected Output:<br>Country Name ordered by Country Code: Afghanistan<br>Algeria Angola Albania Andorra<br>Antarctica | 2 |
| 11 | Write a Python program to get all values from an enum class.<br>Expected output: [93, 355, 213, 376, 244, 672]. | 2 |
| 12 | Write a Python program to get an array buffer information Expected Output:<br>Array buffer start address in memory and number of elements.<br>(25855056, 2) | 2 |
| 13,14 | Write a Python program to push three items into a heap and return the smallest item from the heap. Also Pop and return the smallest item from the heap<br>ExpectedOutput:<br>Items in the heap:<br>('V', 1)<br>('V', 3)<br>('V', 2)<br>---<br>The smallest item in the heap: ('V', 1)<br>---<br>Pop the smallest item in the heap: ('V', 2)<br>('V', 3) | 4 |
| 15,16 | Write a function named print_big_enough that accepts two parameters, a list of numbers and a number. The function should print, in order, all the elements in the list that are at least as large as the second parameter. | 4 |
| 17,18 | Write a function called draw_rectangle that takes a Canvas and a Rectangle as | 4 |



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| | | |
|---|---|---|
| | arguments and draws a representation of the Rectangle on the Canvas. 2. Add an attribute named color to your Rectangle objects and modify draw_rectangle so that it uses the color attribute as the fill color. 3. Write a function called draw_point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas. 4. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw_circle that draws circles on the canvas. 5. Write a program that draws the national flag of the India. Hint: you can draw a polygon like this: points = [[-150,-100], [150, 100], [150, -100]] canvas.polygon(points, fill='saffron,white,green') | |
| 19,20 | The datetime module provides date and time objects that are similar to the Date and Time objects in this chapter, but they provide a rich set of methods and operators. Read the documentation at http: // docs. python. org/ 2/ library/ datetime. html . 1. Use the datetime module to write a | 4 |
| | program that gets the current date and prints the day of the week. 2. Write a program that takes a birthday as input and prints the user"s age and the number of days, hours, minutes and seconds until their next birthday. 3. For two people born on different days, there is a day when one is twice as old as the other. That"s their Double Day. Write a program that takes two birthdays and computes their Double Day. 4. For a little more challenge, write the more general version that computes the day when one person is n times older than the other. | |
| 21,22 | This exercise is a cautionary tale about one of the most common, and difficult to find, errors in Python. Write a definition for a class named Kangaroo with the following methods: 1. An_init_ method that initializes an attribute named pouch_contents to an empty list. 2. A method named put_in_pouch that takes an object of any type and adds it to pouch_contents. 3. A_str method that returns a string representation of the Kangaroo object and the contents of the pouch. Test your code by creating two Kangaroo objects, assigning them to variables named kanga and roo, and then adding roo to the contents of kanga"s pouch. | 4 |
| 23,24 | You will write code that makes Turtles play tag. If you are not familiar with the rules of tag, see http: // en. wikipedia. org/ wiki/ Tag_ ( game) . 1. Download http: // thinkpython. com/ code/ Wobbler. py and run it. You should see a TurtleWorld with three Turtles. If you press the Run button, the Turtles wander at random. 2. Read the code and make sure you understand how it works. The Wobbler class inherits from Turtle, which means that the Turtle methods lt, rt, fd and bk work on Wobblers. The step method gets invoked by TurtleWorld. It invokes steer, which turns the Turtle in the desired direction, wobble, which makes a random turn in proportion to the Turtle"s clumsiness, and move, which moves forward a few pixels, depending on the Turtle"s speed. 3. Create a file named Tagger.py. Import everything from Wobbler, then define a class named Tagger that inherits from Wobbler. Call make_world passing the Tagger class object as an argument. 4. Add a steer method to Tagger to override the one in Wobbler. As a starting place, write a version that always points the Turtle toward the origin. Hint: use the math function atan2 and the Turtle attributes x, y and heading. 5. Modify steer so that the Turtles stay in bounds. For debugging, you might want to use the Step button, which invokes step once on each Turtle. 6. Modify steer so that each Turtle points toward its nearest neighbor. [Hint: Turtles have an attribute, world, that is a reference to the TurtleWorld they live in, and the TurtleWorld has an attribute, animals, that is a list of all Turtles in the world. 7. Modify steer so the Turtles play tag. You can add methods to Tagger and you can override steer and_ init_ , but you may not modify or override step, wobble or move. Also, steer is allowed to change the heading of the Turtle but not the position. Adjust the rules and your steer method for good quality play; for example, it | 4 |



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| | | |
|---|---|---|
| | should be<br>possible for the slow Turtle to tag the faster Turtles eventually.] | |
| 25,26 | A vector graphics editor is a program that allows users to draw and edit shapes on the screen and generate output files in vector graphics formats like Postscript and SVG. Write a simple vector graphics editor using Tkinter. At a minimum, it should allow users to draw lines, circles and rectangles, and it should use Canvas.dump to generate a Postscript<br>description of the contents of the Canvas. As a challenge, you could allow users to select and resize items on the Canvas | 4 |
| 27,28 | Use Tkinter to write a basic web browser. It should have a Text widget where the user can enter a URL and a Canvas to display the contents of the page. You can use the urllib module to download files (see Exercise 14.6) and the HTMLParser module to parse the HTML tags (see http: // docs. python. org/ 2/ library/ htmlparser. html ). At a minimum your browser should handle plain text and hyperlinks. As a challenge you<br>could handle background colors, text formatting tags and images. | 4 |
| **Total Lab hours** | | **56** |

**Minor Project(s) – (Only for 2 credit lab)**

1. Create a Python project of a Magic 8 Ball which is a toy used for fortune-telling or seeking advice.
    a. Allow the user to input their question.
    b. Show an in progress message.
    c. Create 10/20 responses, and show a random response.
    d. Allow the user to ask another question/advice or quit the game.
2. The "rank" of a word is its position in a list of words sorted by frequency: the most common word has rank 1, the second most common has rank 2, etc. Zipf"s law describes a relationship between the ranks and frequencies of words in natural languages (http: // en. wikipedia. org/ wiki/ Zipf's_ law ). Specifically, it predicts that the frequency, f , of the word with rank r is: f = cr−s where s and c are parameters that depend on the language and the text. If you take the logarithm of both sides of this equation, you get: log f = log c − slog r. So if you plot log f versus log r, you should get a straight line with slope −s and intercept log c. Write a program that reads a text from a file, counts word frequencies, and prints one line for each word, in descending order of frequency, with log f and log r. Use the graphing program of your choice to plot the results and check whether they form a straight line. Can you estimate the value of s?

**Suggested Books/Resources:**


1. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey , Jeffrey Elkner, 2015
2. Exploring Python, Timothy A. Budd, Mc Graw Hill Education
3. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr
4. Learning Python, Fourth Edition, Mark Lutz, O"Reilly publication
5. How to Make Mistakes in Python Author: Mike Pirnat
6. Head First Python Paperback – by Paul Barry
7. Link to topics related to course:
    a. Think Python How to Think Like a Computer Scientist
    b. https://greenteapress.com/wp/think-python/
    c. https://www.w3schools.com/python/
    d. https://www.python.org/



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**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 2.1 |
| CO2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2.3 |
| CO3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 2.3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2.5 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2.4 |
| C06 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2.3 |
| Average | 3 | 2.8 | 3 | 1.7 | 2.3 | 2.8 | 2.8 | 2.5 | 1.8 | 1 | 1 | 3 | |

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# Object-Oriented Systems and Programming Lab

COURSE CODE: 18B17CI371

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. To use object modelling technique to analyze problem requirements, design a solution to the problem and then implement the solution in Object-Oriented Programming Language(s) or database.
2. To strengthen their problem solving ability by applying the characteristics of an object-oriented approach.
3. To strengthen ability to design and represent solutions to problems using UML notations.
4. To introduce object-oriented concepts in C++ and Java.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To learn the concepts of Objects, Classes, Methods, Constructors and Destructors | Usage |
| CO2 | To learn the designing of complex classes: Friend Functions and Static member functions, Inline functions, constant functions. | Usage |
| CO3 | To learn Inheritance: Single Inheritance, Multiple Inheritance, Multi-level Inheritance, Hierarchical Inheritance and Hybrid Inheritance. | Usage |
| CO4 | To learn the concept of Abstract classes and interfaces | Usage |
| CO5 | To learn the concepts of Operator overloading and conversion function | Usage |
| CO6 | To learn File Handling. Writing and reading data from the file, reading and writing the objects into the file. | Usage |
| CO7 | To learn the Exception Handling: try --catch and finally block, making user-defined exceptions. | Usage |
| CO8 | To learn the Unified Modeling Language (UML): Use Case Diagrams, State Diagrams, Sequence Diagrams, Communication Diagrams, and Activity Diagrams. | Familiarity |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Create a class called Complex in C++ for performing arithmetic with complex numbers. Use double variables to represent the private data of the class. Provide public member functions for each of the following: *(Define all the member functions outside the class)*<br><br>a) Enter the values of real and imaginary part.<br>b) Addition of two Complex numbers: (The real parts are added together and the imaginary parts are added together.<br>c) Subtraction of two Complex numbers. (The real part of the right operand is subtracted from the real part of the left operand and the imaginary part of the right operand is subtracted from the imaginary part of the left operand.<br>*d)* Printing Complex numbers in the form: **a + b *i*** | **2** |
| 2 | Define a class in C++ to represent a bank account. Include the following members: | **2** |

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| | ***Data members:***<br><br>a) Name of the depositor<br>b) Account number<br>c) Type of account<br>d) Balance amount in the account<br>***Member functions:*** *(Define all the member functions inside the class)*<br><br>a) To assign initial values<br>b) To deposit an amount<br>c) To withdraw an amount after checking the balance<br>d) To display name and balance<br>Write a main function to create a database of 10 customers | |
| 3 | a) Employees have a number, date of birth (dd-mm-yyyy), rank, and salary. When an employee is first recruited then all these are given values of 0. Upon confirmation, the actual values of these are entered for the employee. Their rank can be incremented by 1 and when this happens an employee gets an increment of 25%. Write a C++ class for Employee.<br>b) Students are registered in a University. When students are created then they are given default values (zeroes or blanks) for roll_number, department, year, and semester of study. At registration time, the values of these attributes of student are updated with the proper<br>values. Students can be promoted and their departments can be changed. Write a C++ class for Student. | **2** |
| 4 | Users of the computer have profile which consists of Name, Password, and Access Rights. Access rights take on values X, R, W, and ALL. It is possible to have default values for Password and Access rights which are the first three letters of the Name and ALL respectively. Users can change their password and access rights. Write a class User in C++ and create a user named Rajesh. | **2** |
| 5 | Define two classes Distance1 and Distance2 in C++. Distance1 stores distance in miles and Distance2 in kmeters & meters. Write a program that reads values of the class objects and adds one object of Distance1 with the object of Distance2 class. The display should be in the format of miles or kmeters & meters depending on the type of object (Distance1 or Distance2) being used to invoke the function. (Hint: Make use of friend function). | **2** |
| 6 | Implement a singleton class in C++. A class whose number of instances that can be instantiated is limited to one is called a singleton class. (Hint: make use of static members). | **2** |
| 7 | Imagine a publishing company that markets both books and audio- cassette version of its works. Create a class Publication in C++ that stores the title (a string) and price (type float) of a publication. From this class derive two classes: Book, which adds a page count and Tape, which adds playing time in minutes. These classes should have getdata() function to get its data from the user and the putdata() function to display its data. Write a main() program to test the book and tape classes by creating instances of them, asking the user to fill in their data with getdata() and displaying the data with putdata(). | **2** |
| 8 | Implement the class hierarchy as shown in the following figure (using C++). | **2** |
| | | |

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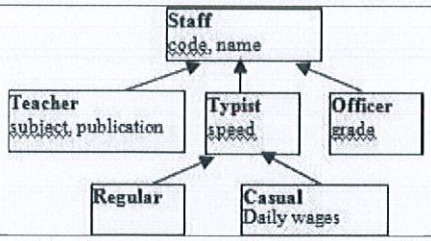
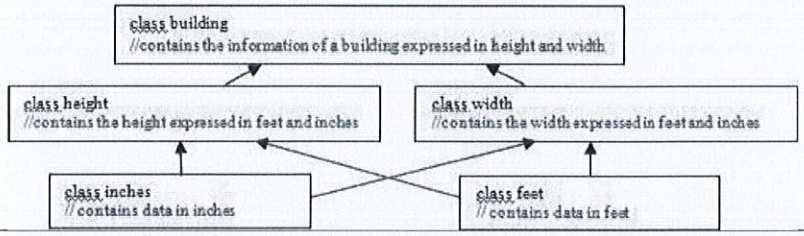
| |  | |
| 19 | The database created in the experiment 8 does not include educational information of the staff. It has been decided to add this information to teacher and officers (not for typists) which will help the management in decision making with regard to training, promotion, etc. Add another data class called Education that holds two pieces of education information, namely, highest qualification in general education and highest professional qualification. The class should be inherited by the class Teacher and Officer. Modify the program of above exercise to incorporate these additions. Include overloaded constructors in all above classes. | 2 |
| 10 | Implement the class hierarchy shown in the following figure, using C++. Define appropriate member functions (including constructors and destructors) to convert feet class object into inches class object and vice versa. Also the objects of the feet and inches constructors should construct their objects using the constructors of the height and width constructor which in turn call building constructor. | 2 |
| |  | |
| 11 | Define a class Directory with members: name and phone number. Use the class object to store each set of data into a text file "phone.txt". The names contain only one word and the names and telephone numbers are separated by white spaces. Write a C++ program to read the file and output the list in two columns, such as:<br><br>John 23456<br><br>Ahmed 9876 | 2 |
| 12 | Write an interactive, menu-driven program that will access the file created in the experiment 11 and implement the following tasks:<br><br>Determine the telephone number of the specified person.<br>b) Determine the name if a telephone number is known. Update the telephone number, whenever there is a change | 2 |
| 13 | Define a class Queue in C++ that contains elements of type integer. Define two operators on Queue, „+" to insert an element in it and „–„ to remove and element from it. Use the friend function approach first and then the one without friends | 2 |
| 14 | A programmer wants to manipulate arrays. Two arrays are equal if (a) they have the same dimension, (b) are of the same size, and (c) contain identical values in their corresponding elements. Comparison is done using the operator „= =" which returns true or false. Also, arrays can be copied to one another using the operator „=". Implement the foregoing using the friend function approach first and then the one without friends. Which one is preferable and why? | 2 |
| 15 | An istream class overloads the >> operator for the standard types [int, long, double, float, char]. For example, the statement cin >> x ; calls the appropriate >> operator function for the istream class defined in iostream.h and uses it to direct this input | 2 |



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| | stream into the memory location represented by the variable x. Similarly, the ostream class overloads the<br><< operator, which allows the statement cout << x to send the value of x to ostream cout for output. Overload these operators to enter the object"s data members through input operator >> and display the values of these members by using the output operator <<. | |
| 16 | Define a class Distance in C++ with data members: kmeter and meter. Define conversion function to convert Distance object into distance in miles (float type). Also make use of constructor to convert distance in miles (float type) into object of Distance class. | 2 |
| 17 | Define two classes Polar and Rectangle (using C++) to represent points in polar and rectangle systems. Use the conversion routines to convert from one system to the other. | 2 |
| 18 | Define a function template in C++ to sort an array of elements of int type, string type, float type and user-defined type Distance with data members: kmeter & meter. | 2 |
| 19 | Define a template class LinkedList in C++ with the following member functions:<br><br>createList(), displayList(), insertElement(), and deleteElement();<br><br>In the main() function invoke above functions for the list of integer numbers, floating numbers and complex numbers. | 2 |
| 20 | Define a class Employee in Java with members: name, age and salary and methods: enterData() to enter the record of the employee through keyboard: displayData() to display the details of the employee. Define two user defined exceptions that are thrown when<br><br>) The name entered has numeric character(s).<br>) The age of the person is less than 18 or greater than 60. | 2 |
| 21 | Write a program in Java that demonstrates handling of exceptions in inheritance tree. For example, create a base class called "Father" and derived class called "Son" which extends the base class. In Father class, implement a constructor which takes the age and throws the exception WrongAge() where the input age <0. In Son class, implement a constructor that uses both father and son"s age and throws an exception if son"s age is >= father"s age. | 2 |
| 22 | Define a class Person in the package MyPackage. The class has data members as: name, age, address and Methods to enter the data through keyboard and display them. Make use of overloaded constructors in the class. Now, import the above class and inherit the class Employee from this. The sub-class should have overloaded functions and also call to the base class constructors. In the main class, define a database of 5 objects and display them. | 2 |
| 23 | Define an abstract class Shape in Java, with two abstract functions: enterData() and displayArea(). Define two classes Circle and Rectangle inside a new file that inherit the class Shape and implement the abstract functions in their own way. Illustrate the concept of dynamic binding in this program. | 2 |
| 24 | Find the source code for the Vector class in the Java source code library that comes with all Java distributions. Copy this code and make a special version called intVector that holds only integers. Consider what it would take to make a special version of Vector for all the primitive types. Now consider what happens if you want to make a linked list class that works with all the primitive types. If parameterized types are ever implemented in Java, they will provide a way to do this work for you automatically. | 2 |

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| 25 | Create a class MyString in Java containing a String object so that you initialize in the constructor using the constructor"s argument. Add a toString() method and a method concatenate() that appends a String object to your internal string. Implement clone() in MyString. Create two static methods that each take a myString x handle as an argument and call x.concatenate("test"), but in the second method call clone() first. Test the two methods and show the difference effects. | |
| 26 | **Design the USE-CASE diagram for the following:**<br><br>A description of the behavior of an automated telling machine (ATM) is given below: A user begins a transaction at the ATM by entering a bank card. If the card is readable by the machine the user is prompted to enter their personal identification number (PIN). Once this number has been entered, a menu is presented to the user containing the following options: show account balance, withdrawal with receipt and withdrawal without receipt. If the user selects one of the withdrawal options, they are prompted to enter an amount of money to withdraw; the amount entered must be a multiple of 10. The user"s PIN is validated when the ATM sends the details of the transaction to the bank"s remote computer. If the PIN is invalid, the user is given the option of re-entering it and the selected transaction is retired. This is repeated if the new PIN is also invalid. Once three invalid PINs have been entered, the transaction processing depends on the transaction type selected. For a show balance transaction, the balance is displayed on the screen and after they have confirmed this, the user is returned to the transaction menu. A withdrawal transaction may fail if the user has executed the amount of money that can be withdrawn from the account; in this case an error message is displayed and, after confirmation, the user is returned to the transaction menu. Otherwise, the user"s card is returned and the money is issued, followed by the receipt if required. At any point where user input, other than a simple confirmation, is required, a cancel option is provided. If this is selected, the user"s card is returned and their interaction with the ATM terminates. | 2 |
| 27 | **Design the Collaboration and Sequence diagram for the following:**<br><br>Many word processors, graphical editors and similar tools provide cut, copy and paste operations by means of some kind of a clipboard facility. At run-time suppose that such a system consists of an instance of an Editor class linked to a number of instances of a Element class. Elements are the items manipulated by a tool, such as words or shapes. Some of the elements may have been selected by the user. The editor is also linked to an instance of a Clipboard class, which in turn maintains links to all the elements that have been placed in the clipboard. An element cannot simultaneously be displayed by the editor and on the clipboard.<br><br>Draw a collaboration showing a configuration where there are several elements displayed by the editor and one element on the clipboard.<br>Assume that the selected elements are identified by an additional link | 2 |
| | from the editor.<br><br>Draw a sequence diagram showing what happens when the editor receives a cut message from a client. The effect of this is that all the currently selected elements are moved to the clipboard. | |



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| | Draw a sequence diagram showing what happens when the editor receives a paste message from a client. The effect of this is that all the elements on the clipboard are moved back to the editor.<br>Draw a sequence diagram showing what happens when the editor receives a copy message from a client. The effect of this is that all the currently selected elements are copied to the clipboard. Assume that elements implement a clone operation, which returns a exact copy of the element.<br>Draw equivalent collaboration diagrams for each of your answers. | |
| 28 | **Draw a state diagram expressing these facts about the display of windows.**<br><br>A window in a window management system on a computer can be displayed in one of the three states: maximized, where it takes up the entire screen; normal, where it is displayed as a small icon. When a window is opened, it will be displayed as a normal window, unless minimize on use has been selected, in which case it will be displayed as an icon. A normal window and an icon can be maximized; a maximized window and a normal window can be minimized or reduced to an icon. Maximized windows can be restored to their normal size and icons can be restored to the size they had before they were minimized. Icons and normal windows can be moved as normal windows can also be resized. No matter how it is displayed, a window can always be closed. | 2 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. Lafore R., Object oriented programming in C++, Waite Group
2. Java 2: The Complete Reference, Fifth Edition -- by Herbert Schildt
3. Satzinger, Jackson, Burd, Object-Oriented Analysis & Design
4. Stroustrap B., The C++ Programming Language, Addison Wesley
5. Bruce Eckel, Thinking in C++
6. Bruce Eckel, Thinking in Java


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2.8 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 2.4 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2.3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 2.5 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 3 | 3 | 2.4 |
| C06 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 2.5 |
| CO7 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.6 |
| CO8 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 1 | 2.5 |
| Average | 3 | 3 | 2.8 | 2.5 | 2 | 1.5 | 2.4 | 2.8 | 2 | 2.4 | 3 | 2.8 | |

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# Database Management Systems Lab

COURSE CODE: 18B17CI373

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Develop the ability to design, implement and manipulate databases.
2. Introduce students to build database management systems.
3. Apply DBMS concepts to various examples and real life applications.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Design and implement a database schema | Usage |
| CO2 | Design different views of tables for different users and to apply embedded and nested queries | Usage |
| CO3 | Understand the use of structured query language and its syntax , transactions, database recovery and techniques for query optimization | Familiarity |
| CO4 | Understand , analyze and apply common SQL statements including DDL , DML , DCL statements to perform different operations | Assessment & Usage |
| CO5 | Develop application programs using PL/SQL | Usage |
| CO6 | Design and implement a project using embedded SQL and GUI | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | To implement Data Definition language commands Create database/table, alter, drop, truncate | 2 |
| 2 | To implement Constraints as a part of Data Definition language Primary key, Foreign Key, Check, Unique | 2 |
| 3 | To implement Constraints as a part of Data Definition language Null, Not null, Default, Enable Constraints, Disable Constraints, Drop Constraints | 2 |
| 4 | To implement Data Manipulation Language Commands Insert, Select, Update, Delete | 2 |
| 5 | To implement Data Control Language, Transfer Control Language Commands commit, rollback, save point, grant, revoke | 2 |
| 6 | To practice in Built Functions Date functions, numerical functions, character functions, conversion functions, group functions, count functions etc. | 2 |
| 7 | To practice group by, having clause and special operators such as between, like, in etc. | 2 |
| 8 | To practice Nested Queries | 2 |
| 9 | To practice Nested Queries and Join Queries Inner join, Left join, Right join, Full join | 2 |
| 10 | To implement Set Operators Union, Intersect, Minus | 2 |
| 11 | To implement Views | 2 |
| 12 | To implement and practice PL/SQL control structure If, if then else, else if, nested if | 2 |
| 13 | To implement and practice PL/SQL control structure For loop, while loop | 2 |

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|---|---|---|
| 14 | To implement and practice PL/SQL procedures | 2 |
| 15 | To implement and practice PL/SQL functions | 2 |
| 16 | To implement triggers | 2 |
| 17 | To study about various Visual Basic (front end) tools | 2 |
| 18 | To design and implement forms using visual basic | 2 |
| 19 | To design and implement a menu design using Visual Basic | 2 |
| 20 | To implement report generation using VB. | 4 |
| 21 | To create a database for payroll processing system using SQL | 4 |
| 22 | Implement the above created database using VB. | 4 |
| 23,24,25 | **Minor Projects – (Only for 2 credit lab)**<br>Banking System University System<br>Company System<br>Hospital Management System Passport Automation System | 6 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. "Fundamentals of Database Systems" Elmasri, Navathe, Pearson Education.
2. "Database system concepts" Henry F Korth, Abraham Silberschatz, S. Sudurshan, McGraw-Hill
3. "Database Systems: A Practical Approach to design, Implementation and Management". Thomas Connolly, Carolyn Begg: Third Edition, Pearson Education.
4. Bipin C Desai, ?An Introduction to Database Systems?, Galgotia. Publications Pvt Limited, 2001
5. "An Introduction to Database Systems", C.J.Date, Pearson Education.
6. "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson, Education.
7. Orcacle manual
8. Link to topics related to course:
   a. https://www.youtube.com/watch?v=EUzsy3W4I0g&list=PL9426FE14B809CC41
   b. https://www.w3schools.com/sql/
   c. https://www.codementor.io/collections/learn-sql-bwclmlodl


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 1 | 2.2 |
| CO2 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2.3 |
| CO3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2.3 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1.8 |
| CO5 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 2.1 |
| C06 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 2.3 |
| Average | 3 | 2.5 | 2.2 | 1.5 | 1.7 | 2.5 | 2.7 | 1.8 | 2 | 2.7 | 2 | 1.2 | |

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# IT Workshop Lab

COURSE CODE: 18B17CI372

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. To introduce the students with the basic features of Matlab for problem solving
2. To introduce the students about the Mathematical functions like matrix generation and Plotting with multiple data sets, line styles and colors.
3. To introduce the students about the Array operations and solving Linear equations in Matlab.
4. To introduce the students about the control flow and operators using if-end structures and loops.
5. To introduce the students about the writing M-file scripts and Debugging M-files

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Writing fundamental programs in Matlab, creating variables and mathematical functions | Familiarity |
| CO2 | Programming the fundamentals concepts of basic Plotting consisting of simple and multiple data sets in one plot | Usage |
| CO3 | Understand how to program matrix operations, array operations and how to solve the system of linear equations | Assessment |
| CO4 | Understand how to program M-file scripts , M- file functions, Input –output Arguments | Assessment |
| CO5 | Program control flow operators, loops, flow structures and debugging M-files | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | 1. Create variable, pounds, to store a weight in pounds. Convert this to kilograms and assign the result to variable kilos. The conversion factor is 1 kilogram = 2.2 pounds.<br>2. The combined resistance RT of three resistors R1, R2, and R3 in parallel is given by | 2 |
| | $RT = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$<br>Create variables for the three resistors and store values in each, and then calculate the combined resistance. | |
| 2 | Write a MATLAB program to calculate the following expression and round the answers to the nearest integer.<br>a) z = 5x2 + y2 where x=2, y=4<br>b) z = 4cos(x)+ j6sin(x) where x=π/4<br>c) z = 3sin(x)+4cos(x)+3ey where x=π/3 , y=2<br>d) y=sin(x) / x where $0 \leq x \leq 2\pi$<br>2. Solve the following system x + y - 2z = | 2 |



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| | 3<br>2x + y = 7<br>x + y - z = 4 | |
| 3 | 1. Write a program for three bits parity generator using even-parity bit.<br>2. Write a program to convert a three bits binary number into its equivalent gray code.<br>3. if q=[1 5 6 8 3 2 4 5 9 10 1],x=[ 3 5 7 8 3 1 2 4 11 5 9], then:<br>a) find elements of (q) that are greater than 4.<br>b) find elements of (q) that are equal to those in (x).<br>c) find elements of (x) that are less than or equal to 7.<br>4. If x=[10 3 ; 9 15], y=[10 0; 9 3], z=[-1 0; -3 2], what is the output of the following statements:<br>a) v = x > y<br>b) w = z >= y<br>c) u = ~z & y<br>d) t = x & y < z | **2** |
| 4 | 1.Plot sin(x) on the interval [-pi,pi] using spacing 0.5, 0.1 and 0.01 between the points where you will sample the function. (This will change the resolution). Experiment with the hold on command.<br>2. Attach labels to the axis of the previous plot and give a title to the graph.<br>3. Plot 5 cos(x2+1) on [-2pi,2pi]. Note that the squaring operation will require you to use the dot . in order for the squaring operation to act on each element individually. However, the addition operation (+)<br>automatically acts on elements individually. | **2** |
| 5 | 1. Type x=[1 2 3]<br>y =[4 5 6]<br>a=2 x+y x-y a*x<br>and observe what happens.<br>If want to apply an operation such as squaring each element in a matrix we have to use a dot . before the operation we wish to apply. Type the following commands in MATLAB.<br>x=1:10<br>x.^2<br>A=[1 2 3 ; 4 5 6 ; 7 8 9 ]A.^2<br>A^2<br>and observe the result. The dot allows us to do operations element wise. | **2** |

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| | All built-in functions such as sin, cos, exp and so on automatically act elementwise on a matrix. Type<br>y=[0 1/4 1/2 3/4 1]<br>y=pi*y<br>sin(y)<br>and observe the result.<br>2. Create a array x with 10 elements x=[ 1 2 3 4 5 6 7 8 9 10]<br>We can also create this vector by typing x=1:10. The vector (1 1.1 1.2 1.3 1.4 1.5) can be created by typing x=[ 1 1.1 1.2 1.3 1.4 1.5 ] or by typing x=1:0.1:1.5.<br>Matrices can be created according to the following example. The matrix<br>A= $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$ is created by typing<br>A=[1 2 3 ; 4 5 6; 7 8 9],<br>i.e., rows are separated with semi-colons. If we want to use a specific element in a vector or a matrix, study the following example:<br>Example:<br>x=[10 20 30]<br>A=[ 1 2 3 ; 4 5 6 ; 7 8 9]<br>x(2)<br>A(3,1)<br>Here we extracted the second element of the vector by typing the variable and the position within parentheses. The same principle holds for matrices; the first number specifies the row of the matrix, and the second number specifies the column of the matrix. Note that in MATLAB the first index of a vector or matrix starts at 1, not 0 as is common with other programming languages. | |
| 6 | 1. A Pythagorean triple is a set of positive integers (a,b,c) such that a2 + b2 = c2. Write a function ispythag that will receive three positive integers (a, b, c in that order) and will return 1 for true if they form a Pythagorean triple, or 0 for false if not.<br>2. Whether a storm is a tropical depression, tropical storm, or hurricane is determined by the average sustained wind speed. In miles per hour, a storm is a tropical depression if the winds are less than 38 mph. It is a tropical storm if the winds are between 39 and 73 mph, and it is a hurricane if the wind speeds are >= 74 mph. Write a script that will prompt the user for the wind speed of the storm, and will print which<br>type of storm it is. | 2 |
| 7 | 1. Write a script that will prompt the user for N integers, and then write the positive numbers (>= 0) to an ASCII file called pos.dat and the negative numbers to an ASCII file called neg.dat. Error-check to make sure that the user enters N integers.<br>2. Write a script that will continue prompting the user for positive numbers, and storing them in a vector variable, until the user types a negative number.<br>3. Write a script that will use the menu function to present the user with choices for functions fix, floor, and ceil. Error-check by looping to display the menu until the user pushes one of the buttons (an error could occur if the user clicks the X on the menu box rather than pushing one of the buttons). Then, generate a random number and print the result of<br>the user"s function choice of that number (e.g., fix(5)). | 2 |

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| 8 | 1. Write a "currency exchange program" similar to the one in Example 1 which can handle two different exchange rates, exchange_rate1 = 0.5 and exchange_rate2 = 0.25. Design the program to first ask for the amount in dollars and then ask the user which rate (represented by the numbers 1 and 2 respectively) he/she wants. Let the program return the amount in the requested foreign currency.<br>2. Write a program that approximates PI by computing the sum<br><br>The more terms you keep in the summation, the more accurate your answer will be. (In fact, the series converges to PI as m goes to infinity.) See how many terms you need to approximate PI with 5 decimals. (Note: This is by no means the most efficient way to approximate PI, but the formula is quite beautiful...)<br>3. Use the sum given in Exercise 2 to approximate PI using 10, 100, 1000, 10000 and 100000 terms. For each of these numbers, compute the error of the approximation. Plot the error as a function of the number of terms used in the sum. | 2 |
| 9 | 1. In Europe daylight time starts on the last Sunday of March and ends on the last Sunday of October. Write a function that determines whether a given daynumber is in the summertime period or in the wintertime period of the Daylight Saving Time<br>2. Write a function that will receive the radius of a circle and will print both the radius and diameter of the circle in a sentence format. This function will not return any value; it simply prints | **2** |
| 10 | 1. Write a program to calculate and print the area and circumference of a circle. There should be one script and three functions to accomplish this (one that prompts for the radius, one that calculates the area and circumference, and one that prints).<br>2. The lump sum S to be paid when interest on a loan is compounded annually is given by S = P(1 + i)n, where P is the principal invested, i is the interest rate, and n is the number of years. Write a program that will plot the amount S as it increases through the years from 1 to n. The main script will call a function to prompt the user for the number of years (and error-check to make sure that the user enters a positive integer). The script will then call a function that will plot S for years 1 through n. It will use 0.05 for the interest rate and $10,000 for P. | **2** |

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| 11 | 1. Write a script that will prompt the user for a temperature in degrees Celsius, and then an F for Fahrenheit or K for Kelvin. The script will print the corresponding temperature in the scale specified by the user. For example, the output might look like this: Enter the temp in degrees C: 29.3 Do you want F or K? F The temp in degrees F is 84.7 The format of the output should be exactly as specified here. The conversions are:<br>F = 9/5 *C+32 K = C+273.15<br>2. Write a function to calculate the volume and surface area of a hollow cylinder. It receives as input arguments the radius of the cylinder base and the height of the cylinder. The volume is given by Π r2 h, and the surface area is 2 Π r h.<br>3. Hurricanes are categorized based on the winds. The following table shows the category number for hurricanes with varying wind ranges and what the storm surge is (in feet above normal). | 2 |
| | 1 74–95 4–5<br>2 96–110 6–8<br>3 111–130 9–12<br>4 131–155 13–18<br>5 >155 >18<br>$\pi \approx 4\sum_{k=0}^{m} \frac{(-1)^k}{2k+1}$<br>Write a function that will receive as an input argument the wind speed, and will return the category number and the minimum value of the typical storm surge. | |

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| 2 | 1. Write a function called geomser that will receive values of r and n, and will calculate and return the sum of the geometric series:<br>1 + r + r2 + r3 + r4 + ... + rn The following examples of calls to this function illustrate what the result should be:<br>>> geomser(1,5) ans = 6<br>>> disp(geomser(2,4))<br>31<br>2. A sound engineer has recorded a sound signal from a microphone. The sound signal was sampled, meaning that values at discrete intervals were recorded (rather than a continuous sound signal). The units of each data sample are volts. The microphone was not on at all times, however, so that data samples below a certain threshold are considered to be data values that were samples when the microphone was not on, and therefore not valid data samples. The sound engineer would like to know the average voltage of the sound signal. Write a script that will ask the user for the threshold and the number of data samples, and then for the individual data samples. The program will then print the average and a count of the valid data samples, or an error message if there were no valid data samples. An example of what the input and output would look like in the Command Window is shown:<br>Please enter the threshold below which samples will be considered to be invalid: 3.0<br>Please enter the number of data samples to be entered: 7 Please enter a data sample: 0.4<br>Please enter a data sample: 5.5 Please enter a data sample: 5.0 Please enter a data sample: 2.1 Please enter a data sample: 6.2 Please enter a data sample: 0.3 Please enter a data sample: 5.4<br>The average of the 4 valid data samples is 5.53 volts | 2 |
| 13 | 1. Create a vector of five random integers, each in the range from –10 to 10. Perform each of the following two ways: using built-in functions, and also using loops (with if statements if necessary):<br>Subtract 3 from each element. Count how many are positive.<br>Get the absolute value of each element. Find the maximum.<br>2. Create a 3 × 5 matrix. Perform each of the following two ways: using built-in functions, and also using loops (with if statements if necessary): Find the maximum value in each column.<br>Find the maximum value in each row.<br>Find the maximum value in the entire matrix.<br>3. Write a script that will print the following multiplication table:<br>1<br>2 4<br>3 6 9<br>4 8 12 16<br>4. 5 10 15 20 25 | 2 |

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| 14 | 1. Biomedical engineers are developing an insulin pump for diabetics. To do this, it is important to understand how insulin is cleared from the body after a meal. The concentration of insulin at any time t is described by the equation $C = C0\ e^{-30t/m}$ where C0 is the initial concentration of insulin, t is the time in minutes, and m is the mass of the person in kg. Write a script that will graphically show how the weight of the person influences the time for insulin to be cleared from the body. It will show in a $2 \times 1$ subplot the concentration of insulin for two subjects, one who weighs 120 pounds, and one who weighs 300 pounds. For both, the time should increment from 0 to 4 minutes in steps of 0.1 minute, and the initial concentration should be 85. The concentration over time will be shown in each subplot, and the weight of the person should be in the title. The conversion factor is 1 pound = 0.4536 kg. In order to better compare, use consistent axes for both plots.<br>2. Sales (in millions) from two different divisions of a company for the four quarters of 2006 are stored in vector variables, for example, div1 = [4.2 3.8 3.7 3.8];<br>div2 = [2.5 2.7 3.1 3.3];<br>Using subplot, show side-by-side the sales figures for the two divisions. What kind of graph shows this in the best way? Why? In one graph, compare the two divisions. What kind of graph shows this in the best way? Why? | 2 |
| 15 | 1. For the following matrices A, B, and C: A B C<br>1 4 2 1 3 3 2 5<br>3 2 1 5 6 4 1 2<br>3 6 0<br>Which are symmetric?<br>For all square matrices, give their trace. Give the result of 3*A.<br>Give the result of A*C.<br>Are there any other matrix multiplications that can be performed? If so, list them.<br>2. Given the following matrices:<br>A B C<br>3 2 1 2 1 0 0<br>0 5 2 1 0 1 0<br>1 0 3 3 0 0 1<br>Perform the following MATLAB operations, if they can be done. If not, explain why.<br>A * B B * A I<br>+A A .* I<br>trace(A) | 2 |
| 16 | 1. Write a function issquare that will receive an array argument, and will return 1 for true if it is a square matrix, or 0 for false if it is not.<br>2. Write a function mydiag that will receive an array argument, and will return a vector consisting of the main diagonal (without using the built- in diag function). | 2 |

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| 17 | 2. Write a function that will receive a square matrix as an input argument, and will return a row vector containing the diagonal of the matrix. If the function is called with a vector of two variables on the left-hand side of the assignment, the function will also return the trace of the matrix. (Note: It will return the trace only if there is two variables on the left-hand side of the assignment.) You may assume that the matrix is square. The function must preallocate the diagonal vector to the correct size.<br>2. Write a function randdiag that will return an n x n diagonal matrix, with random integers each in the range from low to high on the diagonal. Three arguments are passed to the function: the value of n,<br>low, and high, in that order. | 2 |
| 18 | 1. Write a function to receive a matrix and return its transpose (for more programming practice, do not use the built-in operator for the transpose).<br>2. We have already seen the zeros function, which returns a matrix of all 0"s. Similarly, there is a function ones that returns a matrix of all 1"s. Note: No, there aren"t functions called twos, threes, and such (just ones and zeros!). However, write a fives function that will receive two arguments for the number of rows and columns and will return a matrix<br>with that size of all 5"s. | 2 |
| 19 | 1. The function magic(n) returns an n n magic matrix, which is a matrix for which the sum of all rows, columns, and the diagonal are the same. Investigate this built-in function.<br>2. The function pascal(n) returns an n n matrix made from Pascal"s triangle. Investigate this built-in function, and then write your own. | 2 |
| 20 | 1. For the following 2 x 2 system of equations:<br>3x1 + 2x2 = 4 x1<br>= 2<br>Write this in matrix form.<br>Using the method for 2 x 2 systems, find the determinant D. Use D<br>to find the inverse of A.<br>Use the Gauss elimination method to find the solution. Use the<br>Gauss-Jordan method to solve.<br>Check your work in MATLAB.<br>2. For the following set of equations:<br>2x1 + 2x2 + x3 = 2 x 2 + 2x3<br>= 1 x1 + x2 +<br>3x3 = 3<br>Put this in the augmented matrix [A\|b]. Solve<br>using Gauss.<br>Solve using Gauss-Jordan.<br>In MATLAB, create the matrix A and vector b. Find the inverse and determinant of A. Solve for x. | 2 |
| 21 | 1. Solve the simultaneous equations x – y = 2 and x2 + y = 0 using solve. Plot the corresponding functions, y = x – 2 and y = –x2, on the same graph with an x range from –5 to 5.<br>2. For the following set of equations: 2x1 +<br>2x2 + x3 = 2<br>x 2 + 2x3 = 1 | 2 |

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| | x1 + x2 + 3x3 = 3<br>In MATLAB, create the coefficient matrix A and vector b. Solve for x using the inverse, using the built-in function.<br>Create the augmented matrix [A\|b] and solve using the rref function. Write this in symbolic form and solve using the solve function. From the symbolic solution, create a vector of the numerical (double) equivalents | |
| 22 | 1. Rewrite the following system of equations in matrix form: 4x1 − x2 + 3x4 = 10<br>−2x1 + 3x2 + x3 − 5x4 = −3 x1 + x2<br>− x3 + 2x4 = 2<br>3x1 + 2x2 − 4x3 = 4<br>Set it up in MATLAB and use any method to solve.<br><br>2. For the following 2 2 system of equations:<br>−3x1 + x2 = −4<br>−6x1 + 2x2 = 4<br>In MATLAB, rewrite the equations as equations of straight lines and plot them to find the intersection.<br>Solve for one of the unknowns and then substitute into the other equation to solve for the other unknown.<br>Find the determinant D.<br>How many solutions are there? One? None? Infinite? | **2** |
| 23 | 1. For the following 2 x 2 system of equations:<br>−3x1 + x2 = 2<br>−6x1 + 2x2 = 4<br>Rewrite the equations as equations of straight lines and plot them to find the intersection.<br>Solve for one of the unknowns and then substitute into the other equation to solve for the other unknown.<br>Find the determinant D.<br>How many solutions are there? One? None? Infinite?<br>2. Write a function to return the determinant of a 2 x 2 matrix.<br>3. Write a function to return the inverse of a 2 x 2 matrix. | **2** |
| 24 | 1. Write a script that will do the following. Create two vectors with 20 random integers in each; in one the integers should range from 1 to 5, and in the other from 1 to 500. For each vector, would you expect the mean and median to be approximately the same? Would you expect the standard deviation of the two vectors to be approximately the same? Answer these questions, and then use the built-in functions to find the minimum, maximum, mean, median, standard deviation, and mode of each. Do a histogram for each in a subplot. Run the script a few times to see the variations.<br>2. Write a function that will return the mean of the values in a vector, not including the minimum and maximum values. Assume that the values in the vector are unique. It is OK to use the built-in mean function. To test this, create a vector of 10 random integers, each in the range from 0 to 50, and pass this vector to the function. | **2** |

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| 25 | 1. A student missed one of four exams in a course, and the professor decided to use the average of the other three grades for the missed exam grade. Which would be better for the student: the mean or the median if the three recorded grades were 99, 88, and 95? What if the grades were 99, 70, and 77?<br><br>2. A weighted mean is used when there are varying weights for the data values. For a data set given by x = {x1, x2, x3, x4, . . . , xn} and corresponding weights for each xi, w = {w1, w2, w3, w4, . . . , wn}. Write a function that will receive two vectors as input arguments: one<br>for the data values and one for the weights, and will return the weighted mean. | 2 |
| 26 | 1. DNA is a double-stranded helical polymer that contains basic genetic information in the form of patterns of nucleotide bases. The patterns of the base molecules A, T, C, and G encode the genetic information. Construct a cell array to store some DNA sequences as strings, such as<br>TACGGCAT<br>ACCGTAC<br>and then sort these alphabetically. Next, construct a matrix to store some DNA sequences of the same length and then sort them alphabetically.<br>2. Write a function that will receive two arguments: a vector and a character (either „a" or „d") and will sort the vector in the order specified by the character (ascending or descending). | 2 |
| 27 | 1. Write a function matsort to sort all the values in a matrix (decide whether the sorted values are stored by row or by column). It will receive one matrix argument and return a sorted matrix. Do this without loops, using the built-in functions sort and reshape. For example:<br>>> mat mat = 4 5 2<br>1 3 6<br>7 8 4<br>9 1 5<br>>> matsort(mat) ans = 1<br>4 6<br>1 4 7<br>2 5 8<br>3 5 9<br>2. Write a function that will receive two arguments: a vector and a character (either „a" or„d") and will sort the vector in the orderspecified<br>by the character (ascending or descending). | 2 |

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|---|---|---|
| 8 | 1. Find the roots of the equation f(x) = 0 for the following function. Also, create x and y vectors and plot this function in the range from –3 to 3 in order to visualize the solution.<br>f(x) = 3x2 - 2x – 5<br>2. Evaluate the polynomial expression 3x3 + 4x2 + 2x – 2 at x = 4, x = 6, and x = 8.<br>3. Sometimes the roots of polynomial equations are complex numbers. For example, create the polynomial row vector variable pol:<br>>> pol = [3 6 5];<br>Use the roots function to find the roots. Also, use ezplot(poly2sym(pol))<br>to see a plot. Then, change the last number in pol from 5 to –7 and again find the roots and view the plot. | 2 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. Stormy Attaway, Matlab: a Practical Introduction to Programming and Problem Solving, Elsevier
2. Essentials of MATLAB Programming Stephen J. Chapman , 2005
3. MATLAB for Engineers Holly Moore, 2007
4. MATLAB Programming for Engineers Stephen J. Chapman , 1999
5. Matlab, An Introduction With Applications Amos Gilat , 2003
6. MATLAB Guide 2000
7. https://nptel.ac.in/courses/103106118/
8. Link to topics related to course:
   i. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
   ii. https://www.math.utah.edu/~wright/misc/matlab/matlabintro.html
   iii. https://web.stanford.edu/class/ee254/software/using_ml.pdf


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1.9 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 2 | 2.2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2.3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2.3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2.3 |
| Average | 3 | 3 | 3 | 2.2 | 2 | 1.4 | 1.6 | 2 | 1.6 | 2 | 2.6 | 2 | |

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# Discrete Computational Mathematics

COURSE CODE: 18B11CI414

COURSE CREDITS: 3

CORE/ELECTIVE: COR

L-T-P: 3-0-0

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**Pre-requisite:** Basic Mathematics Algebra

**Course Objectives**

1. To simplify and evaluate any logical expression and to express logical statements in terms of logical connectives, predicates and quantifiers.
2. Use of various set operations, relations and functions concept to solve applied problems.
3. To solve counting problems using elementary counting techniques.
4. To learn and perform various graphs and trees terminologies, traversals & their applications.
5. Problem solving using recursion and recurrence relations by analyzing algorithms.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will be able to express logical statements in terms of logical connectives, predicates and quantifiers. | Familiarity |
| CO-2 | Students will be able to apply various proving techniques such as direct, indirect proofs, mathematical induction, etc. | Assessment |
| CO-3 | They will learn basic set operations along with relations & functions with their types and usage. | Familiarity |
| CO-4 | They will be familiar with graph & tree terminologies along with their various applications in computer science. | Familiarity |
| CO-5 | Students will be able to solve counting problems using permutation, combinations techniques. | Assessment |
| CO-6 | They will learn about algebraic structures such as group, abelian group, rings, integral domain, fields, etc | Familiarity |
| CO-7 | Students will be able to analyze and solve various algorithms using recurrence relation methods | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction and Applications of Discrete Mathematics, Mathematical Logic: Propositional & Predicate; Quantifiers, Proving Techniques: Direct Proof, Contra positive, Contradiction, Principle of Mathematical Induction; Pigeonhole Principle | 6 |
| 2 | Sets, Types of Sets, Various set operations, Venn Diagrams, Identities in sets, Principle of Inclusion & Exclusion | 3 |
| 3 | Relations: Types & Representation; Properties of Binary Relations, Equivalence Relations, Partial Ordering Relations, Partitions. Functions, Types of Functions, inverse of function, composition of functions. | 5 |
| 4 | Graph, Graph Terminologies, Types of Graphs, Paths & Circuits, Euler & Hamiltonian Graphs, Planar Graphs, Graph Traversals: Breadth First Search & Depth First Search, Shortest Path Algorithms. | 7 |

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|---|---|---|
| **5** | Trees, Tree Terminologies, Types of Trees: General, Binary, Strictly Binary, Full & Complete Binary Tree; Tree Traversals, Binary Search Tree, AVL Trees. | 7 |
| **6** | Basic Counting Techniques, The Sum and Product Rule, Permutations, Combinations, Generation of Permutations and Combinations | 4 |
| **7** | Properties of Algebric Structures, Semigroups, Monoids, Groups, Abelian Groups, Subgroups, Homomorphism & Isomorphism of Groups, Rings, its characteristics & its types, Integral Domain & Fields. | 6 |
| **8** | Recurrence Relations, Linear Recurrence Relations with constant coefficients (homogeneous & non-homogeneous) with their solving techniques. | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

a. C.L. Liu & D.P. Mohapatra, "Elements of Discrete Mathematics: A Computer Oriented Approach", 4th Edition, TMH

b. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th Edition, TMH

**Suggested Reference Book(s):**

1. B. Kolman, R. Busby & S.C. Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education.
2. S. Lipschutz & M. Lipson, "Discrete Mathematics", 3rd Edition, TMH.
3. J.P. Tremblay & R. S. Manohar, "Discrete Mathematical Structures with Applications to Computer Science, TMH, New York 1997.
4. Richard Hammack, "Book of Proof", 2nd Edition, VCU Mathematics Text Book Series

**Other useful resource(s):**

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18_cs53/preview
2. Link to topics related to course:
   i. https://www.youtube.com/watch?v=xlUFkMKSB3Y
   ii. https://www.youtube.com/watch?v=RMLR2JHHeWo
   iii. https://www.youtube.com/watch?v=9AUCdsmBGmA
   iv. https://www.youtube.com/watch?v=7cTWea9YAJE

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

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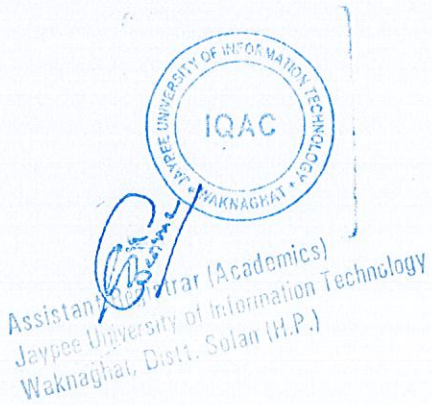
## Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Discrete Computational Mathematics ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2.2 |
| CO-2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2.3 |
| CO-3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2.3 |
| CO-4 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2.1 |
| CO-6 | 3 | 2 | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 1.9 |
| CO-7 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 2.3 |
| Average | 3 | 2.6 | 2.3 | 1.1 | 1.6 | 2.6 | 2.6 | 1.7 | 1.9 | 2.6 | 2 | 1.4 | |

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# Modeling and Simulation Techniques

COURSE CODE: 18B11CI413

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 2-0-0

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**Pre-requisite:** Discrete Mathematics, Algorithm, Software Engineering

**Course Objectives:**

1. Student will model real-world systems and implement the model as a computer program
2. Student will learn model design and development comparison to analytical models.
3. Student will learn important methods of computing and statistics.
4. Student will learn important techniques of real world project development and management.
5. Student will learn to evaluate the performance of real-world systems by analyzing the output of the model under various conditions..

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the basic concepts, applications and terminology of computer simulation and modeling. | Familiarity |
| CO-2 | To learn statistical methods of estimation and testing and other relevant concepts | Technical |
| CO-3 | To explain the working and applications of different types of simulation such as Monte Carlo, VS. Discrete Event | Technical |
| CO-1 | You will learn how to model a system and the execution of simulation tools. | Technical |
| CO-2 | You will learn to analyze input data, its parameters, and the use of random number in a typical simulation study. | Technical |
| CO-3 | Student will learn different techniques for the Verification and Validation of a simulation study | Technical |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Simulation and Modeling:** Simulation: Definition, Methods, Systems, Variability, Complexity, Advantages. Modelling: Definition, characteristics, description, categories. | 5 |
| 2 | **Statistical Concepts:** Hypothesis, Estimation, Statistical Significance, Error/Risks. Statistical tests, Bounds and Correlation. Input Data Modelling, Output Data Analysis. | 5 |
| 3 | **Discrete-Event Simulation, Monte Carlo Simulation:** Queuing System Model Components, Simulation Methodology, DES Example, Implementation, Arena Simulation. The Monte Carlo Method, Sensitivity Analysis | 8 |
| 4 | **Systems Modeling:** System Model Types, Modeling Methodologies and Tools, Analysis of Modeling and Simulation, Operation Research Methods, Coding the Model, Use of Pseudo Random Number Streams. | 8 |
| 5 | **Data Collection and Analysis :** Obtaining Data, Data Format, Representing Unpredictable Variability, Distributions, Bootstrapping. | 8 |

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|---|---|---|
| | Fitting Statistical Distributions to Empirical Data | |
| 6 | **Verification, Validation, and Accreditation:** Definition and concepts, Difficulties, Confidence as Validity. Conceptual Model Validation, Data Validation, White-Box Validation, Black-Box Validation, Experimentation Validation, Solution Validation, Independent Verification and Validation | 8 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Modeling and Simulation: Exploring Dynamic System Behavior, Authors: Birta, Louis G., Arbez, Gilbert
2. Simulation (5th Edition) , Authors: Sheldon Ross.

**Suggested Reference Book(s):**

1. MODELING AND SIMULATION FUNDAMENTALS Theoretical Underpinnings and Practical Domains by John A. Sokolowski Catherine M. Banks.
2. Science in the Age of Computer Simulation by ERIC WINSBERG
3. Modeling and Simulation: The Computer Science of Illusion. By Raczynski, S..

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106104019/
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/106104019/1
   ii. https://nptel.ac.in/courses/106104019/4
   iii. https://nptel.ac.in/courses/106104019/26
   iv. https://nptel.ac.in/courses/106104019/2Ev

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Data Simulation and Modeling Techniques) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | 2.5 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-2** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO-3** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO-4** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO-5** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO-6** | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **2.8** |
| **Average** | **3** | **3** | **3** | **2.3** | **2** | **2** | **3** | **3** | **2.2** | **3** | **3** | **3** | |

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# Operating System

COURSE CODE: 18B11CI411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite: C/C++**

**Course Objectives:**

1. To learn the mechanisms of OS to handle processes and threads and their communication.
2. To learn the mechanisms involved in memory management in contemporary OS.
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
4. To know the components and management aspects of concurrency management.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | An appreciation of the role of an operating system. | Familiarity |
| CO-2 | Create processes and threads. | Assessment |
| CO-3 | Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. | Assessment |
| CO-4 | For a given specification of memory organization develop the techniques for optimally allocating memory to processes by Increasing memory utilization and for improving the access time | Assessment |
| CO-5 | Design and implement file management system. | Assessment |
| CO-6 | For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers. . | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System. | 4 |
| 2 | **Process:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. | 4 |
| 3 | **Process Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, Priority, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF | 4 |
| 4 | **Inter-process Communication:** Critical Section, Race Conditions, Mutual | 10 |

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|---|---|---|
| | Exclusion, Hardware Solution, Strict Alternation, Peterson"s Solution, Lamport"s Bakery Algorithm, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader"s & Writer Problem, Dinning Philosopher Problem etc. | |
| 5 | **Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker"s algorithm, Deadlock detection and Recovery. | 4 |
| 6 | **Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. | 6 |
| 7 | **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU). | 5 |
| 8 | **I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms.<br><br>**File Management:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. "Operating System Concepts" 9th Edition by Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. "Operating Systems: Internals and Design Principles" 9th Edition, William Stallings, Pearson.

**Suggested Reference Book(s):**

1. "Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. "Operating Systems: A Modern Perspective" 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India.
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106108101//
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/106106144/
   ii. https://www.class-central.com/course/udacity-introduction-to-operating-systems-3419

**Evaluation Scheme:**

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| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Operating System ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.4 |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 2.4 |
| CO-4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO-6 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| Average | 3 | 3 | 3 | 2 | 2.7 | 2.8 | 2 | 2 | 2.5 | 3 | 1 | 3 | |

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# Design and Analysis of Algorithms

COURSE CODE: 18B11CI412

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Data structure and algorithms

**Course Objectives:**

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms. | Technical |
| CO-2 | Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms. | Technical |
| CO-3 | Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation. | Technical |
| CO-4 | Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity. | Technical |
| CO-5 | For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems. | Technical |
| CO-6 | Explain the ways to analyze randomized algorithms (expected running time, probability of error). | Technical |
| CO-7 | Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS). | Technical |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters" theorem. Examples: Binary counter, Recursive Fibonacci in LogN | 10 |
| 2 | Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design | 8 |



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|---|---|---|
| | of Algorithms; Illustrations of these techniques for Problem- Solving , Bin Packing, Knap Sack TSP. Heuristics characteristics and their application domains. Examples: Greedy and dynamic scheduling, Hoffman encoding, Dynamic programming: Longest common subsequence, Matrix chain multiplication, Dynamic programming: Bin packing, Knapsack, Dynamic programming: TSP, Branch and Bound TSP, Backtracking: SAT, Maze Sudoku solver, 8 queen | |
| **3** | Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm. Examples: Best first search, Binomial heap MST: Prims, Kruskal, Fibonacci heap MST: Tarjan, Lazy decrease key implementation and Dijkstra, MaxFlow/ MinCut Ford-Fulkersion | **8** |
| **4** | Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook"s theorem, Standard NP-complete problems and Reduction techniques. Examples: Set Cover, Vertex cover, Map coloring, chromatic number | **8** |
| **5** | Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems, beyond NP – P SPACE, Examples: Approximate matrix inversion, Randomized Eigen vector computation | **8** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Rntroduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

**Suggested Reference Book(s):**

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,
3. Michael T Goodrich and Roberto Tamassia, Wiley.
4. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

**Other useful resource(s):**

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18_cs20/preview
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/106101060/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

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| Course outcomes (Design and Analysis of Algorithms) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 2.5 |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | | 1 | 2 | 1.6 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 2.2 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | | 2 | 2 | 1.8 |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1.9 |
| CO-6 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| CO-7 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Average | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 1.7 | 1 | 1.6 | 2.3 | 2 | 1.6 | 2.3 | |

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# Environmental Studies

COURSE CODE:18B11GE411

COURSE CREDITS: AUDIT

CORE/ELECTIVE: CORE

L-T-P: 2-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Estimate the population- economic growth, energy requirement and demand.
3. Analyze material balance for different environmental systems
4. Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
5. Identify the major pollutants and abatement devices for environmental management and sustainable development.
6. Recognizing the major concepts of environmental studies, developing problem solving ability, forecasting the global climate change

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introducing basic concept of environmental studies, interdisciplinary nature and scope of the subject | Familiarity |
| CO-2 | Understanding ecosystem services and its functioning as well as equitable use of natural resources. | Assessment |
| CO-3 | Understanding Pollution, A threat to the environment and finding its solutions, Pollutant sampling and monitoring of samples. | Assessment |
| CO-4 | Correlating the concept of Biodiversity and its importance to human mankind | Usage |
| CO-5 | Understanding social issues and their impact on environment. | Usage |
| CO-6 | Role of Information Technology in environment and human health | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Unit 1: Multidisciplinary nature of environmental studies:** The Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness. Types of ecosystems, World Biomes, Ecosystem functioning, Biogeochemical cycles. | 3 |

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| | | |
|---|---|---|
| 2 | **Unit 2: Natural resources, their consumption & Protection:** Natural resources, their consumption & Protection: Water, Land Energy (Renewable, non-renewable, wind, solar, hydro, Biomass), Mineral, Forest, & Food resources, Role of an individual in conservation of natural resources, Equitable use of resources. | 4 |
| 3 | **Unit 3: Pollution- a threat to environment:** Pollution- a threat to environment: Air, Water & Land pollution, sources & causes, Space pollution, causes & effects, toxicity limits of pollutants. Critical issues concerning global Environment (Urbanization, population growth, global warming, climate change, acid rain, ozone depletion etc.) and the Roots in: Cultural, Social, Political, Commercial, industrial, territorial domains | 4 |
| 4 | **Unit 4: Environmental standards & Quality:** Environmental standards & Quality: Air, Water & Soil Quality, Pollutant sampling, pollution control systems. Green Chemistry and its applications | 3 |
| 5 | **Unit 5: Biodiversity and its conservation:** Biodiversity loss: Diversity of flora and fauna, species and wild life diversity, Biodiversity hotspots, threats to biodiversity | 4 |
| 6 | **Unit 6: Social Issues and the Environment:** Waste land reclamation, consumerism and waste products, eco-consumerism, dematerialization, green technologies, eco-tourism. Water conservation, rain water harvesting, watershed management. Environment protection act, Air (prevention and control of population) act; Water (prevention and control of pollution) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation National Environmental Policy; Function of pollution control boards (SPCB and CPCB), their roles and responsibilities. | 4 |
| 7 | **Unit 7: Human Population and the environment:** Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education.HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. Case Studies. | 4 |
| 8 | **Unit 8: Field work:** Field Work: Explore the surrounding flora & fauna (Study of common plants, insects, birds document environmental assets), documentation of industries in local region and their possible effects, measure of water, air and land quality, Visit to a local polluted site-Urban/Rural /Industrial / Agricultural, Study of simple ecosystems-pond, river, hill slopes etc | 4 |
| **Total lectures** | | **30** |

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# Data Simulation Lab

COURSE CODE: 18B17CI473

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Student will learn simulation of real world problems using python, numpy, scipy and simpy.
2. Students will learn structural development of complex system in terms of process, resources and lavels
3. Student will learn to use random number generator.
4. Students will learn to monitor and tally simulation results.
5. Students will apply simulation and modeling techniques in many real examples and develop projects.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Student will learn simulation of real world problems using python, scipy and simpy. | Familiarity |
| CO-2 | Students will learn structural development of complex system in terms of process, resources and levels | Assessment |
| CO-3 | Student will learn to use random number generator. | Assessment |
| CO-4 | Students will learn to monitor and tally simulation re0sults. | Assessment |
| CO-5 | Students will apply simulation and modelling techniques in many real examples. | Usage |
| CO-6 | Students will apply simulation and modelling techniques in a real life project. | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Simpy Getting started | 2 |
| 2 | Simple simulation | 2 |
| 3 | Simulation with tracing | 2 |
| 4 | Executing simulations event-by-event | 2 |
| 5 | Synchronizing simulation time with wallclock time | 2 |
| 6 | Event stepping of models with a GUI | 2 |
| 7 | Debugging | 2 |
| 8 | GUI for SimPy simulations | 2 |
| 9 | Plot for simulation | 2 |
| 10 | Statistical parameters | 2 |
| 11 | Random number | 2 |
| 12 | Inference and Output monitoring | 2 |
| 13 | MID SEM TEST | 2 |
| 14 | DES simulation on simpy | 2 |
| 15 | Simpy more features | 2 |
| 16 | Simpy internals | 2 |
| 17 | Example: MACHINE BREAKDOWN | 2 |
| 18 | Example: CAR WASH | 2 |
| 19 | Example: CELL PHONE NETWORK | 2 |
| 20 | Example: Resource pool | 2 |

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| | | |
|---|---|---|
| 21 | Group Project | 2 |
| 22 | Group Project | 2 |
| 23 | Group Project | 2 |
| 24 | Group Project | 2 |
| 25 | Group Project | 2 |
| 26 | Group Project | 2 |
| 27 | Group Project | 2 |
| 28 | End Semester Test | 2 |
| **Total Lab hours** | | 56 |

**Suggested Books/Resources:**


i. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
ii. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.
iii. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007
iv. https://nptel.ac.in/courses/106104019/26
v. https://nptel.ac.in/courses/106104019/2Ev


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | **2.5** |
| **CO2** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | **2.8** |
| **C06** | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **2.8** |
| **Average** | **3** | **3** | **3** | **2.3** | **2** | **2** | **3** | **3** | **2.2** | **3** | **3** | **3** | |

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# Operating Systems Lab

COURSE CODE: 18B17CI471

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Be able to create sockets and analyze different (client/server) models.
2. Be able to create processes, threads, semaphores.
3. Be able to analyze different protocols.
4. Be able to learn how resources are being managed in Operating system.
5. Be able to manage system memory.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand basics of MATLAB syntax, functions and programming. | Familiarity |
| CO2 | Generate and characterize various continuous and discrete time signals. | Familiarity |
| CO3 | Perform the basic operations on the signals. | Computational skills |
| CO4 | Design and analyze linear time-invariant (LTI) systems and compute its response. | Technical skills |
| CO5 | Analyze the spectral characteristics of signals using Fourier analysis. | Technical skills |
| CO6 | Analyze the systems using Laplace transform and Z-transform. | Technical skills |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Process Handling | 2 |
| 2 | Zombie and Orphan Process | 2 |
| 3 | FCFS Scheduling Algorithm | 2 |
| 4 | SJF Scheduling Algorithm | 2 |
| 5 | Priority Scheduling Algorithm | 2 |
| 6 | Round-Robin Scheduling Algorithm | 2 |
| 7 | Process Groups | 2 |
| 8 | Inter-Process Communication | 2 |
| 9 | Shared Memory Concept | 2 |
| 10 | Peterson"s Critical Section Problem Solution | 2 |
| 11 | Mutex | 2 |
| 12 | Semaphores | 2 |
| 13 | MID SEM TEST | 2 |

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| | | |
|---|---|---|
| 14 | Safety Algorithm | 2 |
| 15 | Banker"s Algorithm | 2 |
| 16 | Page Replacement algorithm: FIFO | 2 |
| 17 | Page Replacement algorithm: LRU | 2 |
| 18 | Page Replacement algorithm: Optimal Replacement | 2 |
| 19 | Disk Scheduling : C-SCAN | 2 |
| 20 | Disk Scheduling : C-LOOK | 2 |
| 21 | Group Project | 2 |
| 22 | Group Project | 2 |
| 23 | Group Project | 2 |
| 24 | Group Project | 2 |
| 25 | Group Project | 2 |
| 26 | Group Project | 2 |
| 27 | Group Project | 2 |
| 28 | END SEM TEST | 2 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. Silberschatz and Galvin, Operating System Concepts.
2. Tanenbaum ,S.A Woodhull, Operating System :Design and Implementation
3. W. Stallings, Operating System:Internals and Design Principles


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.4 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 2.4 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO6 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| Average | 3 | 3 | 3 | 2 | 2.7 | 2.8 | 2 | 2 | 2.5 | 3 | 1 | 3 | |

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# Design and Analysis of Algorithms Lab

COURSE CODE: 18B17CI472

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Student will understand the running time using time library functions. Learn to prepare table for input size vs. running time. Learn to measure best run and worst run of the experiments.
2. Students will learn to implement various types of design for an algorithms and compare the approaches.
3. Students will learn to implement network algorithms and their applications.
4. Students will learn to implement approximate algorithms for real world problems.
5. Students will learn to implement randomized solution for difficult real world problems.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Student will understand the running time using time library functions. Learn to prepare table for input size vs. running time. Learn to measure best run and worst run of the experiments. | Technical |
| CO2 | Students will learn to implement various types of design for algorithms and compare the approaches. | Technical |
| CO3 | Students will learn to implement network algorithms and their applications. | Technical |
| CO4 | Student will learn to implement classical NP problems | Technical |
| CO5 | Students will learn to implement approximate algorithms for real world problems. | Technical |
| CO6 | Students will learn to implement randomized solution for difficult real world problems. | Technical |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Getting acquainted with time.h, clocktick, cputime, I/O time | 2 |
| 2 | Getting acquainted with worst case time | 2 |
| 3 | Getting acquainted with Average case time | 2 |
| 4 | Getting acquainted with recursive program | 2 |
| 5 | Recursive Fibonacci in log n | 2 |
| 6 | Greedy and dynamic scheduling | 2 |
| 7 | Hoffman encoding | 2 |
| 8 | Dynamic programming: Longest common subsequence, Matrix chain multiplication | 2 |
| 9 | Dynamic programming: Bin packing, Knapsack | 2 |
| 10 | Dynamic programming: TSP | 2 |
| 11 | Branch and Bound TSP | 2 |
| 12 | Backtracking: SAT, Maze | 2 |

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| | | |
|---|---|---|
| 13 | Sudoku solver, 8 queen | 2 |
| 14 | MID sem TEST | 2 |
| 15 | Best first search | 2 |
| 16 | Binomial heap MST: Prims, Kruskal | 2 |
| 17 | Fibonacci heap MST: Tarjan | 2 |
| 18 | Lazy decrease key implementation and Dijkstra | 2 |
| 19 | MaxFlow/ MinCut Ford-Fulkersion | 2 |
| 20 | Set Cover, Vertex cover | 2 |
| 21 | Map coloring, chromatic number | 2 |
| 22 | Approximate matrix inversion | 2 |
| 23 | Randomized Eigen vector computation | 2 |
| 24 | Minor Project | 2 |
| 25 | Minor Project | 2 |
| 26 | Minor Project | 2 |
| 27 | Minor Project | 2 |
| 28 | Final test | 2 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**

1. Data Structures and Algorithms with Python, Lee and Hubbard.
2. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson
3. ink to topics related to course:
   - **a.** Python
   - **b.** SciPy
   - **c.** NumPy

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 2.5 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | | 1 | 2 | 1.6 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 2.2 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | | 2 | 2 | 1.8 |
| CO5 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1.9 |
| CO6 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Average | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 1.7 | 1 | 1.5 | 2.3 | 2 | 1.5 | 2.3 | |

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# Web Technology Lab

COURSE CODE: 18B17CI474

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. To develop the ability to design and implement web enabled applications.
2. The student shall acquire the skill to design and develop web based applications with high usability, scalability and efficiency.
3. They shall be exposed to various technologies required to design web sites
4. They shall acquire the skill to choose the technology to use based on the requirements and functionality of the web site

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Basic PHP Concepts, PHP Operators, PHP Function, PHP Variables and Super globals. | Familiarity |
| CO2 | Conditional Statements, Looping Statements, Array, Cookies, PHP Form, PHP Session, File Upload, File Handling, User login and Registration. | Usage |
| CO3 | Database Connectivity, MySQL, MySQL connect, create DB/Table, Instructions such as select, where, order By, update and delete etc., encryption methods. | Familiarity |
| CO4 | Create and save an XML document at the server, which contains 10users information. Write a program which takes User Id as input and returns the user details by taking the user information from the XML document. | Assessment |
| CO5 | To get familiar with JavaScript, working with operators, Conditional Statements, looping statements, Alert Box, Confirm Box and Prompt Box, Functions, Array, event handler, regular expressions and modifiers, Cookie and form validations. | Assessment |
| CO6 | Validate the registration, user login, user profile and payment by credit card pages using JavaScript. | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Basic PHP Concepts, PHP Operators, PHP Function, PHP Variables and Super globals, | 6 |
| 2 | Conditional Statements, Looping Statements, Array, Cookies, PHP Form, PHP Session, File Upload, File Handling, User login and Registration | 6 |
| 3 | Database Connectivity, MySQL, MySQL connect, create DB/Table, Instructions such as select, where, order By, update and delete etc., encryption methods. | 6 |
| 4 | Project-To develops and implement, and demonstrate Database Driven Websites through a project that meet stated specifications. | 4 |
| 5 | Create and save an XML document at the server, which contains 10users information. Write a program which takes User Id as input and returns the user details by taking the user information from the XML document. | 6 |
| 6 | To get familiar with JavaScript, working with operators, Conditional Statements, | 6 |

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| | | |
|---|---|---|
| | looping statements, Alert Box, Confirm Box and Prompt Box, Functions, Array, event handler, regular expressions and modifiers, Cookie and form validations. | |
| 7 | Validate the registration, user login, user profile and payment by credit card pages using JavaScript. | 4 |
| 8 | Bean Assignments<br>a. Create a JavaBeans which gives the exchange value of INR (Indian Rupees) into equivalent American/Canadian/Australian Dollar value.<br>b. Create a simple Bean with a label which is the count of number of clicks. Then create a Bean info class such that only the count properly is visible in the property Window.<br>c. Create two Beans – a) Keypad b) Display pad. After that integrate the two Beans to make it work as a calculator.<br>d. Create two Beans Traffic Light (implemented as a label with only three background colors-red, green, yellow) and Automobile (Implemented as a Text Box which states its state/movement). The state of the Automobile should depend on the following Light Transition table | 8 |
| 9 | XML Concepts, XML Elements and Attributes, DTD and Schema, XML with CSS. | 4 |
| 10 | Install TOMCAT web server. Convert the static web pages of assignments 2 into dynamic web pages using servlets and cookies. Hint: User"s information (user id, password, credit card number) would be stored in web. Xml. Each user should have a separate shopping cart | 6 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. Web Enabled commercial Application development using HTML,DHTML, Java Script, Perl CGI" by Ivan Bayross, BPB Publication
2. "Internet and World Wide Web – How to Program" by Deitel, Deitel and Nieto ,Pearson Education Asia Publication
3. "PHP and MYSQL Manual" by Simon Stobart and Mike Vassileiou
4. "PHP and MYSQL Web Development" by Luke Welling and Laura Thomson(Pearson Education


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.4 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 2.4 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2.6 |
| CO6 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | 2.5 |
| Average | 3 | 3 | 3 | 2 | 2.7 | 2.8 | 2 | 2 | 2.5 | 3 | 1 | 3 | |

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# Computer Graphics

COURSE CODE: 18B11CI515

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisites:** Elementary Knowledge about the algorithms, programming, matrices and linear algebra is required

**Course Objectives:**

1. To learn and understand the basics of computer graphics applications and graphics devices
2. To learn and understand the geometric figure drawing algorithm on graphic device
3. To learn and understand the Two-Dimensional transformations
4. To learn and understand the Three-Dimensional transformations
5. To understand the concepts of solid modelling and representation
6. To learn about the Visible-Surface, Illumination and Shading

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO 1 | Student will learn about the overview of computer graphic applications and graphics devices (Display Technologies, Raster Refresh (Raster- Scan), CRT, LCD displays, etc.) | Familiarity |
| CO 2 | Student will learn about the scan conversion - lines, circles and Ellipses, filling, clipping and aliasing | Usage |
| CO 3 | Student will learn about the Two-Dimensional transformations and matrix representation of 2D Transformations (Translations, Rotation, Reflection, Scaling and Combined Transformation) and Window-to- Viewport transformations | Familiarity |
| CO 4 | Student will learn about the Three-Dimensional transformations and viewing in 3D | Assessment |
| CO 5 | Student will learn about the solid modelling: representing solids, regularized Boolean Set operations, primitive instancing, sweep representations, spatial-partitioning representations - Octree representation, B-Reps and Constructive Solid Geometry | Assessment |
| CO 6 | Student will learn about the visible surface detection, illumination and shading | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Computer Graphics: Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Colour CRT Raster Scan Basics, Video Basics, The Video Controller, Random-Scan Display Processor, LCD displays, Touch screen, Graphics Primitives. | 4 |
| 2 | Scan conversion – lines, circles and Ellipses; Filling polygons and clipping algorithms, Scan Converting Lines, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons, edge data structure, Clipping Lines algorithms– Cyrus-Beck, | 14 |



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| | | |
|---|---|---|
| | Cohen-<br>Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components | |
| 3 | Two-Dimensional Transformations: Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of The Unit Square, Solid Body Transformations, Rotation About an Arbitrary Point, Reflection through an Arbitrary Line,<br>A Geometric Interpretation of Homogeneous Coordinates, The Window- to-Viewport Transformations | 6 |
| 4 | Three-Dimensional Transformations and Viewing in 3D: Introduction, Three-Dimensional Scaling, Three-Dimensional Shearing, Three- Dimensional Rotation, Three-Dimensional Reflection, Three- Dimensional Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, Affine and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, the Perspective Geometry and camera models, Orthographic Projections, Axonometric Projections, Oblique<br>Projections, View volumes for projections. | 10 |
| 5 | Solid Modelling: Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Spatial- Partitioning Representations: Octree representation, B-Reps,<br>Constructive Solid Geometry, Comparison of Representations | 3 |
| 6 | Visible-Surface Determination: Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter''s algorithms (depth sorting), Area<br>sub-division method, BSP trees, Visible-Surface Ray Tracing, | 3 |
| | comparison of the methods | |
| 7 | Illumination and Shading: Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenuation, Phong''s model, Gouraud<br>shading, some examples. | 2 |
| 8 | Image Manipulation and Storage: What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization,<br>smoothing and median Filtering. | **Self- Learning** |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. Hearn Donald & Baker, M. Pauline (1990). "Computer Graphics – C Version" Prentice Hall of India Pvt. Ltd.

**Suggested Reference Book(s):**

1. Foley, J.D. & Dam, A. Van (1982), "Fundamentals of Interective Computer Graphics", Addison-Wesley
2. Harrington, S. (1983). "Computer Graphics: A Programming Approach"" Mc-Graw Hill Book Co.

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |

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| | | | | |
|---|---|---|---|---|
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Sr. No. | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | **1.8** |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 3 | 3 | **2.6** |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 3 | 3 | **2.3** |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 1 | 3 | 3 | **2.5** |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | **1.9** |
| CO-6 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | **1.9** |
| Average | **2.5** | **2.5** | **2.5** | **2.5** | **2.5** | **1.7** | **1.7** | **1** | **2.5** | **1.7** | **2.5** | **2.5** | |

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# Formal Languages and Automata

COURSE CODE: 18B11CI513

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisites:** Graduate level courses in C programming, algorithms and complexity of algorithms are desirable.

**Course Objectives:**

1. To introduce the students to the mathematical foundations of computation including automata theory
2. To introduce the students about the theory of formal languages and grammars
3. To introduce the students about the theory of Automata which includes Finite Automata, Push down Automata and Turing Machines
4. To introduce the students about the notions of algorithm, decidability
5. To introduce the students about the Complexity and computability

**Course Outcome (CO):**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Broaden knowledge of the fundamental mathematical and computational principles that are the foundation of computer science | Familiarity |
| CO-2 | Understand the concept of Deterministic Finite Automata and Non-Deterministic Finite Automata | Usage |
| CO-3 | Understand how to minimize the states, usage Moore and Mealy Machine | Assessment |
| CO-4 | Understand how to use the context free grammars in languages and how to derive parse trees and solve ambiguity problems | Assessment |
| CO-5 | Understand Normal forms for Context Free Grammar"s Chomsky and Greibach Normal Forms | Assessment |
| CO-6 | Understand the Push Down Automaton algorithm | Assessment |
| CO-7 | Understand how the push down automata will accept arbitrary context free languages. To understand the properties of CFG To understand the determinism and parsing. To understand different parsing methodologies | Assessment |
| CO-8 | Understand the basic concepts of Turing Machine, configuration of Turing Machine, computing with the Turing Machine | Usage |
| CO-9 | Understand multiple tapes, two way infinite tape concepts, the real computers random access memories working, concept of non-deterministic Turing machines | Assessment |
| CO-10 | Understand the computational power of languages, numerical functions applied to Turing machines, numerical functions applied to Turing machines, various mathematical models applied to Turing machines, the concept of halting problem, undecidable problems about Turing machines and grammars, properties of recursive languages, concept of polynomial decidable | Assessment |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction &Motivation, Infinite Sets, Closures, Alphabets, Languages & Representation | 3 |
| 2 | Deterministic finite automata, Non-Deterministic finite automata, Closure Properties & Equivalences, State Minimization, Moore and Mealy Machine | 6 |
| 3 | Formal Languages, Regularity, Regular Grammars, Regular Expressions and Finite Automata | 6 |
| 4 | Context Free Grammars, Parse Trees & Ambiguity, Chomsky and Greibach Normal forms | 8 |
| 5 | Push Down Automata, Equivalence of PDA and CFG, Properties of context free languages, Determinism & Parsing DCFG, Top-down & Bottom-up Parsing | 6 |
| 6 | Turing Machine-Introduction, Notations, Recursive and Recursively Enumerable Language, Extensions of Turing machines, Non-deterministic Turing machines, Primitive Recursive Functions, Mu-recursive functions | 8 |
| 7 | Church-Turing Thesis & Universal Turing machines, Halting problem, Undecidable problems, Properties of Recursive languages | 2 |
| 8 | The Complexity Class P, Satisfiability, The Complexity Class NP, NP Completeness and Reducibility NP complete problems, Cook's Theorem, NP Complete Problems | 3 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Elements of the Theory of Computation. Harry Lewis, Christos Papadimitriou, Second Edition, Pearson Education, 1998

2. Theory of computer Science: Automata, Language and Computation - KLP Mishra N Chandra Sekhran - PHI, 3rd edn.

**Suggested Reference Book(s):**

1. Formal Languages and Automata- Peter Linz , Narosa Pub. 4th edn.
2. M. Sipser, Introduction to the Theory of Computation, Thomson Asia, 1997.
3. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Pearson, 2001.

4. D. C. Kozen, Automata and Computability, Springer-Verlag, 1997.

**Other useful resource(s):**

1. https://nptel.ac.in/courses/111103016/
2. Link to topics related to course:
   - i. https://ocw.mit.edu/courses/mathematics/18-404j-theory-of-computation-fall-2006/
   - ii. http://www.aduni.org/courses/theory/
   - iii. http://www.cse.iitd.ernet.in/~sak/courses/toc/
   - iv. http://cse.iitkgp.ac.in/~abhij/course/theory/FLAT/Spring13/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |

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| | | | | |
|---|---|---|---|---|
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Formal Languages and Automata) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.2** |
| **CO-2** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | **2.5** |
| **CO-3** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | **2.5** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | **2.4** |
| **CO-5** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | **2.1** |
| **CO-6** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | **2.6** |
| **CO-7** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | **2.6** |
| **CO-8** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | **2.7** |
| **CO-9** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | **2.7** |
| **CO-10** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | **2.7** |
| **Average** | **3** | **2.9** | **2.9** | **2.2** | **2** | **2.8** | **2.8** | **2.5** | **1.7** | **2.8** | **2.5** | **1.7** | |

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# Computer Organization and Architecture

COURSE CODE: 18B11CI514
COURSE CREDIT: 3
CORE/ELECTIVE: CORE
L-T-P: 3-0-0

**Pre-requisites:** Basic Understanding of Computer System

**Course Objectives:**

1. To calculate the performance of a modern digital computer from parameters such as processor speed, cycles per instruction.
2. To understand the fixed-point and floating-point numbers are represented in a computer.
3. Discuss about pipelining in a processor functions and describe how hazards are resolved in various ways.
4. Wide understanding of memory organization and management in a modern digital computer, including virtual and physical memory, address translation, multilevel, unified, and multi-way set-associative caches, the translation-look-aside buffer (TLB), and the page table.
5. To understand the working strategies of parallel processing and multi-core computers.

**Course Outcomes:**

| S. No | Course Outcome (Computer Organization & Architechture) | Level of Attainment |
|---|---|---|
| CO-1 | To learn the basic concepts, terminology and evolution in computer organization and architecture | Familiarity |
| CO-2 | Understanding the computer architecture and computer arithmetic. | Assessment |
| CO-3 | Understanding of the computer memory and the issues related to memory. | Assessment |
| CO-4 | Understanding the concept of memory I/O, interrupt handling and DMA. | Assessment |
| CO-5 | Learn the organization of Processor and the concept of pipelining. | Assessment |
| CO-6 | Learning concepts of Parallel processing and related issues. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Basic Structure of Computers: Functional units:** Basic operational concepts – Bus structures – Performance and metrics – Instructions and instruction sequencing – Hardware – Software Interface – Instruction set architecture – Addressing modes – RISC – CISC. | 7 |
| 2 | **Basic Processing Unit of Computers:** ALU design – Integer Representation, floating point and its Arithmetic. Interconnection Structure, Bus interconnection Structure, point to point interconnection PCI express structure. | 7 |
| 3 | **Computer Memory:** Cache Memory: Overview of computer Memory, Cache memory principles and its elements to design P-4 Cache organization. | 6 |
| 4 | **Internal and External Memory:** Semiconductor Memory: Semiconductor Main Memory, Error correction. External Memory: Magnetic Disk and Tape, RAID, SSD, Optical Memory. | |
| 5 | **Input/output:** Access of I/O devices, I/O ports, I/O control mechanisms - Program controlled I/O Interrupt controlled I/O and DMA controlled I/O I/O interfaces Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces - Serial port, | 6 |

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| | | |
|---|---|---|
| | Parallel port, PCI bus, SCSI bus, USB bus | |
| 6 | **Central Processing Unit:** Processor Structure and Functions: Processor structure, register organization, instruction cycle and pipelining. | 4 |
| 7 | **Instruction level Parallelism:** Overviews, design issues, vector processing | 3 |
| 8 | **Parallel Processing:** Multiple Processor Organization, Symmetric Multi-processors, cache coherence, multithreading, clusters, non- uniform memory access, and vector computation. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. William Stallings, Computer Organization & Architecture - Designing for Performance Eighth Edition, Pearson, 2010. ISBN 978-81-317-3245-8.
2. M. Morris Mano, Computer System Architecture, Pearson.

**Suggested Reference Book(s):**

1. John L. Hennessy and David A. Patterson ,Computer Architecture: A Quantitative Approach, Fourth Edition, Morgan Kaufmann Publishers
2. M. Morris Mano , Computer System Architecture, Third Edition, Pearson Education Inc
3. Luiz Andre Barroso and Urs Holzle;The Datacenter as a Computer – An Introduction to the Design of Warehouse Scale Machines Morgan and Claypool Publishers

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/syllabus/106103068/
2. Link to topics related to course: https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs):**

| Course Outcomes (Computer Organization and Architecture) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1.8 |
| CO-2 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2.3 |
| CO-3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.3 |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2.4 |
| CO-5 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2.4 |
| CO-6 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 2.2 |
| Average | 3 | 2.3 | 2.5 | 2.5 | 2 | 2.5 | 2 | 1.8 | 2.5 | 1.7 | 1.8 | 2 | |

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# Computer Graphics Lab

COURSE CODE: 18B17CI575
COURSE CREDITS: 2
CORE/ELECTIVE: CORE
: 0-0-4

**Pre-requisite: None**

**Course Objectives:**

1. Using OpenGL for Graphics
2. Programming User-interface issues
3. Concepts of 2D & 3D object representation
4. Implementation of various scan & clipping algorithms
5. 2D modelling
6. Implementation of illumination model for rendering 3D objects
7. Visibility detection & 3D viewing
8. Implementation of a project based on learned concepts.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Using OpenGL for Graphics | Familiarity |
| CO-2 | Programming User-Interface Issues | Assessment |
| CO-3 | Concepts of 2D & 3D object representation | Assessment |
| CO-4 | Implementation of various scan and clipping algorithms | Assessment |
| CO-5 | 2 D Modelling | Assessment |
| CO-6 | Implementation of a project using learned models | Usage |

**List of Experiments:**

| S. No | Description | Hours |
|---|---|---|
| 1 | Basics of OpenGL: Draw a line, rectangle and pentagon | 2 |
| 2 | Implement DDA Line Algorithm | 2 |
| 3 | Implement Bresenham"s Line drawing Algorithm | 2 |
| 4 | Implement Bresenham"s Circle drawing Algorithm | 2 |
| 5 | Implement Bresenham"s Ellipse drawing Algorithm | 2 |
| 6 | Implement Boundary Fill Algorithm | 2 |
| 7 | Implement Flood Fill Algorithm | 2 |
| 8 | Implement Cohen Sutherland Line clipping algorithm | 2 |
| 9 | Implement Liang Barsky Line clipping algorithm | 2 |
| 10 | Implement Sutherland-Hodgman polygon clipping algorithm | 2 |
| 11 | Implement Nicholl-Lee-Nicholl Line clipping algorithm | 2 |
| 12 | Implement Weiler-Atherton polygon clipping algorithm | 2 |
| 13 | MID SEM TEST | 2 |
| 14 | Implement 2D Translation Transformation | 2 |
| 15 | Implement 2D Rotation Transformation | 2 |
| 16 | Implement 2D Scaling Transformation | 2 |
| 17 | Implement 2D Shear Transformation | 2 |
| 18 | Implement 3D Translation Transformation | 2 |
| 19 | Implement 3D Rotation Transformation | 2 |

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| | | |
|---|---|---|
| 20 | Implement 3D Scaling Transformation | 2 |
| 21 | Group Project | 2 |
| 22 | Group Project | 2 |
| 23 | Group Project | 2 |
| 24 | Group Project | 2 |
| 25 | Group Project | 2 |
| 26 | Group Project | 2 |
| 27 | Group Project | 2 |
| 28 | END SEM TEST | 2 |
| **Total Lab Hours** | | **56** |

**Minor Project(s) – (*Only for 2 credit lab)***

1. Interactive 3D maze
2. Scene Recreation
3. Real-time rendering Technology

**Suggested Books/Resources:**


1. Donald Hearn and M. Pauline Baker. "Computer Graphics with OPENGL" 3rd Edition Pearson Publishers, 2011.
2. James D. Foley, Van Adams, K.Fenier and F. Hughes, "Computer Graphics-Principle and Practices", 3rd Edition Pearson Publishers, 2002.
3. Harrington, S. "Computer Graphics: A Programming Approach" Mc-Graw Hill Book Co.


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.4** |
| **CO-2** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **CO-3** | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | **2.4** |
| **CO-4** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-5** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-6** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **Average** | **3** | **3** | **3** | **2** | **2.7** | **2.8** | **2** | **2** | **2.5** | **3** | **1** | **3** | |

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# Computer Organization and Architecture Lab

COURSE CODE: 18B17CI574
COURSE CREDITS: 1
CORE/ELECTIVE: CORE
: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. To get familiar with the working scenario of logic gates.
2. Understanding the way in which arithmetic operations are done.
3. Structure of ALU and its Design
4. Understanding of Memory Design and its issues

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Ability to understand basic structure of computer. | Assessment |
| CO-2 | Ability to perform arithmetic operations on computer. | Assessment |
| CO-3 | Ability to understand the memory concepts including Cache. | Assessment |
| CO-4 | Familiarity with CPU design. | Familiarity |

**List of Experiments:**

| S. No | Description | Lab Hours |
|---|---|---|
| 1 | To Study And Verify The Truth Table Of Logic Gates | 2 |
| 2 | Realization Of A Boolean Function | 2 |
| 3 | Adders And Subtractors | 2 |
| 4 | Multiplexer And Demultiplexer | 2 |
| 5 | Registers and Counters | 2 |
| 6 | Booth"s Multiplier | 2 |
| 7 | Design Of ALU | 4 |
| 8 | Memory Design | 4 |
| 9 | Associative Cache Design | 4 |
| 10 | Direct Mapped Cache Design | 2 |
| 11 | CPU Design | 2 |
| **Total Lab Hours** | | **28** |

**Suggested/Resources:**


1. Computer Organization & Design: The Hardware/Software Interface - David Patterson and John Hennessey.
2. William Stallings, Computer Organization & Architecture - Designing for Performance Eighth Edition, Pearson, 2010. ISBN 978-81-317-3245-8.
3. Dr. M. Usha, T. S. Srikanth, "Computer System Architecture and Organization",First Edition, Wiley-India.
4. "Computer Organization" by ISRD Group, Tata McGraw-Hill
5. Link to topics related to course:
   i. http://cse10-iitkgp.virtual-labs.ac.in/index.html


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**Course Outcomes (COs) contribution to the Programme Outcomes (POs):**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2.2 |
| CO-2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2.3 |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2.4 |
| CO-4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2.3 |
| Average | 3 | 2.8 | 2.5 | 2 | 2 | 2.5 | 2.5 | 2 | 2.3 | 2 | 2 | 2 | |

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# Multimedia Lab

COURSE CODE: 18B1WCI575
COURSE CREDITS: 1
CORE/ELECTIVE: CORE
: 0-0-2

**Pre-requisite: None**

**Lab Course Objectives:** This course focuses on the development of applications that manipulate media assets. Significant time is spent on intermediate to advanced programming and scripting as well as the synchronization of aural and graphical components. Students are requited to plan, design and implement lab projects.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn how to design and develop multimedia for real world e-learning. | Familiarity |
| CO-2 | To learn how to implement multimedia e-leaning in Macromedia Flash. | Assessment |
| CO-3 | Students will learn to create multi-user multimedia applications. | Assessment |
| CO-4 | Students will learn to create a 3D multimedia application. | Assessment |
| CO-5 | Students will learn to write interactive programs on the Android. | Assessment |
| CO-6 | Students will learn to analyze and design's to interact with other apps on the device | Usage |

**List of Experiments:**

| S. No | Description | Hours |
|---|---|---|
| 1 | Write a program to justify a text entered by the user on both left and right hand side. for example the test " An architect may have a graphics program to draw an entire building but be interested in only ground floor", can be justified in 30 columns. An architect may have a graphics programs draw an entire building but interested in ground floor. | 2 |
| 2 | Study the notes of a piano and stimulate them using the keyboard and store them in file. | 1 |
| 3 | Write a program to read a paragraph and store it to a file name suggested by the author. Devise a routine to produce the animation effect of a square transforming to a triangle and then to a circle | 2 |
| 4 | To implement text and image compression algorithms: Huffman coding, Lempel-Ziv algorithm, Lempel–Ziv–Markov chain algorithm (LZMA), run length encoding, entropy encoding, area image compression, DPCM and predictive coding | 3 |
| 5 | Write a program to show a bitmap image on your computer screen. | 2 |
| 6 | Create a web page for a clothing company which contains all the details of that company and at least five links to other web pages. | 2 |
| 7 | Write a program by which we can split mpeg video into smaller pieces for the purpose of sending it over the web or by small capacity floppy diskettes and then joining them at the destination. | 4 |
| 8 | Write a program to simulate the game of pool table. | 4 |
| 9 | Write a program to simulate the game mine sweeper. | 4 |
| 10 | Write a program to play "wave" or "midi" format sound files. | 4 |

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| | |
|---|---|
| **Total Lab Hours** | **28** |

**Suggested/Resources:**


1. Flash MX Action Script Programming, Robert Reinhardt and Joey Lott, Wiley.
2. Flash 5 Magic with Action Script, J. Scott Hamlin and David J. Emberton, Techmedia
3. Beginning Android Application Development, Wei-Meng Lee, paperback
4. An introduction, Villamil & Molina, Multimedia Mc Milan, 1997
5. Multimedia: Sound & Video, Lozano, 1997, PHI, (Que)
6. Multimedia: Production, planning and delivery, Villamil & Molina,Que, 1997
7. Multimedia on the PC, Sinclair,BPB
8. Multimedia: Making it work, Tay Vaughan, fifth edition, 1994, TMH.
9. Multimedia in Action by James E Shuman, 1997, Wadsworth Publ.,
10. Multimedia in Practice by Jeff coate Judith, 1995,PHI.
11. Multimedia Systems by Koegel, AWL
12. Multimedia making it Work by Vaughar, etl.
13. Multimedia Systems by John .F. Koegel, 2001, Buford.
14. Multimedia Communications by Halsall & Fred, 2001,AW
15. Link to topics related to course:
    a. https://nptel.ac.in/courses/117105083/


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO1 1 | PO1 2 | Avera ge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | | 2 | 1 | 1 | 1.5 |
| CO2 | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO3 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| CO6 | 1 | 1 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 |
| Average | 1.2 | 1 | 1 | 1.3 | 1 | 1.2 | 1.2 | 1 | 1 | 1.2 | 1 | 1 | |

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# Compiler Design

COURSE CODE: 18B11CI612

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisites:** Perquisite for this course is programming languages like C, C++, java and basic knowledge of formal language and automata theory. This is a programming-intensive course. The primary languages used are C and Java and familiarity with them is assumed.

**Course Objectives:**

1. To understand the basic concept of compilation particular, lexical analyzer, syntax and semantic analysis, code generation and optimization phases of compilation.
2. Ability to create lexical rules and grammars for a programming language.
3. Ability to use flex or similar tools to create a lexical analyzer and Yacc/Biscon tools to create a parser
4. Ability to implement a various parser such as a bottom-up SLR parser without using any compiler-generation tools
5. Ability to implement a various intermediate code generation techniques without using any compiler generation tools
6. Ability to implement various code optimizing techniques without using any compiler-generation tools
7. Ability to implement semantic rules into a parser that performs attribution while parsing
8. Ability to design a compiler for a concise programming language.

**Course Outcomes**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand the basic concept of compilation particular, lexical analyzer, syntax and semantic analysis, code generation and optimization phases of compilation | Familiarity |
| CO-2 | Ability to create lexical rules and grammars for a programming language | Familiarity |
| CO-3 | Ability to use flex or similar tools to create a lexical analyzer and Yacc/Biscon tools to create a parser | Computational skills |
| CO-4 | Ability to implement a various parser such as a bottom-up SLR parser without using any compiler-generation tools | Technical skills |
| CO-5 | Ability to implement a various intermediate code generation techniques without using any compiler generation tools | Technical skills |
| CO-6 | Ability to implement various code optimizing techniques without using any compiler-generation tools | Technical skills |
| CO-7 | Ability to implement semantic rules into a parser that performs attribution while parsing | Assessment |
| CO-8 | Ability to design a compiler for a concise programming language | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Compilers, Analysis of Source Program, Phases of Compiler, Issues in a Compiler Structure, Major Data Structures in Compiler, Bootstrapping and Porting | 3 |
| | **Lexical Analysis:** Role of the Lexical Analyzer, Scanning Process- Input Buffering, Specification of Tokens, Recognition of Tokens, Regular Language, | |

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|---|---|---|
| 2 | Finite Automata, Regular Expression, Regular Expression to Finite automata, Scanner Generator (lex, flex) | 4 |
| 3 | **Syntax Analysis:** Parsing Process, Context-Free Grammar, Handle, Ambiguity, Parse Tree, Push-Down Automata , Top Down Parsing: Basic Concept, Recursive Descent Parsing, First Function, Follow Function, Conflicts-Shift Reduce, Reduce-Reduce, LL(1) Grammar, LL(1) Parser, Error Recovery, Bottom up parsing :Basic Concept, Shift Reduce Parsing, Operator Grammar, Operator Precedence Parsing, Augmented Grammar, LR(0) Item Set, LR(0) Parsing, LR(1) Item Set, SLR(1) Parsing, Canonical LR Parser, LALR parsing, Error Recovery, YACC and BISON | 12 |
| 4 | **Semantic Analysis:** Syntax-Direct Definitions, Implementation of Syntax-directed Translators, Bottom-up Evaluation of S-attributed Definitions, L-attributed Definitions, and Top-down Translation | 5 |
| 5 | **Intermediate Code Generation:** Postfix Notation, Parse Trees & Syntax Trees, Three Address Code, Quadruple & Triples, Translation of Assignment Statements, Boolean Expressions, Statements That Alter Flow of Control, Postfix Translation, Array References in Arithmetic Expressions, Procedures Call, Declarations and Case Statements | 5 |
| 6 | **Code Generation: Issues** in the design of a Code Generator, Target Machine, Run-Time Storage Management, Basic blocks and Flow graphs | 4 |
| 7 | **Code Optimization:** Machine-Independent Optimizations, Machine Dependent Optimization, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis | 5 |
| 8 | **Run-time environment and Symbol:** Procedure activation, parameter passing, value return, memory allocation, and scope, Symbol Table, Definition, Structure, Types, symbol attributes and management | 4 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. Compilers: Principles, Techniques, and Tools by Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, Pearson Publisher
2. Compiler Construction, Kenneth C. Louden, 582 pages
3. Modern Compiler Implementation in C, Andrew W. Appel, 544 pages

**Suggested Reference Book(s):**

1. http://ecomputernotes.com/compiler-design
2. http://www.diku.dk/~torbenm/Basics/basics_lulu2.pdf

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Compiler Design) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.1** |
| **CO-2** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | **2.3** |
| **CO-3** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | **2.2** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **2.3** |
| **CO-5** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | **2.2** |
| **CO-6** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | **2.6** |
| **CO-7** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | **2.5** |
| **CO-8** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | **2.6** |
| **Average** | **3** | **2.9** | **2.6** | **2** | **1.9** | **2.6** | **2.8** | **1.6** | **1.9** | **2.6** | **2.4** | **1.6** | |

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# Computer Networks

COURSE CODE: 18B11CI611

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisites:** None

**Course Objectives:**

1. The course introduces the concepts and fundamental design principles of modern computer networking, focusing on the Internet''s architecture and protocols.
2. The course introduces the concepts of data and computer communications, computer network introduction and its applications in our real life.
3. Reference models such as OSI and TCP/IP and its way toward the physical layer concepts, data link layer and its protocols, multiple access protocols.
4. Provide students Network layer and its different routing protocols, the concepts/design of IP addressing.
5. To provide students Transport layer and its protocols such as TCP, UDP and SCTP to application layer and its protocol such as HTTP, FTP, SMTP and DNS.

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the basic concepts and terminology in computer networks | Familiarity |
| CO-2 | To learn about the layered models in computer networks and different types of network topologies and protocols | Assessment |
| CO-3 | To learn about the data link layer and MAC layer protocols and related issues | Assessment |
| CO-4 | To learn concepts associated with subnetting and routing mechanisms. Understand network industry standards such as: Routing Protocols, Address Resolution and Reverse Address Resolution Protocols, IP Addresses and Subnetting, MAC Addressing. | Assessment |
| CO-5 | To learn about the transport layer protocols and related issues | Assessment |
| CO-6 | You will learn about the session, presentation and application layers protocols. | Usage |
| CO-7 | Further, to learn about the some advanced topics in networks such as Cryptographic algorithms, Network security and management, and concepts of wireless networks | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Computer Networks**: Network Software Architecture: layers and protocols, OSI vs. TCP, Network Model, Connection Oriented and Connectionless services, Network Topology, Delay. | 4 |
| 2 | **Physical Layer:** Transmission Terminology, Analog and Digital Signal, Transmission Impairments, Transmission Media, Modulation, Switching Techniques, Multiplexing Techniques | 8 |

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| | | |
|---|---|---|
| 3 | **Data Link Layer:** Introduction and services to Data Link layer, Error detection and Correction techniques, Bit and Byte stuffing, Bit/Byte oriented protocol, Flow Control Mechanism, Multiple access protocol, Ethernet, Hubs and switches, Router and Gateways. | 8 |
| 4 | **Network Layer:** Network service model, Virtual circuit and Datagram networks, Logical Addressing and Sub-netting, Internet protocol: IPv4 and IPv6, ARP vs RARP, DHCP, Routing algorithms and standards, Internetworking, The network layer in the internet, Broadcast and multicast routing, Congestion Control Algorithms, | 8 |
| 5 | **Transport Layer:** Transport layer services and principles, End-to-end protocols: Issues and services, Multiplexing and De-multiplexing, Connectionless transport: UDP, Principles of reliable data transfer, Connection-oriented Transport: TCP, SCTP, Principles of congestion control, TCP Congestion Control, Quality of services. | 8 |
| 6 | **Application Layer:** Principle of application layer protocols, WWW and HTTP, FTP, Telnet, SMTP, DNS etc. | 3 |
| 7 | **Some Advanced Topics:** Symmetric-key algorithms, Public key algorithms, RSA, Digital Signatures, Communication security, authentication protocols, Web security, Wireless LAN, Mobile IP, Introduction to Multimedia networking, Network management. | 3 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Andrew S. Tanenbaum, "Computer Networks" 4th Edition PHI
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet" 3rd Edition Pearson Education

**Suggested Reference Book(s):**

1. UNIX Network Programming, Volume 1, Second Edition: Networking APIs: Sockets and XTI, Prentice Hall, 1998, ISBN 0-13-490012-X.
2. Arnold Robbins, "UNIX in a Nutshell", O''Reilly 4th Edition
3. David I. Schawartz, "Introduction to UNIX", Prentice Hall, Second Edition
4. BEHROUZ a. Forouzan and Richard F. Gilberg, "UNIX and Shell Programming: A Textbook"
5. NS Simulator for Beginner"s, Lecture notes Univ. de Los Andes, France.
6. Angela Orebaugh, Gilbert Ramirez,Josh Burke, Larry Pesce, Joshua Wright, Greg Morris, "Wireshark & Ethereal Network Protocol Analyzer Toolkit", Syngress Publishing, Inc.

**Other useful resource(s):**

3. Link to topics related to course:
   i. https://www.coursera.org/specializations/networking-basics
   ii. https://nptel.ac.in/courses/106105080/
   iii. https://swayam.gov.in/course/4066-computer-networks

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

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## Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Computer Networks) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.4** |
| **CO-2** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **CO-3** | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | **2.4** |
| **CO-4** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-5** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | **2.6** |
| **CO-6** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **CO-7** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | **2.5** |
| **Average** | **3** | **3** | **3** | **2** | **2.6** | **2.9** | **2.1** | **2** | **2.4** | **3** | **1** | **3** | |

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# Compiler Design Lab

COURSE CODE: 18B17CI672

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** An understanding in Theory of computation, Introduction to any programming language (Preferably, C)

**Course Objectives:**

1. The lab course provides the complete description about inner working of a compiler.
2. The main focus is on the design of compilers and optimization techniques.
3. The course also aims to convey the language specifications, use of regular expressions and context free grammars behind the design of compiler.
4. It builds an understand ability of various parsing techniques like predictive parsing, LR parsing, LALR parsing. It also focuses on the design of Compiler writing tools.

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Gain an in-depth understanding of the principles underlying the design | Familiarity |
| CO-2 | Construction of compilers | Familiarity |
| CO-3 | Functioning of Compiler writing tools | Computational skills |
| CO-4 | Building various parsing techniques | Technical skills |

**List of Experiments:**

| S. No. | Description | Hours |
|---|---|---|
| 1 | a. Write a program to read and translate integers into numbers.<br>e.g. 1=ONE 12 =<br>ONE TWO<br>856 = EIGHT FIVE SIX<br>Generate an error if the number of digits is more than 3<br>b. Write a program to convert infix notation to postfix notation. | 4 |
| 2 | 1. Implement a DFA which simulates the regular expression a + (aa)*b.<br>2. The following rules define the translation of an English word into pig Latin:<br>a) If the word begins with a nonempty string of consonants, move the initial consonant string to the back of the word and add the suffix AY; e.g., pig comes igpay.<br>b) If the word begins with a vowel, add the suffix YAY; e.g., owl becomes owlyay.<br>c) U following a Q is a consonant. | 8 |

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|---|---|---|
| | d) Y at the beginning of a word is a vowel if it is not followed by a vowel.<br>e) One-letter words are not changed.<br>Write a C program to generate pigLatin from an English word. | |
| 3 | Implementation of Lexical analysis | 4 |
| 4 | Program for computation of FIRST AND FOLLOW of non-terminals. | 4 |
| 5 | Write a program to check whether a grammar is left recursive or not, if it is remove left recursion. | 4 |
| 6. | Implementation of Predictive Parsing Table Construction | 6 |
| 7. | Implementation of Shift Reduce Parsing | 6 |
| 8. | Implementation of Operator Precedence Parsing | 6 |
| 9. | Implementation of LR Parsing | 4 |
| 10 | Intermediate Code Generation | 4 |
| 11 | Implementation of Code Generation | 4 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**

1. Compilers : Principles, techniques and tools, Aho, Sethi and Ullman
2. Compiler design in C, Holub
3. Advanced compiler design and implementation, Muchnick, Morgan and Kauffman

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.1** |
| **CO-2** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | **2.3** |
| **CO-3** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | **2.3** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **2.3** |
| **Average** | **3** | **2.8** | **2.3** | **1.3** | **1.8** | **2.5** | **2.8** | **1.5** | **2.3** | **2.5** | **2.5** | **1.5** | |

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# Computer Networks Lab

COURSE CODE: 18B17CI671

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

**Pre-requisite:** None

**Course Objectives:**

1. To implement important computer networking protocols in a high – level programming language.
2. To understand the working principle of various communication protocols.
3. To analyze the various routing algorithms.
4. To know the concept of data transfer between nodes.
5. To become acquainted with socket programming and some of the important computer networking tools.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand the working concepts of Networking and inter – networking Devices. | Familiarity |
| CO-2 | To understand the concepts of different shortest path algorithms. | Assessment |
| CO-3 | To understand different error detection and correction techniques/algorithms. | Assessment |
| CO-4 | To understand Flow control techniques/algorithms. | Assessment |
| CO-5 | To understand the concepts of client – server interaction using connection oriented and connectionless protocols. | Assessment |
| CO-6 | To understand the proficiency in Traffic Shaping Algorithms. | Usage |
| CO-7 | You shall be exposed to working of encryption and decryption algorithms. | Familiarity |

**List of Experiments:**

| S. No. | Description | Hours |
|---|---|---|
| 1 | Representation of a computer network using matrix representation of a graph | 4 |
| 2 | Finding shortest path between any two nodes in a computer network using Dikjstra"s shortest path algorithm | 4 |
| 3 | Finding shortest path between any two nodes in a computer network using Prim"s shortest path algorithm | 4 |
| 4 | Study of network troubleshooting using Ping and Traceroute commands | 4 |
| 5 | Study of various networking and inter – networking devices | 4 |
| 6 | Implementation of CRC generator and checker algorithm in C / C++ / Java | 4 |
| 7 | Implementation of Hamming code algorithm in C / C++ / Java | 4 |
| 8 | Study of client – server programming using sockets in a UNIX / Linux and Windows environment | 4 |
| 9 | Implementing client – server program using TCP / UDP sockets | 4 |
| 10 | Implementation of Stop – and – Wait protocol in C / C++ / Java in a client – server environment using sockets | 4 |
| 11 | Implementation of Sliding Window protocol in C / C++ / Java in a client – server environment using sockets | 4 |

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| | | |
|---|---|---|
| 12 | Implementation of encryption algorithm converting plain text to cipher text using C / C++ / Java | 4 |
| 13 | Design and implement Traffic Shaping Algorithms:<br>a. Leaky Bucket<br>b. Token Bucket | 4 |
| 14 | Implementation of chat system | 4 |
| 15 | Allocation of Mini projects | 4 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**


1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet" 3rd Edition Pearson Education
2. Andrew S. Tanenbaum, "Computer Networks" 4th Edition PHI
3. UNIX Network Programming, Volume 1, Second Edition: Networking APIs: Sockets and XTI, Prentice Hall, 1998, ISBN 0-13-490012-X.
4. Arnold Robbins, "UNIX in a Nutshell", O''Reilly 4th Edition
5. David I. Schawartz, "Introduction to UNIX", Prentice Hall, Second Edition
6. BEHROUZ a. Forouzan and Richard F. Gilberg, "UNIX and Shell Programming: A Textbook"
7. NS Simulator for Beginner''s, Lecture notes Univ. de Los Andes, France.
8. Link to topics related to course:
   i. https://www.coursera.org/specializations/networking-basics
   ii. https://nptel.ac.in/courses/106105080/
   iii. https://swayam.gov.in/course/4066-computer-networks


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 3 | 2.5 |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | | 1 | 2 | 1.6 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 2.2 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | | 2 | 2 | 1.8 |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1.9 |
| CO-6 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| CO-7 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Average | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 1.7 | 1 | 1.6 | 2.3 | 2 | 1.6 | 2.3 | |

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# Python Programming with Raspberry PI

COURSE CODE: 18B11CI315

COURSE CREDITS: 3

: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

Raspberry Pi chose Python as its teaching language of choice to encourage a new generation of programmers to learn how to program. This approachable book serves as an ideal resource for anyone wanting to use Raspberry Pi to learn to program and helps you get started with the Python programming language. Aimed at first-time developers with no prior programming language assumed, this beginner book gets you up and running.

1. Covers variables, loops, and functions
2. Addresses 3D graphics programming
3. Walks you through programming Mine craft
4. Zeroes in on Python for scripting.

**Course Outcomes:**

| S.No. | Course outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introducing Raspberry pi: what is programming, why raspberry pi, introducing the raspberry pi | Familiarity |
| CO-2 | Introducing Python: Scripting vs. a Programming Language, The Python Philosophy, Getting Started with Python, Python basics, Programming with Python | Assessment |
| CO-3 | Graphical Programming: Graphical User Interface (GUI) Programming, Adding Controls, Creating a Web Browser, Adding Window Menus, the web bolt, Calculating the Distance of the Point from the Light Source. | Assessment |
| CO-4 | Creating games: building a game, installing Pi game, creating a worlds, detecting collisions, adding sound, adding scenery, adding the finishing touches, realistic game physics, Calculating Reflecting Angles, Building the 3D Model, Speaking to Your Pi. | Usage |
| CO-5 | Networked Python: Understanding Hosts, Ports, and Sockets, Locating Computers with IP Addresses, Building a Chat Server, Tweeting to the World. | Familiarity |
| CO-6 | Multimedia: Using Pi Audio to Get Sound into Your Computer, Recording the Sound, Speaking to Your Pi, Making Movies, Adding Computer Vision Features with Open CV, Creating Live Streams. | Usage |

**Course Contents:**

| Unit | Contents | Lecture required |
|---|---|---|
| 1 | Introduction: what is programming, why raspberry pi, introducing the raspberry pi | 3 |
| 2 | Introducing Python: Scripting vs. a Programming Language, The Python Philosophy, Getting Started with Python, Python basics, Programming with Python | 9 |

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| | | |
|---|---|---|
| **3** | Graphical Programming: Graphical User Interface (GUI) Programming, Adding Controls, Creating a Web Browser, Adding Window Menus, the web bolt, Calculating the Distance of the Point from the Light Source. | **9** |
| **4** | Creating games: building a game, installing Pi game, creating a worlds, detecting collisions, adding sound, adding scenery, adding the finishing touches, realistic game physics, Calculating Reflecting Angles, Building the 3D Model, Speaking to Your Pi. | **1** |
| **5** | Networked Python: Understanding Hosts, Ports, and Sockets, Locating Computers with IP Addresses, Building a Chat Server, Tweeting to the World. | **6** |
| **6** | Multimedia: Using Pi Audio to Get Sound into Your Computer, Recording the Sound, Speaking to Your Pi, Making Movies, Adding Computer Vision Features with Open CV, Creating Live Streams. | **4** |
| **7** | Scripting: Getting Started with the Linux Command Line, Using the Sub process Module, Command-Line Flags, and Scripting with Networking. | **3** |
| **8** | Interfacing with hardware and testing and debugging: Setting Up Your Hardware Options, Sneed of hardware, Finding Bugs by Testing, Checking Bits of Code with Unit Tests, Using Test Suites for Regression Testing, Making Sure Your Software's Usable. | **2** |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**

1. **Learning Python with Raspberry Pi** By Alex Bradbury, Ben Everard
2. **Learn Raspberry Pi Programming with Python** By Wolfram Donat

**Suggested Reference Book(s):**


1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978- 1111822705.
2. Chun, Wesley. Core python programming. Vol. 1. Prentice Hall Professional, 2001.
3. Zelle, John M. Python programming: an introduction to computer science. Franklin, Beedle& Associates, Inc., 2004.
4. Gold, Steve. "Python: Python Programming Learn Python Programming In A Day-A Comprehensive Introduction To The Basics Of Python & Computer Programming." (2016).


**Other useful resource(s):**

1. https://onlinecourses.nptel.ac.in/noc18_cs35/preview
2. https://nptel.ac.in/courses/106106145/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to- computer-science-and-programming-in-python-fall-2016/index.htm
4. https://docs.python.org/3/tutorial/index.html

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| | | | | |

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| | | | | |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

*In Test-I Paper the 20% of 15 Marks will be allocated to Introduction to Computers portion and 80% of 15 Marks will be allocated toIntroduction to Programming portion.

#In Test-II Paper the 20% of 25 Marks will be allocated tosyllabus of Test-I and 80% of 25 Marks will be allocated tofurther covered portion.

$In Test-III Paper the 40% of 30 Marks will be allocated to syllabus of Test-I+ Test-II and 60% of 30 Marks will be allocated to further covered portion.

~Internal Assessment will purely be focused on the assignments and quizzes based on Python Programming.

### Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)

| Course outcomes (Python Programing with Raspberry PI) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | **2.1** |
| **CO-2** | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | **2.3** |
| **CO-3** | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | **2.3** |
| **CO-4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | **2.5** |
| **CO-5** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | **2.4** |
| **CO-6** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | **2.3** |
| **Average** | **3** | **2.8** | **3** | **1.7** | **2.3** | **2.8** | **2.8** | **2.5** | **1.8** | **1** | **1** | **3** | |

## Python Programing with Raspberry PI (Lab)

COURSE CODE: 18B11CI311

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Python Programming with Raspberry PI (Lab)

COURSE CODE: 18B17CI375

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** No prior programming experience is expected however, mathematical maturity level of science or engineering undergraduate is assumed.

**Course Objectives:**

1. Introduce students to the Raspberry Pi (RPi) single-board computer, and how to use its text-based commands to explore the environment of the RPi.
2. Introduce students to coding programs in Python language to display messages and images using the add- on display module (Sense HAT board) on RPi board.
3. Student will understand the basics of python programming.
4. Understand the implementation of various data structure using python library including string, list, dictionary and its operations in python programming.
5. Understand about files handling to manage large data using Python.
6. Develop real time applications using oops, graphics etc.

**Equipment and accessories required**

1. Raspberry Pi 3 Model B (RPi3) board with Sense HAT add-on display module/board.
2. HDMI monitor, USB keyboard and USB mouse.
3. A USB power source to power the RPi3 board (E.g. Power Bank, Adaptor or USB port of a desktop computer).
4. Optional – A computer (desktop PC or notebook) with Ethernet port and cable for remote access of RPi3. Software (open source) to be installed on the computer – PuTTy and VNC Viewer.

**Course outcomes:**

**Course outcomes:**

| S.NO | Course outcomes ( Python Programming Lab ) | Level of Attainment |
|---|---|---|
| CO-1 | Learn about basics of Python programming . | Familiarity |
| CO-2 | Learn how to use Python and Shell scripts to control GPIO ports on the Pi | Assessment |
| CO-3 | Understanding Python Programing and GPIO in Pi 3 | Assessment |
| CO-4 | Understanding interfaces on a Pi 3 (I2C, SPI, etc.) | Usage |
| CO-5 | Storing sensor data in a dBase and plotting it | Familiarity |
| CO-6 | MQTT Protocol | Usage |

**List of Experiments:**

| Experiment | Details | Lab Hours |
|---|---|---|
| **Experiment 1** | 1. Write a Python program to get the Python version you are using.<br>2. Write a Python program which accepts the radius of a circle from the user and compute the area. | **2** |
| **Experiment 2** | 1. Write a Python program to display the current | **2** |

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| | | |
|---|---|---|
| | date and time.<br>2. Write a Python program which accepts the radius of a circle from the user and compute the area. | |
| **Experiment 3** | What is GPIO?<br>Using the GPIO Pins From Python<br>• Controlling GPIO Pins<br>Example 1: Controlling an LED<br>• Reading Input<br>Example 2: Button Input<br>Simple button input with the Raspberry Pi. | **2** |
| **Experiment 4** | • Binary numbers<br>o Bitwise operations<br>o Operator NOT<br>o Operator AND<br>o Operator OR<br>o Operator XOR<br>o Bitwise operations in python<br>• Bit shift<br>o Bit shift in python<br>o Testing for bits in python<br>• Representing binary numbers with LED on the Raspberry Pi | **2** |
| **Experiment 5** | Creating Circuits on the Breadboard<br>• The 74xx Series<br>• Half Adders<br>o Circuit Design<br>o Hardware Setup | **2** |
| **Experiment 6** | Full Adders<br>• Circuit Design<br>• Hardware Setup | **2** |
| **Experiment 7** | • The MCP3008 SPI ADC chip<br>• SPI<br>• ADC using SPI from a Raspberry Pi | **2** |
| **Experiment 8** | • How is a Servo Controlled?<br>• Controlling a servo from the Raspberry Pi<br>• Example of controlling a servo from the Raspberry Pi | **2** |
| **Experiment 9** | o The $I^2C$ bus<br>o Digits<br>• Controlling the 4-digit 7-segment display<br>o Download the support code<br>o Connections<br>o Testing connections<br>o Test program<br>o Exercise | **2** |
| **Experiment 10** | Controlling a seven-segment display from the Raspberry Pi – Part 2 | **2** |
| **Experiment 11** | ARM assembler in Raspberry Pi | **2** |

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| | | |
|---|---|---|
| **Experiment 12** | Write a Python program to get an array buffer information<br>Expected Output:<br>Array buffer start address in memory and number of elements. (25855056, 2) | **2** |
| **Experiment 13**<br>**Experiment 14** | Write a Python program to push three items into a heap and return the smallest item from the heap. Also Pop and return the smallest item from the heap<br>Expected Output:<br>Items in the heap:<br>('V', 1)<br>('V', 3)<br>('V', 2)<br>---<br>The smallest item in the heap:<br>('V', 1)<br>---<br>Pop the smallest item in the heap:<br>('V', 2)<br>('V', 3) | **4** |
| **Experiment 15** | Raspberry Pi Internet Speed Monitor | **4** |
| **Experiment 16** | | |
| **Experiment 17**<br>**Experiment 18** | Capturing images using USB Camera | **4** |
| **Experiment 19**<br>**Experiment 20** | Surveillance Camera Using Android | **4** |
| **Experiment 21**<br>**Experiment 22** | Home theatre on Raspberry Pi | **4** |
| **Experiment 23**<br>**Experiment 24** | Adding audio port to Raspberry Pi zero | **4** |
| **Experiment 25**<br>**Experiment 26** | Face Recognition Using Raspberry Pi | **4** |
| **Experiment 27**<br>**Experiment 28** | XBee interfacing with Raspberry pi | **4** |
| | **TOTAL LAB Hours** | **28** |

**Suggested Text Book(s) for Lab:**

1. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey , Jeffrey Elkner, 2015

2. Exploring Python, Timothy A. Budd, Mc Graw Hill Education

**Suggested Reference Book(s) for Lab:**

1. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr
2. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication
3. How to Make Mistakes in Python Author: Mike Pirnat
4. Head First Python Paperback – by Paul Barry

**Other useful resource(s) for Lab:**

1. Link to topics related to course:
   a. Think Python How to Think Like a Computer Scientist
   b. https://greenteapress.com/wp/think-python/
   c. https://www.w3schools.com/python/
   d. https://www.python.org/

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**Minor Project(s) – (*Only for 2 credit lab)***

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1. **Building your own Raspberry Pi Google Assistant**

This Raspberry Pi Google assistant project will walk you through on how to build and set up your very own Pi-powered Google Assistant. This assistant will actively listen to your voice and respond to your queries, all you need to say is "Ok Google" or "Hey Google" followed by your query. To set up your own Google Assistant, we will be walking you through how to test your audio setup, signing up for the Google Assistant API and also show you how to download and set up the actual Google Assistant examples. By the end of this tutorial, you should have a very capable assistant operating.Setting up your very own Google Assistant on your Raspberry Pi all you will need is a USB Microphone and a set of speakers. Of course, you will also need all the default equipment that you need for getting your Raspberry Pi started.

2. **Controlling your Raspberry Pi with Telegram CLI**

In this project, we will be building upon our Telegram tutorial by showing you how to utilize Telegram to control your Raspberry Pi. We will be doing this by utilizing the LUA interpreter that is built into the Telegram CLI which opens it up to quite a wide variety of functionality.The LUA interpreter allows us to program certain functions that trigger when something occurs on the Telegram CLI, such as when it receives a message.This interpreter allows us to do certain actions based on the received message, the two simple tasks we will be showing you how to do is a simple receive message and reply, and also how to set up the Telegram CLI so we can trigger an outside bash script and upload a photo automatically.

**Evaluation Scheme:**

| | |
|---|---|
| Mid Term Test | 20 |
| End Term Test | 20 |
| Lab Records | 25 |
| Regular Assessment | 20 |
| Attendance & Disciplines | 15 |
| Total | 100 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes ( Python Programming Essentials) | PO-1 | PO- 2 | PO- 3 | PO -4 | PO -5 | PO -6 | PO-7 | PO-8 | PO- 9 | PO -10 | PO-11 | PO-12 | Weigh tage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 74% |
| CO-2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 85% |
| CO-3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 84% |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 88% |
| CO-5 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 92% |
| CO-6 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 80% |
| Weightage | 100 % | 94% | 100 % | 55 % | 77 % | 94 % | 94% | 83% | 61 % | 33 % | 33% | 100% | |

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# Advanced Java

COURSE CODE: 18B11CI511

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

**Pre-requisite:** Object-Oriented Systems and Programming

**Course Objectives:**

1. Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
2. Design and develop dynamic web applications using Servlets and JSP.
3. Designing client-server networking applications.
4. Designing distributed applications using RMI.
5. Designing Enterprise based applications by encapsulating an application's business logic.
6. Designing applications using pre-built frameworks.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn and design a full set of Event driven UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings | Usage |
| CO-2 | To learn Java Data Base Connectivity (JDBC) so as to retrieve and manipulate the information on any relational database through Java programs. | Usage |
| CO-3 | To learn the server side programming using Servlets and JSP. | Usage |
| CO-4 | To learn client-server networking programming. | Usage |
| CO-5 | To learn the invocation of the remote methods in an application using RMI | Usage |
| CO-6 | To learn the development of Enterprise based applications, using EJB: Stateful, Stateless and Entity Beans, Using Struts and Hibernate Frameworks. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | GUI Programming Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework : Collections of Objects , Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of ArrayList& Vector. Event Handling Event-Driven Programming in Java, Event- Handling Process, EventHandling Mechanism, The Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling. | 6 |

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|---|---|---|
| 2 | **Java Database Connectivity (JDBC):** JDBC Product, Types of Drivers, Two-Tier Client/Server Model, Three-Tier Client/Server Model, Basic Steps of JDBC, Creating and Executing SQL Statement, The Result Set Object, Working with Database MetaData Interface. | 5 |
| 3 | Networking Basics, Client-Server Architecture, Socket Overview, Networking Classes and Interfaces, Network Protocols Network Programming in Java Using the java.net Package, Establishing the two- way Communication between Server and Client, Retrieving a file at server, Learning the DatagramSocket and DatagramPacket Classes,<br>Understanding the Content and Protocol Handlers | 6 |
| 4 | Web Application Basics, Architecture and challenges of Web Application, Introduction to servlet, Servlet life cycle, Developing and Deploying Servlets, Exploring Deployment Descriptor (web.xml), Handling Request and Response, Initializing a Servlet, Accessing Database, Servlet Chaining, Session Tracking & Management, Dealing with cookies, Transferring Request, Accessing Web Context, Passing INIT and CONTEXT Parameter, Sharing information using scope object, Controlling concurrent access, User Authentication, Filtering Request and Response, Programming Filter, Filter Mapping, Servlet Listeners.<br>Java Server Pages: Basic JSP Architecture, Life Cycle of JSP (Translation, compilation), JSP Tags and Expressions, Role of JSP in MVC-2, JSP with Database, JSP Implicit Objects, Tag Libraries, JSP Expression Language (EL), Using Custom Tag, JSP Capabilities, Exception Handling, Session Management, Directives, JSP with Java<br>Bean | 10 |
| 5 | RMI, Naming Service, Serialization, and Internationalization, RMI Architecture, RMI Registry, Dynamic Code Loading in RMI, RMI API, Creating a Distributed Application using RMI, Naming Services, Directory and Naming Services, Overview of JNDI, Object Serialization, Internationalization, Java and Internationalization, Internationalizing<br>Web Applications | 6 |
| 6 | **Enterprise Java Beans (EJB):** Types of EnterpriseJava beans, Session Bean & Entity Bean, Features of Session Bean, Life-cycle of StatefulSeession Bean, Features of Entity Bean, Life-cycle of Entity Bean, Container-managed Transactions & Bean-managed Transactions, Implementing a container-managed Entity Bean<br>Struts: Introduction to the Apache Struts, MVC Architecture, Struts Architecture, How Struts Works? Introduction to the Struts Controller, Introduction to the Struts Action Class, Using Struts ActionFrom Class, Using Struts HTML Tags, Introduction to Struts Validator Framework, Client Side Address Validation in Struts, Custom Validators example, Developing Application with Struts Tiles.<br>Hibernate: Introduction to Hibernate 3.0, Hibernate Architecture, First Hibernate Application. | 9 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Java the Complete Reference, ninth edition by Herbert Schild, Publisher: McGraw Hills

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2. Advanced Java Programming by Uttam K. Roy, Publisher: Oxford University Press

**Suggested Reference Book(s):**

1. Head First EJB 3.0 by Kathy Sierra, Bert Bates, Publisher: O'Reilly Media
2. Head First Servlets and JSP by Bryan Basham, Kathy Sierra & Bert Bates, Publisher: O'Reilly Media
3. Just Hibernate, A Lightweight Introduction to the Hibernate Framework by MadhusudhanKonda, Publisher: O'Reilly Media
4. Programming Jakarta Struts, 2nd Edition by Chuck Cavaness, Publisher: O'Reilly Media

**Other useful resource(s):**

1. Link to NPTEL course contents:
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://nptel.ac.in/courses/106105084/28

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Java Programming) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 3 | 2 | 3 | 2.3 |
| CO-2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 2.3 |
| CO-3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 2.6 |
| CO-4 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 2.6 |
| CO-5 | 3 | 1 | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 2 |
| CO-6 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2.5 |
| Average | 3 | 2.5 | 2 | 2.3 | 1.8 | 2.7 | 1.5 | 2.7 | 1.7 | 2.8 | 2.7 | 2.7 | |

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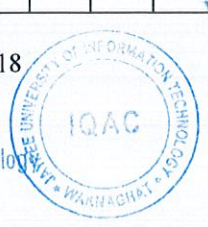

# Information Systems

COURSE CODE: 18B11CI512

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P-: 3-0-0

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**Pre-requisite:** Java Programming

**Course Objectives:**

1. Understand various technologies and processes available for developing business software.
2. Study and understand underlying infrastructure of information systems.
3. Learn to identify and analyze requirements for information systems
4. Develop proficiency in structuring, collecting, and analyzing data to support business operations and strategic decision making.
5. Understand and apply design principles in Information Systems
6. Demonstrate proficiency in selecting, implementing and operating information technology solutions to meet organizational requirements.
7. Develop an understanding of the social issues and ethical implications of technology across organizations and society.
8. Develop a proficiency in the selection of tools, techniques, processes, and success factors related to effective management of IT projects.
9. Develop proficiency in business reporting and strategic analysis of data..

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand the fundamental terms and concepts of information systems, associated technologies and underlying infrastructure. | Familiarity |
| CO-2 | To understand how IT provides value by improving the management process through access to better information. | Familiarity |
| CO-3 | To acquire knowledge and develop hands on skills on various information system development technologies. | Usage and Assessment |
| CO-4 | To understand and analyze information system categories along with their principles and design issues. | Familiarity and Assessment |
| CO-5 | To understand and analyze the social issues and ethical implications of technology across organizations and society. | Familiarity and Assessment |
| CO-6 | To develop the ability to evaluate information systems, assess user needs, propose solutions, and evaluate proposals for implementation. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Information Systems, Concept and characteristics of information, Essential aspects of information systems in a company, Information technology, | 4 |

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| | | |
|---|---|---|
| **2** | Architectural components of information systems, MVC approach to building Information Systems | **2** |
| **3** | Information system development technologies, Java Servlets, Java Server pages, Session Management, Enterprise Java Beans, Enterprise Computing, Java cryptography Architecture. | **8** |
| **4** | Information System categories<br>• Transaction Processing Systems (TPS)<br>• Management Information System (MIS)<br>• Decision Support Systems (DSS): Problem resolution with DSS, Possibilities of DSS, Use of spreadsheets as decision-making support systems, Using DSS in decision making process,<br>• Executive Information Systems (EIS): Evolution, EIS concepts and categories | **12** |
| **5** | Information System categories Specification:<br>• design issues and principles<br>• User interface design; demonstrating good UI design principles;<br>• Contemporary Information Systems Architectures;<br>• Contemporary information system development tools, components and techniques;<br>• Specific documents and other analysis and design artifacts | **4** |
| **6** | Prototype demonstration Contemporary Issues In Information Systems: Internet mediated communication, Three dimensional communities, Collaboration and digital natives, | **4** |
| **7** | Crowd Sourcing, E-Governance, E-Commerce and location based services, Gender and cyber behaviour, Ethics of building Information Systems | **4** |
| **8** | Introduction to Information Security: What is security approaches to information security implementation, The Security Systems Development Life Cycle, Different types of threats and attacks. | **4** |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**


1. Rafael L. Alcami, Carlos D. Caranana, "Introduction to Management Information Systems".
2. Marty Hall, Larry Brown, "Core Servlets and Java Server Pages", Prentice Hall
3. Whitman, M.E. and Mattord, H.J., 2011. Principles of information security. Cengage Learning.


**Suggested Reference Book(s):**


1. Ethan Cerami, "Web Services Essentials", O'Reilly
2. Kogent, "Java Server Programming tutorial, J2EE Black Book", Dreamtech Press
3. Herbert Schildt, "The Complete Reference: JAVA", Tata McGraw- Hill
4. Kathy Sierra & Bert Bates, "Head First EJB", O'Reilly
5. Phil Hanna, "The Complete Reference: JSP 2.0" Tata McGraw-Hill


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6. Stefan B. Harsh, "Management Information Systems"

**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/122105022/
2. Link to topics related to course:
3. https://www.coursera.org/learn/information-security-data
4. https://www.journaldev.com/2114/servlet-jsp-tutorial
5. https://www.javatpoint.com/servlet-tutorial
6. http://www.springer.com/business+%26+management/business+information+systems/journal/10796
7. http://www.irma-international.org/journal/international-journal-enterprise-information-systems/1086/
8. https://www.journaldev.com/1854/java-web-application-tutorial-for-beginners
9. https://www.udemy.com/javawebtut/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 9<br>Quizzes(2) -12<br>Attendance - 4 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Information Systems) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2.1 |
| CO-2 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 2.3 |
| CO-3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2.2 |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2.3 |
| CO-5 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2.3 |
| CO-6 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1.8 |
| Average | 3 | 2.7 | 2.2 | 1.2 | 1.7 | 2.5 | 2.7 | 1.8 | 2 | 2.5 | 2 | 1.5 | |

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# Advanced Java Lab

COURSE CODE: 18B17CI571

COURSE CREDITS:2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** None

**Course Objectives:**

1. Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
2. Design and develop dynamic web applications using Servlets and JSP.
3. Designing client-server networking applications.
4. Designing distributed applications using RMI.
5. Designing Enterprise based applications by encapsulating an application's business logic.
6. Designing applications using pre-built frameworks.

**Course Outcomes:**

| S.No. | Course outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn and design a full set of Event driven UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings | Usage |
| CO-2 | To learn Java Data Base Connectivity (JDBC) so as to retrieve and manipulate the information on any relational database through Java programs. | Usage |
| CO-3 | To learn the server side programming using Servlets and JSP. | Usage |
| CO-4 | To learn client-server networking programming. | Usage |
| CO-5 | To learn the invocation of the remote methods in an application using RMI | Usage |
| CO-6 | To learn the development of Enterprise based applications, using EJB: Stateful, Stateless and Entity Beans, Using Struts and Hibernate Frameworks. | Usage |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Design a GUI to create a tabbed pane with two tabs as: Cities and Flavors. The Cities tab consists of four push buttons labeled as "New York", "London", "New Delhi", and "Tokyo". The Flavors tab contains a combo box with three items as "Vanilla", "Chocolate", and "Strawberry". | 2 |

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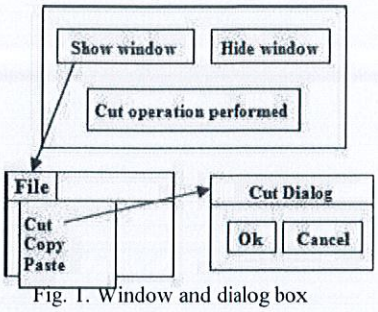
| | | |
|---|---|---|
| 2 | Design a GUI using awt/swing components as shown in Fig. 1. The applet window consists of two push buttons (labeled as "Show window" and "Hide window") and a text field. After clicking on the "Show window" button, a window should appear with a menu labeled as File. The File menu consists of three menu items: Cut, Copy, and Paste. After clicking on any of the menu items, a dialog box appears with two push buttons: "Ok" and "Cancel". If "Ok" button is pressed, a message "Cut operation performed" (assuming that the menu item Cut was selected) is displayed on the text field of the applet window. Conversely, if "Cancel" button is pressed, a message "Cut operation cancelled" is displayed on the text field. The dialog box disappears after clicking on the Ok or Cancel button. Similarly, the window disappears after clicking on to the "Hide window" button   Fig. 1. Window and dialog box | 2 |
| 3 | Design a GUI to create a tabbed pane with two tabs: Table and Tree. The first tab contains a table displaying the information of Employee {empid, ename, age}. The second tab contains a tree structure. Insert both JTable and JTree in JScrollPane. JScrollPane has to be inserted at the centre of the BorderLayout manager (with panels). When user clicks on any node of the tree, its path should be displayed on the TextField. | 2 |
| 4 | Consider a table Bank {account_no, customer_name, balance, phone_no, and address}. Write a database application which allows insertion, updation and deletion of records in the Bank table. Print values of all customers whose balance is less than 5,000. | 2 |
| 5 | Write a servlet program to display the current date and time. | 2 |
| 6 | User enters the name and password through an HTML form. Both these parameters are being passed to the Servlet1. The Servlet1 after retrieving the parameters generates a Cookie with username being stored in the cookie. The Servlet1 generates an HTML form, which is linked to the Servlet2. Along with the response object, the Cookie is stored permanently on the client's hard disk. The same user then submits the form to invoke the Servlet2. The Servlet2 must have the provision to access and display the cookie name. | 2 |
| 7 | Write a Servlet to validate the username and password entered by the user. If the username and password are 'abc' and 'def' respectively, the | 2 |
| | Sevlet should forward the request to WelcomeServlet; otherwise, it should display an error message: "Incorrect username or password!" | |
| 8 | Write a Servlet that connects to the database (MySql) and creates a table emp with the following schema:<br>emp{empid char(5) Primary Key, ename varchar2 not null , age number(2) not null, salary number(7, 2) , address varchar2}; | 2 |
| 9 | Write a JSP program to display your brief profile including your image, date of birth, address, and educational qualification. Do proper formatting and coloring of this web page. | 2 |

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| | | |
|---|---|---|
| **10** | Write an online phone directory based application using JSP and JDBC. Use the following table to store the phone details: Directory{phone_no, first_name, last_name, address}. The application should have the search facility on all the fields. | **2** |
| **11** | Write a JSP program using Java Bean to register users into a web-site. The registration details of users are kept in USER table with attributes as userid varchar2(10), username varchar2(15), and email_id varchar2(15). | **2** |
| **12** | Write an enterprise-based application to find the sum of first n numbers. A positive integer number is passed through an HTML form to invoke a servlet called SumSurvlet. SumServlet calls the method int sum(int) that has been defined inside a stateless session bean SumBean. Assume that the web container and the EJB container are available on the same server. | **2** |
| **13** | Design a stateful session bean that provides a calculator services. The calculator has the functionality to perform addition, subtraction, multiplication, and division of two real numbers. It can also detect the zero divisors in division operation. Use namespace in this component. | **2** |
| **14** | Design an on-line auction business application using entity beans and session beans and other Java Web components. The business includes all routine auction activities such as bidding price, starting price, current highest bid price, time period control, winner notification, and so on. | **2** |
| **Total lab hours** | | **28** |

**Suggested Books/Resources:**

1. Head First EJB 3.0 by Kathy Sierra, Bert Bates, Publisher: O'Reilly Media
2. Head First Servlets and JSP by Bryan Basham, Kathy Sierra & Bert Bates, Publisher: O'Reilly Media
3. Just Hibernate, A Lightweight Introduction to the Hibernate Framework by Madhusudhan Konda, Publisher: O'Reilly Media
4. Programming Jakarta Struts, 2nd Edition by Chuck Cavaness, Publisher: O'Reilly Media

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 3 | 2 | 3 | **2.3** |
| **CO-2** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | **2.3** |

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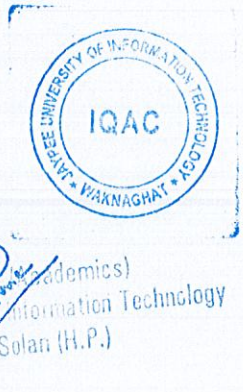
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-3** | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | **2.6** |
| **CO-4** | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | **2.6** |
| **CO-5** | 3 | 1 | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | **2** |
| **CO-6** | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | **2.5** |
| **Average** | **3** | **2.5** | **2** | **2.3** | **1.8** | **2.7** | **1.5** | **2.7** | **1.7** | **2.8** | **2.7** | **2.7** | |

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# Information Systems Lab

COURSE CODE: 18B17CI572

COURSE CREDITS:1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. Understand various technologies and processes available for developing business software.
2. Study and understand underlying infrastructure of information systems.
3. Learn to identify and analyze requirements for information systems.
4. Develop proficiency in structuring, collecting, and analyzing data to support business operations and strategic decision making.
5. Understand and apply design principles in Information Systems.
6. Demonstrate proficiency in selecting, implementing and operating information technology solutions to meet organizational requirements.
7. Develop an understanding of the social issues and ethical implications of technology across organizations and society.
8. Develop a proficiency in the selection of tools, techniques, processes, and success factors related to effective management of IT projects.
9. Develop proficiency in business reporting and strategic analysis of data.

**Course Outcomes:**

| S.No. | Course outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To analyze how IT provides value by improving the management process through access to better information. | Familiarity |
| CO-2 | To understand and apply system development and project management principles. | Familiarity and usage |
| CO-3 | To acquire knowledge of various information system development technologies. | Usage |
| CO-4 | To have hands on skills to evaluate Servlet technology for information development. | Assessment |
| CO-5 | To have hands on skills to evaluate JSP technology for information development. | Assessment |
| CO-6 | To develop the ability to evaluate information systems, assess user needs, propose solutions, and evaluate proposals for implementation. | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Understanding Existing Information Systems | 2 |
| 2 | Building MVC based solution in Java, java Servlets | 6 |
| 3 | Implement Java Server pages | 6 |
| 4 | Implement Stateless EJB | 6 |
| 5 | Build Stateful EJB | 4 |

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|---|---|---|
| 6 | Implementing Container Managed Persistence EJB | 4 |
| 7 | Design Bean Managed Persistence EJB | 4 |
| 8 | Implement XML based SOAP | 4 |
| 9 | Implement blog website using Java Server pages | 4 |
| 10 | Building Thin & Thick client MVC based solution in Java | 4 |
| 11 | Implement Java based cryptography technique | 4 |
| 12 | Show use of DSS in decision making process | 4 |
| 13 | Understanding Executive Information Systems (EIS) | 2 |
| 14 | ImplementingTransaction Processing Systems | 2 |
| **Total lab hours** | | **56** |

**Suggested Books/Resources:**


1. Rafael L. Alcami, Carlos D. Caranana, "Introduction to Management Information Systems".
2. Marty Hall, Larry Brown, "Core Servlets and Java Server Pages", Prentice Hall
3. Ethan Cerami, "Web Services Essentials", O'Reilly
4. Kogent, "Java Server Programming tutorial, J2EE Black Book", Dreamtech Press
5. Herbert Schildt, "The Complete Reference: JAVA", Tata McGraw- Hill
6. Kathy Sierra & Bert Bates, "Head First EJB", O'Reilly
7. Phil Hanna, "The Complete Reference: JSP 2.0" Tata McGraw-Hill
8. Stefan B. Harsh, "Management Information Systems"


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2.2 |
| CO-2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2.3 |
| CO-3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2.3 |
| CO-4 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1.8 |
| CO-5 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2.1 |
| CO-6 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 2.3 |
| Average | 3 | 2.7 | 2.2 | 1.2 | 1.7 | 2.5 | 2.7 | 1.8 | 2 | 2.5 | 2 | 1.5 | |

## Computer Organization and Architecture Lab

Course Code: 18B17CI574

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# Data Mining

COURSE CODE: 18B11CI613

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisites:** Data Structures, Compilers, Operating Systems, Computer Networks, Machine Learning and Genetic Algorithms.

**Course Objectives:**

1. To describe the concept of Data warehouse & its attributes.
2. To study different data warehouse models, architectures and implementation.
3. To understand the basic concept of data mining and its functionality.
4. To understand the concept of classification techniques and its implementation.
5. To understand the concept of association rules, different techniques and implementation details.
6. To understand the concept of cluster analysis, anomaly detection and its usage and implementation details.

**Course Outcomes**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To describe the concept of Data warehouse & its attributes | Assessment |
| CO-2 | To study different data warehouse models, architectures and implementation | Assessment |
| CO-3 | To understand the basic concept of data mining and its functionality | Assessment |
| CO-4 | To understand the concept of classification techniques and its implementation | Assessment |
| CO-5 | To understand the concept of association rules, different techniques and implementation details | Assessment |
| CO-6 | To understand the concept of cluster analysis, anomaly detection and its usage and implementation details | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Concepts of Data Warehouse and Data Mining including its functionalities, stages of Knowledge discovery in database(KDD) , Setting up a KDD environment, Issues in Data Warehouse and Data Mining, Application of Data Warehouse and Data Mining | 5 |
| 2 | **Architecture:** DBMS vs. Data Warehouse, Data marts, Metadata, Multidimensional data model, Data Cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact Constellations, Data Warehouse Architecture, Distributed and Virtual Data Warehouse, Data Warehouse Manager, OLTP, OLAP, MOLAP, HOLAP, types of OLAP, servers | 8 |
| | **Introduction:** Data Mining, Motivation, Challenges, Origins of Data Mining, | 5 |

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|---|---|---|
| 3 | Data Mining Tasks, Data: Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity, Exploring Data: Iris Data Set, Summary Statistics,<br>Visualization, OLAP and Multi dimensional Data Analysis | |
| 4 | **Classification:** Basic Concepts andPreliminaries, Approach to Solving a Classification Problem, Decision Tree Induction, Model Over fitting, Evaluating Performance of Classifier<br>**Alternative Techniques**: Rule-Based Classifier, Nearest-Neighbour Classifiers, Artificial Neural Network (ANN), Support Vector Machine (SVM), Ensemble Methods, Class Imbalance Problem, Multiclass Problem | 8 |
| 5 | **Association Analysis:** Basic Concepts andProblem Definition, Frequent Itemset Generation, Rule Generation, Representation of Frequent Itemsets, FP-Growth Algorithm, Evaluation of Association Patterns, Handling Categorical Attributes , Handling Continuous Attributes, Handling a Concept Hierarchy, Sequential Patterns, Subgraph Patterns | 8 |
| 6 | **Cluster Analysis:** Basic Concepts, Characteristics of Data, Clusters, Partitional Clustering, Agglomerative Hierarchical Clustering, Prototype-Based Clustering, Density-Based Clustering, Graph-Based Clustering, Cluster Evaluation<br>**Anomaly Detection:** Preliminaries, Statistical Approaches, Proximity-Based Outlier Detection, Density-Based Outlier<br>Detection, Clustering-Based Techniques | 8 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. Data Mining Concepts and Techniques J. Han and M. Kamber Morgan Kaufmann, 2006, ISBN 1- 55860-901-6

2. Introduction to Data Mining Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education (Addison Wesley), 0-321-32136-7

**Suggested Reference Book(s):**

1. Mininig Massive data sets Anand Rajaram, Jure Leskovec and Jeff Ullman Cambridge University Press

**Other useful resource(s):**

1. https://onlinecourses.nptel.ac.in/noc18_cs14/preview
2. https://www.coursera.org/specializations/data-mining.
3. https://www.futurelearn.com/courses/data-mining-with-wekahttp://ecomputernotes.com/compiler- design

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

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## Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course outcomes (Compiler Design) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.1** |
| **CO-2** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | **2.3** |
| **CO-3** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | **2.2** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **2.3** |
| **CO-5** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | **2.2** |
| **CO-6** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | **2.6** |
| **Average** | **3** | **2.8** | **2.5** | **1.7** | **1.8** | **2.5** | **2.7** | **1.7** | **1.8** | **2.7** | **2.3** | **1.5** | |

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# Data Mining Lab

COURSE CODE: 18B17CI673

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

: 0-0-4

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**Pre-requisite:** Introduction to Programming.

**Course Objectives:**

1. Practical exposure on implementation of well known data mining tasks.
2. Exposure to real life data sets for analysis and prediction.
3. Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting.
4. Handling a small data mining project for a given practical domain.
5. Develop and apply enthusiasm for learning machine learning tools and techniquesThe lab course provides the complete description about inner working of a compiler.

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Practical exposure on implementation of well known data mining tasks. | Familiarity |
| CO-2 | Exposure to real life data sets for analysis and prediction. | Technical skills |
| CO-3 | Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting. | Computational skills |
| CO-4 | Handling a small data mining project for a given practical domain. | Computational skills and Technical Skills |
| CO-5 | Develop and apply machine learning tools and techniques. | Assessment |

**List of Experiments:**

| S. No. | Description | Hours |
|---|---|---|
| 1 | Introduction to Rapid Miner Studio, Weka and R | 4 |
| 2 | Creation of a Data Warehouse in Rapid Miner | 4 |
| 3 | Apriori Algorithm | 8 |
| 4 | FP-Growth Algorithm | 8 |
| 5 | K-means Clustering, K-Means ++ Clustering | 8 |
| 6. | Hierarchical clustering algorithm | 8 |
| 7. | Bayesian Classification | 4 |
| 8. | Decision Tree | 4 |
| 9. | Feature Reduction using PCA | 4 |
| 10 | Model Examination | 4 |
| **Total Lab hours** | | **56** |

**Suggested Books/Resources:**

1. Introduction to Data Mining Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education (Addison Wesley), 0-321-32136-7, 2006

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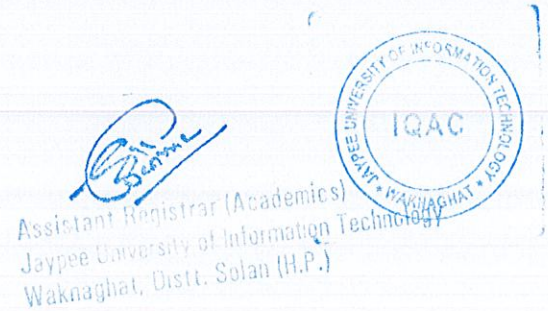
2. Mininig Massive data sets Anand Rajaram, Jure Leskovec and Jeff Ullman Cambridge University Press
3. Data Mining Concepts and Techniques J. Han and M. Kamber Morgan Kaufmann, 2006, ISBN 1-55860- 901-6
4. An Introduction to Information Retrieval, 2008 Cambridge UP.
5. https://onlinecourses.nptel.ac.in/noc18_cs14/preview
6. https://www.coursera.org/specializations/data-mining
7. https://www.futurelearn.com/courses/data-mining-with-weka
8. https://docs.rapidminer.com/
9. https://archive.ics.uci.edu/ml/datasets.html
10. IRIS dataset: http://archive.ics.uci.edu/ml/datasets/Iris
11. Mushroom dataset: http://archive.ics.uci.edu/ml/datasets/Mushroom
12. Breast cancer dataset: http://archive.ics.uci.edu/ml/datasets/Breast+Cancer
13. Car evaluation dataset: http://archive.ics.uci.edu/ml/datasets/Car+Evaluation

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | **2.1** |
| **CO-2** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | **2.3** |
| **CO-3** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | **2.3** |
| **CO-4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **2.3** |
| **CO-5** | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | **2.6** |
| **Average** | **3** | **2.8** | **2.4** | **1.6** | **1.8** | **2.6** | **2.4** | **1.6** | **2.4** | **2.4** | **2.6** | **1.8** | |

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# Environmental Engineering Lab

COURSE CODE:18B17CE572

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. Physical Characteristics of wastewater Sample.
2. Inorganic Constituents of wastewater Sample
3. Biological Characteristics of wastewater Sample.
4. Jar Test.
5. Judge the suitability of water for drinking purposes.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Identify environmental problems arising due to engineering and technological activities and the science behind those problems. | Familiarity |
| CO2 | Determination of various inorganic impurities in wastewater. | Assessment |
| CO3 | Determine physical, chemical and biological characteristics of water and wastewater. | Assessment |
| CO4 | Analyze material balance for different environmental systems. | Usage |
| CO5 | Assess the quality of water and wastewater. | Usage |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | Determination of pH and Temperature of water and wastewater sample. | 2 |
| 2 | Determination of total solids, suspended solids and dissolved solids of water and wastewater sample. | 2 |
| 3 | Determination of specific conductivity of water and wastewater sample. | 2 |
| 4 | Determination of turbidity. | 2 |
| 5 | Determination of chlorides of water and wastewater sample. | 2 |

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| | | |
|---|---|---|
| **6** | Determination of type and extent of alkalinity of water and wastewater sample. | **2** |
| **7** | Determination of type and extent of acidity of water and wastewater sample. | **2** |
| **8** | Determination of temporary and permanent hardness. | **2** |
| **9** | Determination of optimum dose of coagulant. | **2** |
| **10** | Determination of Sulphates of water and wastewater sample. | **2** |
| **11** | Determination of Kjeldahl Nitrogen (Inorganic) of the sample. | **2** |
| **12** | Determination of dissolved oxygen. | **2** |
| **13** | Determination of Biological oxygen demand (BOD). | **2** |
| **14** | Determination of Chemical oxygen demand (COD). | **2** |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**


1. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002.
3. Kotaiah, B., and Kumara Swamy, N., Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007.
4. Mathur, R.P., Water and Wastewater testing: A laboratory Manual (2013).


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Environmental Engineering Lab) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **Average** | **2** | **2** | **3** | **3** | **3** | **3** | **1** | **1** | **1** | **1** | **1** | **1** | |

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# Highway Engineering

COURSE CODE:18B11CE511

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Surveying

**Course Objectives:**

1. To provide the students with an in-depth knowledge and understanding of the principles governing the geometric design of highways.
2. To develop an understanding of the construction procedure and material specifications of rigid and flexible pavements.
3. To provide them with an opportunity to apply the design procedures to a "real life" highway design & maintenance project.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The students will get a diverse knowledge of highway engineering practices applied to real life problems. | Familiarity |
| CO-2 | The student will be able to design highway geometrics, vertical profile of road, factors controlling the alignment and explain sight distances, horizontal and vertical curves. | Assessment and Usage |
| CO-3 | The student will be able to describe properties of highway materials, design flexible and rigid pavements and explain factors to be considered for various type of pavements. | Assessment |
| CO-4 | The student will be able to understand the principles of construction and maintenance of highways | Familiarity and Usage |
| CO-5 | The student will be able to design traffic signals, rotary intersections and prepare traffic management plans, traffic signs, define traffic volume, capacity, speed study and density. | Assessment and Usage |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Importance of transportation, different modes, characteristics & Scope of highway engineering in India. | 3 |
| 2 | Highway development in India, classification of roads, planning surveys, highway planning in India. Highway alignment, engineering surveys, drawings and report, highway projects, Preparation of DPR | 3 |
| 3 | Highway cross section elements, Sight distance, Design of horizontal & vertical alignment | 10 |
| 4 | Traffic characteristics, traffic studies & analysis, flow & roadway capacity, traffic regulation & control, design of road intersections, parking & pedestrian facilities, highway lighting | 4 |
| 5 | Materials used in highway construction, soil, stone aggregates, bituminous binders, bituminous paving mixes, Portland cement & cement concrete | 4 |
| 6 | Flexible pavements: components, functions, stresses, design methods, Rigid pavements: components, functions, factors affecting performance of CC pavements, stresses, design methods | 6 |
| 7 | General features of highway construction, embankment & subgrade, excavation of earth, construction of flexible & rigid pavements | 6 |
| 8 | Flexible & rigid Pavement failures, maintenance of bituminous surfaces, & cement concrete pavements, strengthening of existing pavements, overlay design by Benkelman beam deflection studies, Pavement maintenance management system. | 6 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Highway Engineering by _A.K.Justo & S.K.Khanna' Nemchand Publ. Roorkee.(2017)
2. Transportation Engineering, An Introduction by _C.JotinKhisty&B.KentLall; PHI,
3. IRC codes and Manuals

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Traffic and Transportation engineering by _Animesh Das and P. Chakraborty', PHI 3.Principles of Urban
3. Transportation System Engineering, B.G.Hutchinson', TMG, Publication
4. Principles and practices of Highway engg, L.R.Kadyali&N.B.Lal, , Khanna Publishers, Delhi (2006)
5. Principles of pavement design, Yoder.E.J,&witezac, John wiley&sons ,U.S.A



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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Highway Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | **2.42** |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | **2.33** |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | **2.25** |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | **2.25** |
| CO-5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | **2.5** |
| Average | **3** | **2.8** | **3** | **2.6** | **2.2** | **1.6** | **1** | **2.2** | **2.8** | **2.4** | **2.2** | **2.2** | |

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# Highway Engineering Lab

COURSE CODE:18B17CE571

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. To provide a platform to undergraduate students for practical implementation of highway materials
2. To study the physical consensus and source properties of aggregate materials.
3. To measure and study the physical properties of bitumen.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Students will know the principles and procedures of testing Aggregates used in highways | Familiarity and Usage |
| CO2 | Students will know the principles and procedures of testing bitumen used in highways | Familiarity and Usage |
| CO3 | Student will know the techniques to characterize various pavement materials through relevant tests. | Familiarity and Usage |
| CO4 | Students will be able to know the pavement maintenance techniques. | Familiarity and Usage |

**List of Experiments:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | To determine the crushing value of road aggregates. | 2 |
| 2 | To determine the hardness (Abrasion) of aggregates by the Los Angles Abrasion test method. | 2 |
| 3 | To determine the toughness (impact value) of aggregates. | 2 |
| 4 | To determine the flakiness and elongation indices of the given aggregate sample. | 2 |
| 5 | To determine the Specific Gravity and water absorption of aggregate. | 2 |

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| | | |
|---|---|---|
| **6** | To determine the softening point of bitumen | **2** |
| **7** | To determine the ductility of bituminous material | **2** |
| **8** | To determine the penetration value of Bitumen | **2** |
| **9** | To determine the viscosity of bitumen | **2** |
| **10** | To determine the flash and fire point of given bitumen sample | **2** |
| **11** | To determine the specific gravity of bitumen | **2** |
| **12** | To determine the bitumen content of core sample by centrifugal extractor | **2** |
| **13** | To determine the optimum bitumen content using Marshall Mix Design Method | **2** |
| **14** | Demonstration of rebound deflection of pavement by Benkelman Beam | **2** |
| **15** | Demonstration of MERLIN to determine pavement roughness/unevenness | **2** |
| **Total no. of hours** | | **30** |

**Suggested Text Book(s):**

1. Highway Engineering Lab Manual by _A.K.Justo & S.K.Khanna' Nemchand Publ.
2. Highway Engineering by S. K. Khanna &C.E.G.Justo.(2017).
3. IRC codes and Manuals

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Traffic and Transportation engineering by _Animesh Das and P. Chakraborty', PHI
3. Principles and practices of Highway engg, L.R.Kadyali&N.B.Lal, , Khanna Publishers, Delhi (2006)

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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# Pavement Analysis and Design

COURSE CODE:18B1WCE632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To develop skills in conducting analysis of pavements by calculating the response due to vehicular loading
2. To perform design of rigid and flexible pavements based on traffic and environmental factors
3. To develop skills in engineering economics (especially life-cycle cost calculations for alternative designs)
4. To develop basic understanding of the principles of pavement management

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The students will have the opportunity to develop several designs of pavement structures throughout the semester. | Familiarity |
| CO-2 | Through discussion of the topic of pavement management, the students gain an appreciation for the constantly changing nature of engineering decision-making and the impacts of various decisions on an infrastructure network. | Assessment |
| CO-3 | Students will analyze traffic and geotechnical data from real-life projects and theoretical examples. | Assessment |
| CO-4 | The students are required to complete a semester design problem and present their findings to the instructor and other students. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Advanced Pavement materials**: Waste materials: types, uses in flexible pavement, effect and benefit of utilization of waste material, advance pavement material, Design of bituminous mixes by Marshal method, modified Hubbard –field method, Hveem method, etc. | 8 |
| 2 | **Flexible pavement design**: Basis of pavement design, Development of various design methods for Highway and Airport Pavements. | 8 |



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| | | |
|---|---|---|
| | Layered system concept, Classical methods, Mechanistic-Empirical Method and various damage models, pavement failure study: factors responsible for pavement failure, stress-strain behavior, Current practices in India and across the world. | |
| **3** | **Rigid pavement design**: Analysis and design parameters, design of slab, spacing of joints, dowel bars, tie bars and joint details, pavement failure study: factors responsible for pavement failure, stress-strain behavior. | **6** |
| **4** | **Overlays**: Types of overlays, Overlay design, Pavement Evaluation | **6** |
| **5** | **Design Software**: FPAVE, MXRoads, etc. | **8** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1 Yoder, E.J. and Witczak, M.W., —Principles of Pavement Design 2nd Edǁ, John Wiley & Songs, Inc. (1975)

2 O'Flaherty, A. Coleman, -Highways : the Location, Design, Construction and Maintenance of Road Pavementsǁ, 4th Ed., Elsevier (2006)

3 Fwa, T.F., -The Hand Book of Highway Engineeringǁ, CRC Press Taylor &Francies Group, 2006.

4 Khanna, S.K. and Justo, C.E.G., —Highway Engineering Nem Chand Jain & Bros, 2005.

5 Papagiannakis, A.T. and Masad, E.A., -Pavement Design and Materials, John Wiley & Sons Inc, 2008.


**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

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## Course Outcomes (COs) contribution to the Programme Outcomes (POs)

| Course Outcomes (Pavement Analysis and Design) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | **2.17** |
| CO-2 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | **2.17** |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | **1.92** |
| CO-4 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | **2.17** |
| **Average** | **2** | **2.5** | **2** | **2.75** | **2.5** | **1.5** | **2** | **1.75** | **2** | **2.25** | **2** | **2** | |

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# Geotechnical Engineering

COURSE CODE:18B11CE411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:**

**Course Objectives:**

1. To learn what Geotechnical Engineering is and how it is important to civil engineering.
2. To learn how three phase system is used in soil and how are soil properties estimated using three phase system.
3. The course will explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated.
4. The course will impart the knowledge of compaction, estimating the magnitude and time-rate of settlement due to consolidation.
5. Impart knowledge of determining shear parameters and stress changes in soil due to foundation loads, earth pressure theory and slope stability.

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Identify and classify the soil with ability to solve soil mechanics problems using inter relationships and phase diagrams | Familiarity |
| CO-2 | Characterize soil based on index properties, understand phenomena of capillarity and determine effective stress condition, permeability, seepage within soil mass. Also enabling students to use flow - nets for solving problems related to seepage under hydraulic structures and rectification using filters. | Assessment |
| CO-3 | Understand difference between compaction and consolidation, effect of compaction on various soil properties, method and procedure of lab and field compaction. It will also enable students to relate soil structure variation with compaction and comprehend compressibility and index property changes. | Assessment |
| CO-4 | Understand consolidation and derive terzaghi's one – dimensional consolidation, shear strength of soil under different drainage conditions with understanding of total and effective stress conditions, determination of consolidation and shear strength using laboratory testing, estimation of settlement using concepts of vertical stress, consolidation and shear strength. | Usage |
| CO-5 | Solve practical problems related about to earth pressure theory like retaining walls and stability of the slopes both graphically and analytically. | Usage |

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**Course Contents:**

| UNIT | CONTENTS | LECTURES REQUIRED |
|---|---|---|
| 1 | **Introduction, soil formation and structure**: Introduction to Geotechnical problems in Civil Engineering, Process of soil formation- residual, Transported soil. Formation of fine - grained and coarse – grained, Clay mineralogy. | 4 |
| 2 | **Soil properties, index properties and classification:** Basic soil properties, volumetric and gravimetric inter-relationships, index properties – water content, specific gravity, grain size distribution, Atterberg's limits, in – situ density and I.S. classification system. | 6 |
| 3 | **Effective stress, permeability and seepage analysis:** Capillarity, Total effective and neutral stresses, Darcy's law, permeability and its factors, seepage, flow- nets, Piping, filters and filter design | 8 |
| 4 | **Compaction, Consolidation and Stress distribution:** Laboratory compaction and field compaction of soils, effect of compaction on soil properties; Compressibility, Terzaghi's One-dimension consolidation equation, simple settlement analysis incorporating stress distribution in soils under surface loadings | 8 |
| 5 | **Shear strength of soil:** Shear strength, total and effective strength parameters and their determination, Unconfined shear strength (UCS), laboratory determination of shear strength parameters using direct shear tests, vane shear test and triaxial tests with different drainage conditions as UU, CU and CD tests. Mohr's circle for various drainage and stress conditions. | 6 |
| 6 | **Earth pressure Theories:** Concept Earth pressure: Rankine and Terzaghi's Classical Theories, graphical charts | 5 |
| 7 | **Stability of slopes:** Types of Failure: Failure surfaces - Planar surfaces, Circular surfaces, Non-circular surfaces, Limit equilibrium methods, Total stress analysis versus effective Stress analysis, Short term and Long term stability in slopes, slope stability using tables and graphical methods. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Basic and Applied Soil Mechanics by Gopal Ranjan & A.S. Rao, Publisher New Age International (P) Ltd, ISBN:81-224-1223-8
2. Geotechnical Engineering Principle and Practices of Soil mechanics and Foundation Engineering byV. N. S. Murthy, publisher Marcel Dekker Inc.
3. Soil mechanics and Foundations byDr. B.C. Punmia, Ashok Kumar jain, Arun Kumar Jain, Publisher: Laxmi Publications (P) Ltd, ISSN: 81-7008-081-9




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**Suggested Reference Book(s):**

1. Modern Geotechnical Engineering by Alam Singh, CBS Publications
2. Soil Engineering (vol.-1) Fundamental & General Principles by AlamSingh, CBS Pub.
3. Soil Engineering (vol.-2) Geotechnical Testing & Instrumentation byAlam Singh & Chowdhary, CBS Publications
4. Soil Mechanics by Lambe& Whitman, Wiley Publications
5. Indian Standards Codes

**Other useful resource(s):**

1. Link to NPTEL course content: https://nptel.ac.in/courses/105103097
2. Links related to topics of course:
   https://nptel.ac.in/courses/105103097/32
   https://nptel.ac.in/courses/105103097/37
   https://nptel.ac.in/courses/105103097/43

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Geotechnical Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.75** |
| CO-2 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | **2.08** |
| CO-3 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | **2.08** |
| CO-4 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 1 | 2 | **2.08** |

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**Evaluation**

| Sr. No. | Components | Total Marks |
|---|---|---|
| 1 | **Test 1** | 15 |
| 2 | **Test 2** | 25 |
| 3 | **Test 3** | 35 |
| 4 | **Internal Assessment** | 25 |

| **Recommended Reading** (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format) | |
|---|---|
| **1.** | *Practical English Usage. Michael Swan. OUP.1995.* |
| **2.** | *Remedial English Grammar. F.T. Wood. Macmillan. 2007* |
| **3.** | *On Writing Well. William Zinsser. Harper Resource Book. 2001.* |
| **5.** | *Study Writing.Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006* |
| **6.** | *Communication Skills. Sanjay Kumar and Pushp Lata. OUP. 2011.* |
| **7.** | *Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. OUP* |
| **8.** | *A Communicative Grammar of English. 3rd Edn. G. Leech and J. Svartvik. 2012* |
| **9.** | *Williams, K., Krizan, A. C., Logan, J. & Merrier, P. (2011) Business Communicating in Business 8th Ed. New Delhi: Cengage Learning.* |
| **10.** | *Murphy, Herta A., Herbert Hildebrandt, Jane Thomas (2008) Effective Business Communication 7th Ed. New Delhi:Tata Mcgraw Hill Education Private Limited.* |
| **11.** | *Guffey, M. A. (2000) Business Communication: Product & Process South-Western College Publishing.* |
| **12.** | *Lesikar, R. V., Flatley, M.E., Rentz, K. & Pande, N. (2009) Business communication 11th Ed. New Delhi: Mc Graw Hill.* |
| **13.** | *Business correspondence and Report Writing: by R. C. Sharma & Krishna Mohan* |

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# Geotechnical Engineering Lab

COURSE CODE: 18B17CE471

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

## Course Objectives:

1. To learn determination of index properties of soils.
2. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test
3. Imparting knowledge of and ability to perform laboratory tests needed to determine foundationdesign parameters
4. To estimate the engineering properties of the soils by in-situ tests

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To classify soil by physical observation of the soils, estimated index and engineering characteristics of soils. | Assessment |
| CO2 | To estimate unconfined compressive strength of soil and shear strength parameters by laboratory vane shear test and derive undisturbed and remoulded shear strength of soil. | Assessment |
| CO3 | To perform and calculate free swelling of expansive soils. | Usage |
| CO4 | To analyze the difference between lab tests and in-situ testing conditions. | Assessment |
| CO5 | To become familiar with new soil testing practices. | Familiarity |

## List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Field Identification Test | 1 |
| 2 | Determination of Moisture Content using oven method | 1 |
| 3 | Specific Gravity of soil particles by Pycnometer method and density bottle method | 2 |
| 4 | Particle size distribution of soils (Grain size analysis) by Sieve analysis for course-grained soils and hydrometer analysis for fine - grained | 2 |
| 5 | Determination of Atterberg's limits (Consistency limits) (a) Liquid Limit (b) Plastic Limit (c) Shrinkage limit | 1 |
| 6 | Determination of permeability of soils by Constant head and variable head method | 2 |



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| | | |
|---|---|---|
| 7 | Soil compaction light and Heavy test (Density moisture relations) | 1 |
| 8 | Oedometer test for consolidation of soils | 2 |
| 9 | Determination of swelling index by swelling pressure test | 1 |
| 10 | Determination of shear strength parameters of cohesionless soils by Direct Shear Test | 1 |
| 11 | Determination of shear strength parameters of soil by Unconfined Compressive strength Test | 2 |
| 12 | Determination of shear strength of cohesive soils by Vane Shear Test | 2 |
| 13 | Determination of shear strength parameters by Triaxial Test | 2 |
| 14 | Determination of density of soils by Core cutter method and sand replacement method | 2 |
| 15 | Determination of in – situ shear strength by Standard Penetration test (Demonstration) | 2 |
| **Total Lab hours** | | **24** |

**Suggested/Resources:**

1. Soil Mechanics laboratory manual by Braja M Das; Publisher: Oxford university press
2. Manual of Soil laboratory Testing (Vol. 1 and Vol. 2) by K. H. Head; Publisher: Pentech Press, London

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Geotechnical Engineering Lab) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | **1.92** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | **2.17** |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | **2.00** |
| CO4 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | **1.83** |
| **Average** | **3** | **2** | **3** | **2** | **3** | **3** | **1** | **2** | **1** | **2** | **2** | **1** | |

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# Engineering Mechanics

COURSE CODE: 18B11CE315

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Elementary Knowledge of Physics and Mathematics upto Class XII

**Course Objectives:**

1. Learn to beams under different loading conditions and to find out the shear force and bending moment diagram.
2. Learn to analyze different types to trusses and to find out the forces in the members.
3. Learn to find the centroid and moment of inertia of different types of crosssections.
4. Learn to calculate the types of motion applied to a body and its characteristics.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Analyse the beam under flexure for different loadings and to draw shear force and bending moment diagram. | Familiarity |
| CO-2 | Analyse planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction. | Assessment |
| CO-3 | Determine the resultant force and moment for a given system of forces; Determine the centroid and second moment of area. | Assessment |
| CO-4 | Determine different types of stresses induced in a static body. Types of beams and Shear force and bending moment diagram. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures |
|---|---|---|
| 1 | **Introduction to Engineering Mechanics:** Principles of Statics, System of Forces, Moment of a Force, Varignon's Theorem, Couple Transfer of a Force to Parallel Position, Composition of Concurrent Coplanar Forces, Equilibriant of a Force System, Composition of Coplanar Non-concurrent Force System, X and Y Intercepts of Resultant, Types of Forces on a Body, Free Body Diagram, Equilibrium of Bodies, Equilibrium of Concurrent Force Systems, Equilibrium of Connected Bodies, Equilibrium of Non-concurrent Force Systems. | 8 |
| 2 | **Plane truss and Space truss:** Perfect, Deficient and Redundant Trusses, Assumptions, Nature of Forces in Members, Methods of Analysis, Method of Joints, Method of Section. | 8 |

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| | | |
|---|---|---|
| 3 | **Distributed forces, center of gravity and moment of inertia**: determination of areas and volumes, center of gravity and centroids, centroid of a line, first moment of area and centroid, second moments of plane area, moment of inertia from first principles, moment of inertia of composite sections, theorems of pappus-guldinus, centre of gravity of solids. | **8** |
| 4 | **Simple stresses and strains:** Meaning of Stress, Unit of Stress, Axial Stress, Strain , Stress-Strain Relation , Nominal Stress and True Stress, Factor of Safety, Hooke's Law , Extension/Shortening of a Bar, Bars with Cross-sections Varying in Steps ,Bars with Continuously Varying Cross-sections , Shear Stress, Simple Shear, Poisson's Ratio , Volumetric Strain , Elastic Constants , Relationship between Modulus of Elasticity and Modulus of Rigidity Relationship between Modulus of Elasticity and Bulk Modulus, Composite/Compound Bars Thermal Stresses, Thermal Stresses in Compound Bar, Hoop Stresses. | **9** |
| 5 | **Beams:** Introduction, types of supports, types of beams, types of loading, reactions from supports of beams, shear force and bending moment sign convention, relationship between load intensity, shear force and bending moment, shear force and bending moment diagrams, SFD and BMD for few standard cases, short-cut procedure. | **9** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. S. S. Bhavikatti : Mechanics of solids, 3rd Edition, New age international (p) limited, publishers
2. Vector Mechanics; Static & Dynamics by Beer & Johnston, TMH publication
3. Engineering Mechanics; A.K.Tayal, Umesh Publication

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/106104019/
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/105106116/1
   ii. https://nptel.ac.in/courses/105106116/8
   iii. https://nptel.ac.in/courses/105106116/14

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# Concrete Technology

COURSE CODE:18B11CE611

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. Learn concrete making materials including supplementary cementitious materials
2. Learn Concrete production process.
3. Learn concrete production process and properties and uses of concrete as a modern material of construction.
4. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Identify hydration mechanism and testing of concrete making materials. | Familiarity |
| CO-2 | Understand the behavior of fresh and hardened concrete. | Assessment |
| CO-3 | Understand the influence of chemical and mineral admixture. | Assessment |
| CO-4 | Understand the mix design and durability requirements of concrete | Usage |
| CO-5 | Understand the need for special concretes | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Cement**: Production, composition, and properties; cement chemistry; Types of cements; special cements. | 8 |
| 2 | **Aggregates**: Mineralogy; properties, tests and standards | 8 |

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| | | |
|---|---|---|
| 3 | **Chemical and mineral admixtures**: Water reducers, air entrainers, set controllers, specialty admixtures - structure properties, and effects on concrete properties. Introduction to supplementary cementing materials and pozzolans. Fly ash, blast furnace slag, silica fume, and metakaolin - their production, properties and effects on concrete properties. Other mineral additives - reactive and inert. | 6 |
| 4 | **Concrete mix design**: Basic principles; IS method; ACI method; new approaches based on rheology and particle packing. | 6 |
| 5 | **Concrete Production & Fresh concrete**: Batching of ingredients; mixing, transport, and placement. Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement. Workability of concrete and its measurement | 4 |
| 6 | **Engineering properties of concrete**: Compressive strength and parameters affecting it. Tensile strength - direct and indirect; Modulus of elasticity and Poisson's ratio. Stress strain response of concrete. | 6 |
| 7 | **Dimensional stability and durability:** Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance. Parameters affecting shrinkage; measurement of creep and shrinkage. | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

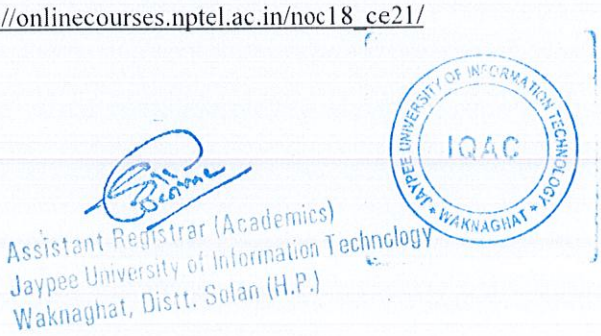

1. A.M.Neville, -Properties of Concrete‖, English Language Book Society/Longman Pub, 1988.
2. P.K.Mehta and J.M.M.Paulo, —Concrete – Microstructure – Properties and Material‖, ICI, Indian First Edition, Reprint 1999.
3. Zonghjin Li, —Advanced Concrete Technology, John Wiley & Sons, INC, Newjersy, 2011‖.


**Suggested Reference Book(s):**


1. Taylor, H. W. F., _Cement Chemistry,' Academic Press, Inc., San Diego, CA, 1990.
2. Lea, F. M., _The Chemistry of Cement and Concrete,' Chemical Publishing Company, Inc., New York, 1971.
3. Mindess, S., and Young, J. F., _Concrete,' Prentice Hall, Inc., NJ, 1981. J. Newman and B. S. Choo, Eds., _Advanced Concrete Technology', Four Volume Set, Elsevier, 2003


**Other useful resource(s):**

1. Link to NPTEL course contents:https://onlinecourses.nptel.ac.in/noc18_ce21/

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Concrete Technology ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 1 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | | 2 | 3 | **1.81** |
| CO-2 | 1 | 2 | 1 | 2 | 2 | 1 | | 2 | 3 | 3 | 1 | 3 | **1.91** |
| CO-3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | | 1 | 3 | **2.18** |
| CO-4 | 3 | 2 | 1 | 3 | 1 | 2 | | 1 | 3 | 2 | 3 | 3 | **2.18** |
| CO-5 | 2 | 3 | 3 | 3 | 1 | 3 | | 1 | 2 | 2 | 3 | 3 | **2.36** |
| **Average** | **2.4** | **2.2** | **2** | **2.2** | **1.2** | **2** | **1.5** | **1.6** | **2.4** | **2.33** | **2** | **3** | |

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# Design of Concrete Structures

COURSE CODE:18B11CE515

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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**Pre-requisite:** None

**Course Objectives:**

1. To understand the design concepts of various structural elements using Limit state method and detailing of reinforcement
2. To understand the design of beam and slab using limit state method.
3. To learn the design and analysis of column in different loading cases.
4. To learn and understand different types of staircases.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn different design philosophies and material properties | Familiarity |
| CO-2 | To design beam, slabs and columns | Assessment |
| CO-3 | To design for shear, anchorage, bond and development length. | Assessment |
| CO-4 | To learn different types of staircases and their design | Usage |
| CO-5 | To learn for the design of torsion | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| **1** | Analysis and design of beams and slabs by Limit state method. | **8** |
| **2** | Limit state of collapse flexure, Limit state of doubly reinforced beam | **8** |
| **3** | Limit state of collapse: Shear | **6** |
| **4** | Design of Slabs: One way, two way and circular slabs | **6** |
| **5** | Design of columns: uniaxial bending, biaxial bending and eccentric column design | **8** |
| **6** | Types and design of different types of staircases | **3** |
| **7** | Design for torsion | **3** |
| **Total lectures** | | **42** |



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**Suggested Text Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006.

**Suggested Reference Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006.

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/downloads/105105104/
2. Link to topics related tocourse:

i. https://nptel.ac.in/courses/106104019/1
ii. https://nptel.ac.in/courses/106104019/4
iii. https://nptel.ac.in/courses/106104019/26
iv. https://nptel.ac.in/courses/106104019/2Ev

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

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# Computer Aided Civil Engineering Drawing

COURSE CODE:18B11CE413

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. To learn the fundamentals of civil engineering drawings.
2. To develop knowledge of civil engineering software tools such as AutoCAD.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To be able to understand and interpret Civil Engineering Drawings. | Familiarity |
| CO2 | Learn and master basic skills in AutoCAD. | Assessment |
| CO3 | Understand basics of multidisciplinary engineering drawings such as mechanical, electrical, plumbing drawings. | Assessment |
| CO4 | To gain proficiency in planning and developing drawings for small residential buildings. | Usage |
| CO5 | Comprehend the basics of building information modeling. | Usage |

**List of Experiments:**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Introduction and interpretation to concept of engineering drawings using AutoCAD (Basic drawing entity commands. | 2 |
| 2 | Entity modification commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards and other advance commands. | 4 |
| 3 | Materials, Architectural, Structural, Electrical and Plumbing symbols drawing and interpretation using AutoCAD. | 2 |
| 4 | Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards. | 2 |
| 5 | English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall. | 2 |
| 6 | Elements of planning building drawing, Methods of making line drawing and detailed drawing. | 2 |
| 7 | Site plan, floor plan, elevation and section drawing of small residential buildings. | 4 |
| 8 | Foundation plan. Roof drainage plans. | 2 |

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|---|---|---|
| **9** | Standard fittings and fixtures, finishes. | **2** |
| **10** | Principles of isometrics and perspective drawing, Perspective view of building | **4** |
| **11** | Fundamentals of Building Information Modelling (BIM). | **2** |
| **Total Lab hours** | | **28** |

**Suggested Text Book(s):**


1. Engineering Graphics with AutoCAD by Kulkarni, Dhananjay M., A. P. Rastogi, and Ashoke K. Sarkar. PHI Learning Pvt. Ltd., 2009.
2. Civil Engineering Drawing by Rangwala and Dalal 3rd edition 2017
3. Civil Engineering Drawing & House Planning: A Text Book, by B.P Verma 2006
4. Building Information Modeling for Dummies by Stefan Mordue, 2015


**Evaluation Scheme:**

| | | |
|---|---|---|
| **1** | Mid Sem. Evaluation | 20 Marks |
| **2** | End Sem. Evaluation | 20 Marks |
| **3** | Attendance | 15 Marks |
| **4** | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Computer Aided Civil Engineering Drawing) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 3 | **2.17** |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 2 | x | x | 3 | 2 | x | 3 | **2.67** |
| **CO3** | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | **2.08** |
| **CO4** | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | **1.83** |
| **CO5** | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 2 | **2.08** |
| **Average** | **2.4** | **1.8** | **2.6** | **2.2** | **1.8** | **2** | **2.25** | **1.25** | **2.6** | **2** | **2** | **2.6** | |

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# OPTIMIZATION TECHNIQUES

COURSE CODE: 18B1WCE640

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

## Course Objectives:

1. To provide optimal solutions to a particular engineering problem.
2. To impart understanding of mathematical tools for solution of engineering problems.
3. To apply modern computer aided tools for solution of optimization problems.

## Course Outcomes:

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understanding the fundamentals of application of Optimization Techniques to Engineering Problems. | Assessment |
| CO-2 | Application of Mathematical modeling to render complex engineering problems solvable. | Assessment |
| CO-3 | Utilization of computer/software tools to solve optimization problems. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1. | Optimization technique's introduction | 2 |
| 2. | Linear Programming Problems (LPP): Definition of LPP, Simplex Method, Artificial Variable Method, Two Phase Method, using MS-EXCEL, reverse simplex, dual problems, Sensitivity analysis | 10 |
| 3. | Study of Mathematical Models, Graphical Solutions of Linear Programming Problems (LPP), Random variables, Binomial, | 8 |

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| | | |
|---|---|---|
| | Poisson, Exponential and Normal Distribution | |
| **4.** | Non- Linear Programming Problems (NLP). Quadratic programming, | **2** |
| **5.** | Geometric programming, Goal programming, Resource allocation, Integer programming, dynamic programming, Game theory | **8** |
| **6.** | Transportation Problems: Introduction to Transportation Model, Matrix Form of TP, Applications of TP Models, Basic Feasible Solution of a TP, Degeneracy in TP, Formation of Loops in TP, Solution Techniques of TP, Different Methods for Obtaining Initial Basic Feasible Solutions Viz. Matrix Minima Method, Row Minima Method, Column Minima Methods, Using MS_EXCEL | **8** |
| **7.** | Evolutionary algorithms for optimization and search, Multi objective optimization – Weighted and constrained methods; Multi level optimization | **4** |
| TOTAL | | **42** |

**Suggested Text Book(s):**


1. Taha, Hamdy A., Operation Research: An Introduction, Prentice Hall.
2. Rao S.S, Engineering Optimization, theory and practice, New age International


## Suggested Reference Book(s):


1. E Polak, Computational Methods in Optimization, Academic Press, New York
2. P E Gill, W Murray and M H Wright, Practical Optimization, Academic Press, New York
3. S J Gass, Linear Programming, McGraw Hill Book Co. New York
4. LjungLennant, System identification: theory for the users, Prentice Hall, India
5. Vedula and Mujumdar Water Resources System Analysis TMH.
6. Deb Kalyanmony, Optimization for engineering design, Prentice Hall, India


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## Other useful resource(s):

1. Link to NPTEL course: https://nptel.ac.in/courses/105/108/105108127/

## Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Throughout the Semester | Assignment (4) – 10<br>Quizzes(2)-10 (Best Score)<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Optimization Techniques) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | 3 | **2.25** |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | **2.67** |
| CO-3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 3 | **2.58** |
| Average | **3** | **3** | **2.67** | **2.67** | **2.67** | **2.33** | **3** | **1.67** | **2.67** | **1** | **2.33** | **3** | |

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# Advanced Reinforced Concrete Design

COURSE CODE:18B1WCE831

COURSE CREDITS 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Design of concrete structures

**Course Objectives:**

1. To understand the design concepts of various structural elements using working stress method and detailing of reinforcement
2. To understand the design of beam and slab using Yield line theory.
3. Underground and elevated liquid retaining structures. To study the design of material storage structures
4. To understand the design concept of cantilever and counterfort types of retaining walls

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Analysis and design of beams and slabs by working stress method | Familiarity |
| CO-2 | Yield line Theory of slabs and Methods of Analysis | Assessment |
| CO-3 | Design of underground and elevated water tanks | Assessment |
| CO-4 | Design cantilever and counterfort retaining walls | Assessment |
| CO-5 | Analysis and design of Foundation | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Analysis and design of beams and slabs by working stress method:** Introduction to working stress method of design. Assumptions in the theory of simple bending, Concept of transformed or equivalent sections, Analysis of singly reinforced section and doubly reinforced sections. | 8 |
| 2 | **Yield line Theory of slabs and Methods of Analysis:** Introduction to yield line theory, Properties of yield lines, Methods of analysis, one way slabs, two way slabs, yield line analysis of slabs | 10 |
| 3 | **Design of underground and elevated water tanks:** Design principles of underground and elevated water tanks, Detailed design of rectangular and circular elevated water tanks as per IS 3370, | 12 |



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| | | |
|---|---|---|
| | Design of Ring Beam and staging for elevated water tanks, Detailed Design of Intz Tanks. | |
| **4** | **Design cantilever and counterfort retaining walls:** Principles of Cantilever and counterfort type retaining walls, Detailed design of cantilever type of retaining walls | **9** |
| **5** | **Analysis and design of Foundations:** Types of foundations and its needs. Analysis and design of a isolated footing | **3** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

**Suggested Reference Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/106104019/
2. Link to topics related tocourse:

i. https://nptel.ac.in/courses/106104019/1
ii. https://nptel.ac.in/courses/106104019/4
iii. https://nptel.ac.in/courses/106104019/26
iv. https://nptel.ac.in/courses/106104019/2Ev

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |

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# Structural Analysis

COURSE CODE:18B11CE513

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To find the advantages and disadvantages of indeterminate structure and their indeterminacy.
2. To solve an indeterminate structure by Force Method.
3. To solve an indeterminate structure by Displacement Method.
4. To find deflection in truss, beam and frame by Energy Method.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Student will able to differentiate between given problems as it comes under determinate or indeterminate problems. | Assessment |
| CO-2 | Student will able to solve simple indeterminate problems by force method and displacement method. | Assessment |
| CO-3 | Student will able to know in what kind of problem force method should be used and for what kind of problem displacement method should be used. | Assessment |
| CO-4 | Student will come to know how to analyze a structure in which footing were settled due to loose soil. | Assessment |
| CO-5 | This course will help the students in reinforced concrete design and steel design as they required moments for designing a structural element. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction**: Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium | 4 |

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| | | |
|---|---|---|
| 2 | **Indeterminacy**: Static and kinematic indeterminacy of beam, frame and truss structures | 4 |
| 3 | **Deflection**: Deflection of truss, beam and frame structures by energy method. | 3 |
| 4 | **Force Method**: Solving Indeterminate beam, truss and frame by force method. | 7 |
| 5 | **Theorems**: Castigliano's theorem, Maxwell-Betti's theorem | 2 |
| 6 | **Three Moment equation**: Derivation and Application of three moment equation | 2 |
| 7 | **Slope Deflection Equation**: Derivation and application of slope deflection equation for beams and frames, support settlement and sway of frames | 7 |
| 8 | **Moment Distribution Method**: Application of Moment Distribution method for beams and frames, support settlement and sway of frames | 7 |
| 9 | **Cables**: Introduction to cables, General cable theorem and its application. | 3 |
| 10 | **Arches**: Three hinged arch, Two hinged arch | 3 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. R.C. Hibbeler: Structural Analysis, Eight Edition., Prentice Hall, 2012
2. C.K, Wang: Intermediate Structural Analysis, 7th Ed., Mc Graw Hill, 2008.

**Suggested Reference Book(s):**

1. Aslam Kassimali: Structural Analysis, 4th edition, Cengage Learning, 2011.
2. Devdas Menon: Structural Analysis, Narosa, 2010

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/downloads/105101085/#

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Structural Analysis) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | **1.75** |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **2** |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.75** |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2** |
| CO-5 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | **2.4** |
| **Average** | **2.2** | **2.4** | **2.6** | **2.6** | **2.4** | **1.4** | **1.2** | **1** | **2** | **2.2** | **1.8** | **2.2** | |

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# Mechanics of Solids

COURSE CODE: 18B11CE415

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** Engineering Mechanics

**Course Objectives:**

1. To impart the knowledge of mechanics of deformable bodies under static loads including temperature variation
2. To teach students the development of strains & stresses in solids and their relationships
3. To develop knowledge of behavior of structural members (beams, columns, shafts, etc.) under loading and draw bending moment and shear forces diagram of members for different loading.
4. To impart knowledge of methods used to compute slope and deflections in beams under transverse loads.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | At the end of the course students will have knowledge of various stress and strain systems, their relationships and behavior of materials under loads. | Assessment |
| CO-2 | The students will develop concept of complex stresses and their treatment to find maximum value of a stress. | Assessment |
| CO-3 | Students will develop understanding of how various forcing functions (shear force, bending moment and torque) vary along a structural element and be able to plot the same. | Assessment |
| CO-4 | The students will be able to analyze a structural member (beams, columns, shafts, etc.) in depth with determination of crucial stresses, strains and deformation characteristics. | Assessment |
| CO-5 | The students will be able to use the subject knowledge to decide failure locations in a solid body subjected to different types of loading. | Assessment |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Mechanics of Deformable Solids:** Definition of stress and strain. Hooke's law for axial loads. Constants of elasticity: Young's modulus, shear modulus, Poisson's ratio. | 7 |
| 2 | **Axial load:** Calculation of stress and strain, design of bars for axial load. Statically indeterminate structures. Thermal effects on axial deformation and geometric —misfits‖. Shear stress and shear strain. Bars of uniform, varying and tapering cross sections, composite bars. | 5 |
| 3 | **Torsion of circular bars:** Computation of shear stress, Hooke's law for shear; design of circular bars. stress distributions in beams. | 3 |
| 4 | **Complex Stresses:** Stresses on inclined planes, principal stresses and strains, Mohr's circle of stresses, theories of elastic failure. Generalized Hooke's law for isotropic materials. | 6 |
| 5 | **Shear Force and Bending Moment Diagram:** Relationships between loads, shear force and bending moment. Shear force and bending moment diagram for different beams and their application. | 5 |
| 6 | **Bending Stress:** Flexural stress in linearly elastic beams; design of beams for strength; differential equations of the deflection curve; computation of slope and deflection; unsymmetrical bending | 6 |
| 7 | **Slope and deflection of beams:** Differential equation of the deflection curve, double integration method, Macaulay's method, moment area method and conjugate beam method. | 7 |
| 8 | **Buckling of columns:** The ideal pin-ended column; Euler buckling load; the effect of end conditions on column buckling. | 3 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Beer , Johnston, Dewolf, Mazurek, Sanghi: Mechanics of Materials, 7th Edition, McGraw Hill Education India Private Limited, 2017
2. Shames Irving H: Introduction to Solid Mechanics, 3rd Edition, Prentice Hall India Learning Private Limited, 2002.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain: Mechanics of Materials, Laxmi Publications; Revised edition (2017)


**Suggested Reference Book(s):**


1. Russell C. Hibbeler: Static and Mechanics of Materials, 5th Edition, Pearson, 2018.
2. William Nash: Schaum'sOtline of Strength of Materials, 6th Edition, McGraw Hill Education India Private Limited, 2013




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**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/105102090/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Mechanics of Solids) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | **2.4** |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | **2.3** |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | **2.2** |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | **2.2** |
| CO-5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | **2.5** |
| **Average** | **3** | **2.8** | **3** | **2.6** | **2.2** | **1.6** | **1** | **2.2** | **2.8** | **2.4** | **2.2** | **2.2** | |

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# Foundation Engineering

COURSE CODE:18B11CE514

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** Geotechnical Engineering

**Course Objectives:**

1. To provide the students with an in-depth knowledge and understanding of the principles governing the design of foundation systems for structures.
2. To develop an understanding of the strength and settlement behavior of different kinds of foundations on different soils and their relative choice.
3. To provide them with an opportunity to apply the design procedures to a "real life" foundation design project.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Identify the essential steps involved in a geotechnical site investigation and specify appropriate laboratory test procedures for the characterization of soil materials with respect to strength and compressibility. | Familiarity and Usage |
| CO-2 | Identify the principal types of foundations and describe the factors governing the choice of the most suitable type of foundation for a given situation. | Familiarity |
| CO-3 | Perform: (a) bearing capacity and, (b) settlement analyses for shallow foundations. | Assessment |
| CO-4 | Evaluate (a) end bearing capacity and (b) skin friction for a given type of deep foundations and hence estimate their axial load capacity. | Assessment |
| CO-5 | Prepare a geotechnical engineering report documenting procedures used and findings from site investigation, laboratory characterization of subsurface materials, analysis performed and final recommendations with regard to the optimum design of the foundations system. | Usage |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Foundation requirement, types and selection of foundation | 3 |
| 2 | **Site Investigation and Soil Exploration Techniques:** Site Investigation and site survey, Dynamic method of site exploration, Geophysical methods | 10 |
| 3 | **Bearing capacity of shallow foundations**: Bearing capacity theories, Raft foundation; types, design principle of rigid raft foundation,Plate Load test | 9 |
| 4 | **Settlement of foundations:** Settlement considerations; allowable, total and differential settlements, estimation of settlement of structures | 4 |
| 5 | **Axially and eccentrically loaded footings** | 4 |
| 6 | **Pile foundation:** Types, pile load capacity, static and dynamic formulae, pile load test, pile groups; load capacity and settlement | 6 |
| 7 | **Well and Cassion foundation:** Introduction to well and cassion foundation, construction and bearing capacity calculation | 6 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Geotechnical Engineering by Venkatrammaiah, New Age International Publishers
2. Basic and Applied soil Mechanics by Gopal Ranjan & Rao, New Age International Publishers
3. Soil Mechanics & Foundation Engineering by K R Arora, Standard Publishers New Delhi

**Suggested Reference Book(s):**

1. Foundation Engineering by E. Bowles,
2. Foundation Design and Construction by Tomlinson, Prentice Hall
3. Design Aids in Soil Mechanics & Foundation Engineering by Kaniraj, TMH
4. Geotechnical Engineering by S.K. Gulhati& Datta, TMH

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |

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# Dams and Reservoir Design

COURSE CODE:18B1WCE736

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Water Resource Engineering, Geotechnical Engineering

**Course Objectives:.**

1. To introduce the students to the basic knowledge of dams and their appurtenances.
2. To develop an understanding regarding selection of a suitable dam for a particular site.
3. Impart knowledge about the construction, design and maintenance of various dams.
4. Train the students to analyze various dams to check their stability and safety.
5. To apply the principles of water resource and irrigation engineering and excel the students in the computation of the reservoir capacity which is indispensable for deciding the inundation area and demand pattern for any dam.
6. To enable the students to apply their knowledge of mechanics to calculate the critical stresses and various forces(static and dynamic) to ensure the proper design and stability of the dam.
7. To introduce the students to the various modern techniques and various challenges of dam construction by exposing them to real field conditions incorporating modern pedagogical methods of learning.
8. To train the students to use software tools for the modeling and analysis of various dams.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Select the suitable site for construction of different dams and suggest the type of dam required as per the topographical, functional, economical and ecological considerations. | Familiarity |
| CO-2 | Know about the various components of a dam, their functions and types. | Familiarity |
| CO-3 | Calculate the reservoir capacity based on demand (outflow) and supply (inflow) patterns. | Assessment/ Usage |
| CO-4 | Calculate the forces and stresses coming on gravity and earthen dams due to static and dynamic forces prevalent in nature | Assessment |
| CO-5 | Analyze the dam for its safety against various forms of failure and suggest the preventive measures. | Assessment/ Usage |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction and project planning:** Dams and their historical emergence, requirement and types of dams, dam appurtenances. Planning of project, Purpose of development, Project study, Ecological and environmental considerations, Flood studies, Economic consideration, Physical factor governing selection of type, legal, economic, aesthetic considerations, and foundation and construction materials. Investigation, Source of information, Surface exploration, sampling, Field and laboratory tests. | 12 |
| 2 | **Reservoir studies:** Types of reservoir, inflow and outflow study into the reservoir, capacity determination by various techniques | 6 |
| 3 | **Concrete gravity dam:** Introduction, Origin and development, Forces acting on dam, Requirements for stability, Dams on pervious foundations | 9 |
| 4 | **Earthfill dams:** Origin, Selection of type, Design principles, Foundation design, Embankments, Embankment details. | 9 |
| 5 | **Rockfill dams:** Origin and usage, Definition and types, Foundation design, Embankment design, Membrane design. | 6 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. S.K. Garg: Irrigation Engineering and Hydraulic Structures, 19th Edition, Khanna Publishers, 2005.
2. W.P.Creager, J.D.Justin and J.Hinds: Engineering for dams, Wiley, 2007.

**Suggested Reference Book(s):**

1. Trevor Turpin: Dams, First edition, Reaktion Books Publishion,2008.
2. S.K. Ukarande: Irrigation and Hydraulic structures, Third Edition, Ane Books Pvt. Limited, 2017.
3. I.H. Siddhiqui: Dams and Reservoirs: Planning and Engineering, First Edition, OUP Pakistan, 2008

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |

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# Water Resource Engineering

COURSE CODE:18B11CE414

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** Fluid Mechanics, Soil Mechanics

**Course Objectives:**

1. To impart the knowledge of hydrology that deals with the occurrence, distribution, movement and properties of water on the earth and beneath the surface as ground water.
2. To supplement the knowledge of various irrigation techniques, water requirements of the crops and the estimation of the water supplies.
3. To learn about distribution systems for canal irrigation, design of unlined and lined irrigation canals design with their economic justification and sediment problems associated with canals.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Knowledge of various components of hydrologic cycle that affect the movement of water in the earth and their estimation techniques. | Familiarity and Assessment |
| CO-2 | Ability to estimate stream flow through various stream flow measurements techniques. | Assessment |
| CO-3 | Grasping of the concepts of movement of ground water beneath the earth and ability to estimate the yielding capacity of the source. | Familiarity and Assessment |
| CO-4 | Knowledge of the basic requirements of irrigation and various irrigation techniques and estimation of water to be supplied for crop requirements. | Familiarity and Usage |
| CO-5 | Understanding of distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals. | Familiarity and Usage |

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**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Engineering Hydrology:** Hydrological cycle, ground and surface water resource, single and multipurpose projects, precipitation, snowfall and snowmelt, evaporation, transpiration, depression storage, infiltration, overland flow, stream flow measurements, hydrograph, flood frequency analysis, flood estimation | 20 |
| 2 | **Ground water:** Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential | 6 |
| 3 | **Irrigation Engineering:** Water requirements of crops, Moisture-crop relationship, Irrigation requirements, duty and delta, Irrigation efficiencies, Design of conventional and modern methods of irrigation, Irrigation of arid lands, Salinity of soil, Salinity control, Quality of irrigation water, Contaminants and their effects on various crop types, Rain water management, conjunctive use of water, Water logging causes and control, drainage system design. | 9 |
| 4 | **Canal system:** Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributary canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining. | 7 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. S. K.Garg: Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2005.
2. K.Subramanya: Engineering Hydrology, McGraw Hill Education, 2005.
3. S. K.Garg: Hydrology and Water Resources Engineering, Khanna Publishers, 2005

**Suggested Reference Book(s):**

1. Ven T Chow, David R Maidment, Larry W Mays: Applied Hydrology, McGraw Hill Education, 1988.

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |

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| | | | | |
|---|---|---|---|---|
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Water Resource Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | **2.08** |
| CO-2 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | **2.08** |
| CO-3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | **2.00** |
| CO-4 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | **2.08** |
| CO-5 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | **2.08** |
| **Average** | **3.00** | **2.60** | **2.00** | **1.60** | **2.80** | **1.80** | **2.60** | **2.20** | **2.80** | **1.00** | **1.00** | **1.40** | |

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# Building Materials and Construction

COURSE CODE:18B11CE313

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To gain understanding of properties and usage of bricks, stones, timber and miscellaneous materials used in construction.
2. To become familiar with classification of buildings, walls, brick masonry and stone masonry
3. To be well versed with the properties and usage of plastering, roofs, floors, doors, damp proofing, stairs etc.
4. To gain state of the art knowledge of properties and usage of scaffolding, sound and fire proofing, paints and distempers.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Learn about properties and usage of bricks, stones, timber and miscellaneous materials used in construction. | Familiarity |
| CO-2 | Learn about classification of buildings, walls, brick masonryand stone masonry | Familiarity |
| CO-3 | Learn the properties and usage of plastering, roofs, floors, doors, damp proofing, stairs etc. | Familiarity |
| CO-4 | Learn the properties and usage of scaffolding, sound and fire proofing, paints and distempers. | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Bricks:** Classification, properties and selection criteria of bricks, burning of bricks, tests for bricks. | 2 |
| 2 | **Stones:** Stone classification, characteristics of good building stone, common building stones in India, Limestone. | 1 |
| 3 | **Timber:** Characteristics of good timber, defects in timber, seasoning of timber, plywood. | 2 |
| 4 | **Miscellaneous Materials:** Cement, Concrete, steel, glass, plastics, P.V.C., paint, varnish, adhesive materials, bitumen, ceramics. | 7 |
| 5 | **Buildings and Walls**: Classification of buildings, types of walls | 1 |
| 6 | **Brick Masonry**: Technical terms, types of bonds, strength of brick masonry, defects in brick masonry, reinforced brickwork | 2 |

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| | | |
|---|---|---|
| 7 | **Stone Masonry**: Technical terms, stones, cutting and dressing, lifting of stones, joints in stone masonry, classification of stone masonry, selection of stone for masonry | 1 |
| 8 | **Plastering and Pointing**: Objects and requirements of plastering, terminologies, tools, methods of plastering, selection of good plaster, types of mortars, plaster finishes, defects, Pointing: Methods and types of pointing | 4 |
| 9 | **Roofs and Floors**: Types and construction of roofs, features, necessity, arches, lintels, types & construction of ground floor, upper floor, floor finishes | 3 |
| 10 | **Doors and Windows**: Location, Technical terms of door & window, door frame, size, designation of door and window, types of door & window | 2 |
| 11 | **Damp Proofing and Termite Proofing**: Causes, effects, various methods and material used for damp proofing and termite proofing | 3 |
| 12 | **Stairs**: Technical terms, requirements, dimension of step, types and classification of stairs | 3 |
| 13 | **Paints, Distemper, White wash and Color wash**: Paints and Paintings, characteristics of ideal paint, Constituents of paint, defects in paintings, painting on different surfaces, classification and type of paints, Distempering & process of distempering, white washing & color washing | 5 |
| 14 | **Scaffolding**: Components and types of scaffolding | 2 |
| 15 | **Sound and Fire proof construction**: Sound Insulation, Insulation values for different type of walls, sound proof materials, Fire: Causes, fire hazards, fire load, grading of building according to fire resistance, characteristics of fire resisting materials, fire alarms, fire extinguishing equipments. | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. S.K Duggal: Building Materials, 4th Edition, New Age International Publishers,2012.
2. B.C Punmia, Ashok Kr. Jain, Arun Kr. Jain: Building Construction,11th Edition, Lakshmi Publications,2016.
3. M.L Gambhir, Neha Jamwal, Building Materials, Mc Graw Hill, 2014


**Suggested Reference Book(s):**


1. Rangwala, Building Construction, 33rd Edition, Charotar Publishing House Pvt. Ltd.,


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# Concrete Technology Laboratory

COURSE CODE: 18B17CE373

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** Concrete Technology

**Course Objectives:**

1. To learn the basics of different tests performed for quality control of cement, fine aggregates, coarse aggregates and water.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Identify Quality Control tests on concrete making materials | Assessment |
| CO2 | Understand the behavior of fresh and hardened concrete | Assessment |
| CO3 | Design concrete mixes as per IS and ACI codes | Assessment |
| CO4 | Understand the durability requirements of concrete | Usage |
| CO5 | Understand the need for special concretes | Usage |

**List of Experiments:**

| S.No. | Description | Hours |
|---|---|---|
| 1 | To determine consistency, fineness, setting time, specific gravity, soundness and strength of cement. | 6 |
| 2 | To determine specific gravity, sieve analysis and zoning, bulking of fine aggregate, bulk density, silt content of fine aggregate. | 6 |
| 3 | To determine specific gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption and moisture content, soundness of coarse aggregate. | 6 |
| 4 | To prepare a Concrete mix design by ACI 211.1-91 method, IS code methodasper 10262- 2007 and 456-2000, DOE method | 4 |
| 5 | Tests on Concrete - workability tests, slump cone test, compaction factor test, Vee-bee consistometer test, flow table test, strength tests- compressive strength, flexural strength, split tensile strength. | 4 |
| 6 | To find the effects of admixture - Accelerator, Retarder, Super Plasticizer | 2 |
| 7 | Nondestructive Testing on concrete by Rebound Hammer test, Ultrasonic Pulse Velocity test | 2 |
| **Total hours** | | **30** |

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**Suggested/Resources:**

1. Concrete technology lab manual by M.L.Gambhir

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Concrete Technology Laboratory) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| **CO4** | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **CO5** | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **CO6** | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **2.25** |
| **Average** | **2.67** | **2.83** | **2.80** | **2.80** | **2.60** | **2.20** | **1.20** | **1.00** | **1.00** | **1.00** | **1.20** | **1.40** | |

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# Design of Steel Structures

COURSE CODE:18B11CE612

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Mechanics of Materials

**Course Objectives:**

1. Learn to analyze algorithms for Time and Space Complexity
2. To provide a basic understanding of the mechanical properties and types of steels used in civil structures, and to develop technical competence in the design of tension and compression members, beams, and simple bolted and welded connections.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Design bolt and weld connections. | Familiarity |
| CO-2 | Design tension and compression members. | Assessment |
| CO-3 | Design beams and beam columns. | Assessment |
| CO-4 | Design built up members and column base. | Usage |
| CO-5 | Design of Plate Girder. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** General- Types of Steel – Mechanical behaviour of steel – Measures of yielding – Measures of Ductility – Types of Structures – Structural steel sections. | 2 |
| 2 | **Methods of Structural design**: Introduction-Design Philosophies-Working Stress Method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor-Load-Load combinations-Classification of coss sections- General aspects in the design. | 2 |

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|---|---|---|
| 3 | **Design of Steel fasteners:** Types of fasteners, Riveted connections, Bolted connections – Assumptions, Failure of bolted joints, Strength of bolted joints, Design examples, Design of Welded connections, Butt weld- fillet weld, Design examples.<br>**Design of Eccentric Connections**: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples | **10** |
| 4 | **Design of Tension Members:** General – Modes of failure of tension member, Analysis of Tension members, Example - Design steps, Design examples: Lug angles. | **6** |
| 5 | **Design of Compression Members:** Modes of Failure of a Column, Buckling Failure: Euler's Theory, Effective Length, Slenderness Ratio, Design Formula: I.S. Code Formula, Design of Compression Members, Design of Built-Up Compression Members: Laced and Battened Columns | **6** |
| 6 | **Design of Beams:** General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples | **4** |
| 7 | **Design of Beam Columns:** Behavior of members under combined loading – Modes of Failures – Design Examples. | **4** |
| 8 | **Design of Column Splices and Column Base:** Design of Column Splice-Design Examples, Slab Base- Gusseted Base- Design Examples | **4** |
| 9 | **Design of Plate Girder:** General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing- Transverse stiffeners - Design Examples. | **4** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Design of steel structures – N Subramanian, Oxford University Press – 2009.
2. Limit State Design of steel structures, S.K. Duggal, Tata McGraw- Hill, 2010.
3. IS - 800:2007.
4. IS – 808:1989.


**Suggested Reference Book(s):**


1. Design of Steel structures by K.S. Sai Ram, Person Education.
2. Design of Steel Structures Edwin H. Gaylord, Jr. Charles N. Gaylord and James Stallmeyer Tata McGraw-Hill Education Pvt. Ltd.
3. Design of Steel Structures Vol. 1 & 2 – Ramchandra, Standard Publications.
4. Design of steel structures, Structures, S.S. Bhavikatti, IK int Publication House, New Delhi, 2010.


**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/105106112/

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# FINANCIAL MANAGEMENT

COURSE CODE:18B1WCE738

COURSE CREDITS: 3

CORE/ELECTIVE:OPEN ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Construction Technology and Management, Costing and Estimation

**Course Objectives:**

1. To understand the Finance in civil engineering
2. To understand concept of alternatives for decision making
3. To analyse alternative investments
4. To understand fund management
5. To apply cash flow analysis to determine any cash shortfall through a construction projectconcept.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the components making upthe financial transaction and selection of suitableaccounting methods | Familiarity |
| CO-2 | Choose best alternatives for financial investments and assess financial health of organization in each environment | Assessment |
| CO-3 | Explain the depreciation, taxation, and inflation of any construction project | Assessment |
| CO-4 | Evaluate capital budgeting and working capital management parameters, risks, financialratios, international finance | Usage |
| CO-5 | Evaluate project cash flow | Usage |

**COURSE CONTENT**

| S No. | Description | Lectures |
|---|---|---|
| 1. | **Basic Principles** - Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest, Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments, (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment toperiodic payments | 6 |

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|---|---|---|
| | Arithmetic Gradient(G), Geometric Gradient (C). | |
| 2. | **Comparing Alternatives Proposals** - Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis,Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis, Benefit/Cost, Analysis, Break Even Analysis | **9** |
| 3. | **Evaluating Alternative Investments** - Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before andafter depreciation – Value Added Tax (VAT) – Inflation. | **9** |
| 4. | **Funds Management** - Project Finance – Sources of finance - Long-term and short - term finance, Working Capital, Management, Inventory valuation, Mortgage Financing - International financial managementforeign currency management. | **9** |
| 5. | **Fundamentals of Management Accounting** - Management accounting, financial accounting principles- basic concepts, financial statements –accounting ratios - funds flow statement – cash flow statement | **9** |
| | **TOTAL LECTURES** | **42** |

**Suggested Textbook(s):**


1. Blank, L.T., and Tarquin,a.J (1988) Engineering Economy,4th Edn. Mc-Graw Hill Book Co.
2. Anthony Higham,Carl Bridge, Peter Farrell, (2016), Project Finance for Construction, Routledge
3. Senthil, L. Madan and N. Robindro Singh (2011), Engineering Economics and Cost Analysis, Lakshmi Publications, New Delhi.


**Suggested Reference Book(s):**


1. Steiner, H.M. (1996) Engineering Economic principles, 2nd Edn. Mc-Graw Hill Book, NewYork.
2. Bose, D. C., (2010), Fundamentals of Financial management, 2nd ed., PHI, New Delhi.
3. Steven J. Peterson , (2012), Construction Accounting & Financial Management, Pearson, USA


**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/105/103/105103023/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |


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|---|---|---|---|---|
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) -10<br>Attendance - 5 |

**Course Outco mes (COs) contribution to the ProgrammeOutcomes (POs)**

| Course Outcomes ( Financial Management) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | **2.4** |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | **2.3** |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | **2.2** |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | **2.2** |
| CO-5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | **2.5** |
| **Average** | **3** | **2.8** | **3** | **2.6** | **2.2** | **1.6** | **1** | **2.2** | **2.8** | **2.4** | **2.2** | **2.2** | |

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# Building Drawing

COURSE CODE: 18B17CE771

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 1-0-4

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**Pre-requisite:** Individuals with knowledge of engineering drawing,understanding of architectural terminology and compatible with using windows operating system.

**Course Objectives:**

1. Learn the AutoCAD user interface.
2. Create sites, profiles, and cross-sections.
3. Use plan production tools to create plan and profile sheets.
4. Prepare detail drawings and Generate perspective view.
5. Creating a 3D building model with walls, curtain walls, windows, and doors
6. Adding floors, ceilings, and roofs to the building model.
7. Adding component features, such as furniture and equipment.
8. Setting up sheets for plotting with text, dimensions, details, tags, and schedules.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Create, edit, view, and analyze surfaces and sites, profiles, and cross-sections, Prepare detail drawings | Assessment |
| CO-2 | Generate perspective view of simple buildingand use plan production tools to create plan and profile sheets. | Assessment |
| CO-3 | Adding floors, ceilings, and roofs to the building model, component features, such as furniture and equipment. | Assessment |
| CO-4 | Creating a 3D building model with walls, curtain walls, windows, and doors | Assessment |

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**Course Contents:**

| Unit | Contents | Lectures |
|---|---|---|
| 1 | Product Overview, AutoCAD Civil 3D Workspaces, Start Tab, AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Toolspace | 2 |
| 2 | Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Breaklines and Boundaries, Surface Analysis Tools | 2 |
| 3 | Creating Alignments from Objects, Creating and Modifying Alignments, Labels and Tables, Create Profiles from Surface, Generate perspective view of simple building | 2 |
| 4 | Creating a Corridor, Creating Sections, Plan Production Tools, Prepare detail drawings for single and two storied residential building | 2 |
| 5 | Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools, Setting Up Levels and Grids | 2 |
| 6 | Working with Doors and Windows, curtain walls, views, Adding Components, Modeling Floors, ceilings and roofs, Stairs, Railings, and Ramps | 2 |
| 7 | Creating Construction Documents, Adding Tags and Schedules and Creating Details in building | 2 |
| **Total lectures** | | **14** |

**List of Experiments:**

| Sr. no. | Description | Hours |
|---|---|---|
| 1 | AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Toolspace, Draw symbols, conventions and Abbreviations | 3 |
| 2 | Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Breaklines and Boundaries | 3 |
| 3 | Surface Process, Breaklines and Boundaries | 3 |
| 4 | Generate perspective view of simple building | 3 |
| 5 | Plan Production Tools, Prepare detail drawings for single and two storied residential building | 3 |
| 6 | Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools | 3 |
| 7 | Doors and Windows, curtain walls | 3 |
| 8 | Floors, ceilings and roofs, Stairs, Railings, and Ramps | 3 |

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| | | |
|---|---|---|
| 9 | Adding Tags and Schedules and Creating Details in building | 4 |
| **Total** | | **28** |

**Suggested Textbook(s):**

- V. B. Sikka, "Civil engineering drawing", Charotar Publication
- Gurcharan singh, Subash chander, "Civil engineering drawing", published by Standard Publishers Distributors
- R. S. Malek G. S. Meo, "Civil engineering drawing", Computech Publication Ltd New Asian

**Other useful resource(s):**

1. nptel.ac.in/
2. www.Autodesk.com
3. www.drawingnow.com
4. www.learn-to–draw.com

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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**Course Outcomes (COs) contribution to the ProgrammeOutcomes (POs)**

| Course Outcomes | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 3 | **2.16** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | **2.5** |
| CO3 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | **2.08** |
| CO4 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | **1.83** |
| **Average** | **2.5** | **2** | **2.75** | **2.25** | **1.5** | **2** | **2.25** | **1.5** | **2.5** | **2** | **1.75** | **2.75** | |

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# Sewage Treatment and Disposal

COURSE CODE:18B11CE512

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. Learn to understand the basic fundamentals for treatment of municipal wastewater systems and the associated flow-sheets of the different treatment systems.
2. Learn about the operations of the wastewater treatment plant and the fundamental scientific principles involved in the treatment process.
3. Learn to design the unit operations and unit processes for treatment of municipal wastewaters.
4. Learn to design the physico-chemical and biological treatment systems for treatment of municipal wastewaters.
5. Learn to design the fundamentals of sludge treatment and tertiary treatment processes

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Critically analyze the problems arising out of the operation of wastewater treatment plant. | Familiarity |
| CO-2 | Ability to utilize proper design considerations depending upon the selected treatment method for wastewater and their potential limitations. | Assessment |
| CO-3 | Estimate design details for different treatment processes including conventional, low-cost treatment systems and advanced systems. | Assessment |
| CO-4 | Ability to learn apply effective disposal methods for treated waste water (sludge handling). | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Collection of Sewage:** Systems of sewerage – separate, combined and partially separate. Quantity of sanitary sewage and variations. Shapes of sewer – circular and egg shaped. Design of sewers, self-cleansing velocity and slopes, Construction and testing of sewer lines. Sewer materials. Joints and appurtenances. | 15 |

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| | | |
|---|---|---|
| 2 | **Sewage Characterization:** Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for disposal of effluents into inland surface sources and on land | 4 |
| 3 | **Sewage Treatment:** Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Tricking filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process, septic tank and Imhoff tank. | 18 |
| 4 | **Disposal of Sewage:** Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (sewage treatment | 5 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**


1. J. S Birdie, G S Birdie: Water Supply and Sanitation Engineering, 9th Edition, Dhanpat Rai Publications, India, 2014.
2. Garg S.K: Environmental Engineering – Sewage Disposal and Air Pollution Engineering (Volume -2), Khanna Publishers, India, 2015.
3. B.C. Punmia, A.K. Jain, A.K. Jain: Wastewater Engineering (including Air Pollution), 2nd Edition, Laxmi Publications. India,2016


**Suggested Reference Book(s):**


1. H. Peavy, D. Rowe, G.Tchobanoglous "Environmental Engineering", 1st Edition, McGraw Higher Education Publications, India, 2017.
2. Metcalf and Eddy Inc: Wastewater Engineering: Treatment and Resource Recovery,4th Edition, McGraw Hill Publications. India,2014


**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/105105048/
2. Link to topics related tocourse:
   i. https://nptel.ac.in/courses/105104102/17
   ii. https://nptel.ac.in/courses/105104102/20#
   iii. https://nptel.ac.in/courses/105104102/23
   iv. https://nptel.ac.in/courses/105104102/26

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Sewage Treatment and Disposal) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | **1.92** |
| CO-2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | **1.92** |
| CO-3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | **1.92** |
| CO-4 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | **2.08** |
| **Average** | **2.5** | **2.25** | **2.25** | **2.25** | **2.25** | **1.75** | **2.00** | **1.50** | **2.00** | **1.75** | **1.25** | **1.75** | |

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# Sustainable Development

COURSECODE: 18B1WCE834

COURSE CREDITS: 3

CORE/ELECTIVE: CORE L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To understand the concept of Sustainability
2. Understanding various kinds of Pollutions and Global Environmental issues.
3. Understanding fundamentals of Environmental Impact Assessment Life Cycle Analysis.
4. Understanding the concept of EMS and ISO 14000 and ISO 9000.
5. Introducing to energy efficiency and Rating Systems of buildings.

**Course Outcomes:**

| Sr. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introduction and understanding the concept of sustainability | Familiarity |
| CO-2 | Awareness and understanding about various kinds of pollution and Global environmental issues | Familiarity |
| CO-3 | Understanding environmental impact assessment and life cycle analysis | Familiarity |
| CO-4 | Understanding the concept of ISO 14000, ISO 9000 and Environment management systems | Usage and assessment |
| CO-5 | Introduction to energy efficiency in buildings and rating systems | Usage and assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction :** Sustainability- need and concept, challenges, Environment acts and protocols, Social and environmental issues (local, national and international), UN sustainable development goals. Environment Protection Act and Water Prevention Act.<br>**Ecosystem:** Concept, Type, Structure, Function; Ecological succession, | 8 |

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| | | |
|---|---|---|
| 2 | **Environmental Issues :** Global, Regional and Local environmental issues, Indicators of Sustainability, Global Environmental conventions, UN Sustainable Indicators<br>**Natural Resources :** Natural resources and their pollution, Air and Water Pollution, Carbon credits, Zero waste concept, Global protocols | 12 |
| 3 | Solid Waste Management, EMS, ISO 14000 and ISO 9000 | 10 |
| 4 | Life Cycle Analysis, Environmental Impact Assessment,<br>**Renewable Sources :** Conventional and renewable sources, Technology and sustainable development, | 6 |
| 5 | Sustainable Materials, Energy efficiency in buildings | 6 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. B Dalal-Clayton, S Bass, 'Suustainable Development Strategies', Earthscan Publications Ltd London Sterling, VA - 2002
2. JD Sachs, 'The Age of Sustainable Development', Columbia University Press 2015

**Suggested Reference Book(s):**

1. A Banerjee, MK Jhariya, DK Yadav, A Raj, 'Environmental and sustainable development through forestry and other resources', 2020.

**Other useful resource(s):**

1. https://onlinecourses.nptel.ac.in/noc22_hs61/preview
2. https://nptel.ac.in/courses/109105190

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course Outcomes (Building Materials and Construction) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | **2.17** |
| CO-2 | 3 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | **2.58** |
| CO-3 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | **2** |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 3 | 3 | **2.5** |
| **Average** | **2.5** | **2** | **3** | **2.25** | **2.5** | **2.25** | **2.25** | **2** | **2.25** | **2** | **2** | **2.25** | |

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# Open Channel Flow and Hydraulic Machines

COURSE CODE:18B1WCE639

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

**Pre-requisite:** Fluid mechanics

**Course Objectives:**

1. To familiarize students with the knowledge of open channel and their behaviors
2. To study the various applications, open channels
3. To study different types of turbines and their application
4. To get familiar with working of different types of pumps and its applications

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Knowledge of flow characteristics of open channel flow. | Assessment |
| CO-2 | Learn the different flow regimes in open channels and their characteristics Predict if hydraulic jumps are to occur during flow, and calculate the fraction of energy dissipated during hydraulic jumps | Assessment |
| CO-3 | Methods of discharge measurement, various phenomenon of flow in open channel | Assessment |
| CO-4 | Different types of turbines, and its applications, working principles, efficiencies and problems associated with turbines | Assessment |
| CO-5 | Knowledge of pumps, its applications, working principles, efficiencies and problems associated with pumps | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Open Channel Flow:** Comparison between open channel flow andpipe flow, geometrical parameters of a channel, classification of open channels, classificationof open channel flow, Velocity Distribution of channel section. | 4 |

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| | | |
|---|---|---|
| 2 | **Uniform Flow:** Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel. Computation of Uniform flow, Normal depth | 7 |
| 3 | **Non-Uniform Flow:** Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions, Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer | 9 |
| 4 | **Hydraulic Jump:** Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. | 5 |
| 5 | **Hydraulic Turbines:** Efficiencies &Classification, Pelton wheel turbine: Design , Velocity triangle , Radial flow Reaction turbines: working principles and Design of, Francis and Kaplan Turbine, Velocity Triangles, Draft tube : Types and theory, specific speed, Operating characteristics . Turbines, Selection of Turbines. | 9 |
| 6 | **Pumps:** Classification, Centrifugal pump Components and working, Velocity triangles, Head Losses and Efficiencies, Minimum starting speed, priming of centrifugal pump, specific speed, Cavitation, selection of pumps, Reciprocating pump, types, Components and working, slip, Indicator diagram, Air vessel. | 8 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Modi, P.N. and Seth, S.M., Hydraulic and Fluid Machines, Standard book house New Delhi, 1995.
2. K. Subramanya, Flow in Open Channels, Tata Mc. Graw Hill, 2009
3. K.G. Rangaraju, Flow through Open Channels, Tata Mc. Graw Hill, 2013

**Suggested Reference Book(s):**

1. M.H Chaudhury: Open Channel Flow, Prentice Hall of India, 2008
2. V.T Chow: Open Channel Hydraulics, Mc Graw Hill, 2009.
3. Terry W. Sturm, Open Channel Hydraulics, Tata Mc. Graw Hill, 2009.
4. Richard H. French, Open Channel Hydraulics, Mc Graw Hill, 1985

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/105103096/
   https://nptel.ac.in/courses/112104117/33

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https://nptel.ac.in/courses/105103021/1

2. Link to topics related tocourse:_
   https://nptel.ac.in/courses/105103096/1-24
   https://nptel.ac.in/courses/105103021/40-43

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (5) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Open Channel Flow and Hydraulic Machine) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 2 | 3 | x | x | 1 | 1 | 1 | 3 | **2** |
| CO-2 | 3 | 3 | 2 | 2 | 2 | 3 | x | x | 2 | 1 | 1 | 3 | **2.2** |
| CO-3 | 3 | 3 | 3 | 2 | 2 | 2 | x | x | 2 | 2 | 1 | 3 | **2.3** |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | x | x | 2 | 2 | 3 | 3 | **2.7** |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | x | x | 2 | 2 | 3 | 3 | **2.7** |
| Average | **3** | **2.8** | **2.6** | **2.4** | **2.4** | **2.4** | **0** | **0** | **1.8** | **1.6** | **1.8** | **3** | |

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# Computer Aided Planning and Costing

COURSE CODE:18B17CE671

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** Engineering Drawing

**Course Objectives:**

1 To learn the fundamentals of planning, designing and estimation of different types of civilengineering structures using software like MS Excel and estimator.
2. Develop expertise in comprehending construction site drawings and generate bar bending schedules for same.
3. Learn to prepare detailed reports for construction projects.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To acquire knowledge in material quantity estimation and costing by applying mathematical methods such as Long Wall/ Short Wall method and Centre-line method. | Familiarity |
| CO-2 | To learn quantity estimation and costing for various materials used in residential buildings, masonry tanks, culverts bridges etc. | Assessment |
| CO-3 | Gain practical experience in using MS Excel and estimator software for making worksheets of various estimates. | Assessment |
| CO-4 | To make the estimates for earthwork for making embankments and cuts for plain and mountainous region roads. | Usage |
| CO-5 | To develop proficiency in making the bar-bending schedules. | Usage |
| CO-6 | To study legal issues related to construction and prepare detailed reports. | Usage |
| CO-7 | To acquire knowledge in material quantity estimation and costing by applying mathematical methods such as Long Wall/ Short Wall method and Centre-line method. | Usage |

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**List of Experiments:**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Introduction and estimation of quantities of materials from a plan of a residential building floor using Short wall and Long wall method using MS Excel Software. | 6 |
| 2 | Prepare section for a given Plan and hence Calculate quantities by Central Line method and Compare it with Long Wall /Short Wall Methods using MS Excel. | 4 |
| 3 | Estimation of an underground masonry tanks and staircase | 4 |
| 4 | Estimation of road works, culverts, bridges, wells, and irrigation works. | 10 |
| 5 | Introduction to bar bending schedule, preparation of bar bending schedule for sketches given. | 4 |
| 6 | Quantity estimation of residential building, culverts, bridges and road works. | 10 |
| 7 | Cost analysis of residential building (Single Storey) as per latest CPWD rate analysis manual. | 4 |
| 8 | Cost estimation of road works, culverts, bridges, wells, and irrigation works using estimator software as per latest CPWD rate analysis manual. | 8 |
| 9 | Cost estimation of steel used in any project as per bar bending schedule using MS Excel. | 2 |
| 10 | Introduction to contracts, Tenders, Bids and Legal Issues related to construction works. | 2 |
| 11 | Preparation of different types estimation reports for various PWD works in MS Word. | 2 |
| **Total Lab hours** | | **56** |

**Suggested/Resources:**


1. Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and valuation by B.N Dutta UHS publishers.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning 2002.s)
3. Construction Management and Planning by B. Sengupta & H. Guha



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# Surveying

COURSE CODE:18B11CE312

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

Surveying is of special importance and interest to a Civil Engineer. Surveying is a general term that covers any survey work carried out in connection with the construction of an engineering project, such as buildings, dam, highways, railways, bridges, canals, water supply, drainage works and other civil engineering works. The main objectives are:

1. To produce up-to-date *Engineering Plans* of the areas in which the work will be carried out. These plans form the basis for the design of the construction, and so the reliability of the design depends heavily on the attention to detail with which the survey is carried out.
2. To determine the required areas and volumes of land and materials needed during construction.
3. To ensure that the construction takes place in the correct relative and absolute position on the ground.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Perform a boundary survey and preparation of engineering maps. | Familiarity |
| CO-2 | Basic principles of various methods of surveying, and related problems. | Assessment |
| CO-3 | To determine the required areas and volumes of land and materials needed during construction. | Assessment |
| CO-4 | Will be able to get correct relative and absolute position on the ground where construction is required. | Assessment |
| CO-5 | Basic knowledge of modern survey equipments, Implement procedures for its use and care of field equipment. | Assessment |
| CO-6 | Apply various corrections in different measurement and methods. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Classification of Surveying, Principles of Surveying, | 1 |
| 2 | **Chain Surveying:** Instruments for chaining, Errors due to incorrect chain, Chaining on sloping ground, Errors in chaining, Tape corrections, Chain triangulation, setting out right angles, basic problems in chaining, conventional symbols used in chaining | 2 |
| 3 | **Compass surveying:** Instruments (prismatic and surveyor compass), bearing and angles, magnetic declination, local attractions. | 3 |

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| | | |
|---|---|---|
| 4 | **Leveling:** Instruments, Optical defects in lenses, Temporary adjustment of a level, and different types of leveling, curvature and refraction corrections, leveling problems, errors in leveling, the level tube. | 5 |
| 5 | **Contouring:** Contours, contour interval, contour gradient, characteristics of contours, methods of locating contours and their interpretation, uses of contour maps. | 4 |
| 6 | **Plane Table Surveying:** Instruments, principle and methods of plane- tabling, three-point problem, two-point problem, errors in plane tabling, advantages and disadvantages. | 4 |
| 7 | **Tacheometric and Theodolite:** Surveying: transit and non-transit, definition and terms, measurement of horizontal and vertical angles, instruments and tachometric method | 5 |
| 8 | **Modern Field Survey Systems:** Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Glosbal Positioning, Systems- Segments, GPS measurements, | 4 |
| 9 | **Curves:** Elements of simple and compound curves – Method of setting out of simple circular curve – Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve. | 5 |
| 10 | **Remote Sensing:** Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing. | 5 |
| 11 | **Photographic Surveying:** Principles, advantages of aerial photography | 4 |
| **Total Lectures** | | **42** |

## Suggested Text Book(s):


1. S K Duggal: Surveying, 3rd Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying,2nd Edition, New Age International Publishers, New Delhi, 2006
3. B.C.Punmia: Surveying-1, Surveying-2, Laxmi Publication Delhi, 2005
4. N.N.Basak: Surveying &Leveling Tata McGraw Hill Publishing Com. New Delhi


## Reference Books:


1. B.C.Punmia: Surveying-3, Laxmi Publication Delhi, 2005


## Suggested Reference Book(s):


1. Kavanagh, Barry F.: Surveying : Principles and applications, 7th Edition, Pearson Education Asia,2006
2. A.M.Chandra: Higher Surveying 2nd Edition, New Age International Publishers New Delhi, 2006
3. Clark David: Plane and Geodetic surveying for Engineers, vol-1 & vol-2,6th Edition, CBS Publishers, 2006


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**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/105107122/
2. Link to topics related tocourse:
   i. https://nptel.ac.in/courses/105107122/1-3
   ii. https://nptel.ac.in/courses/105107122/8-18
   iii. https://nptel.ac.in/courses/105107122/23-32

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (5) - 10<br>Quizzes (2)-10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Surveying) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | **2.25** |
| CO-2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | **2.16** |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | **2.41** |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-4 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | **2** |
| CO-5 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | **2.5** |
| CO-6 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 3 | **2.16** |
| Average | **2.83** | **2.5** | **2.5** | **2.5** | **2.33** | **1.5** | **1.5** | **2** | **1.83** | **2** | **2.5** | **3** | |

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# Surveying Lab

COURSE CODE: 18B17CE372

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

## Course Objectives:

1. To get students familiar about the usage and working principle of different surveying instruments
2. Application of instruments to calculate various parameters such as horizontal angles, ground elevations, vertical distance, vertical angles, horizontal distance etc.
3. Able to plot the ground features in the maps with the help of plane table survey.

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Calculate horizontal angles, bearing of lines, and measurement of horizontal distance, ranging of line using different instruments in the field. | Assessment |
| CO2 | Able to perform different types of leveling operation to be performed in the field, knowledge of establishing BM. | Assessment |
| CO3 | Able to measure vertical distance vertical angles, horizontal distance. | Assessment |
| CO4 | Able to plot the ground features in the field with the help of plane table survey. | Assessment |
| CO5 | Understanding of using Total Station, Tacheometer, Levels in the field. | Assessment |

## List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | To plot a traverse of a given area with the help of compass and a chain. | 2 |
| 2 | To establish bench mark at given site by performing fly leveling. | 2 |
| 3 | To work out difference of elevation between two points by reciprocal leveling. | 2 |
| 4 | To determine the position of station occupied by plane table using three point problem. | 2 |
| 5 | To locate the points at desired locations in the field by the method of intersection. | 2 |
| 6 | Measure angle between two horizontal points with the help of theodolite by method of repetition. | 2 |

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| | | |
|---|---|---|
| 7 | To determine the constants of a given tachometer | 2 |



| | | |
|---|---|---|
| **8** | To determine whether the leveling bubble and telescope line-of-sight are parallel, by peg test method | **2** |
| **9** | Measuring height of the object with the help of Theodolite, when the base of the object is accessible. | **2** |
| **10** | Find out the horizontal distance and difference of elevation between two Points by fixed hair of tacheometry. | **2** |
| **11** | Introduction to Total Station | **2** |
| **Total Lab hours** | | **22** |

**Suggested/Resources:**


1. S K Duggal: Surveying, 3rd Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying,2nd Edition, New Age International Publishers, New Delhi, 2006
3. B.C.Punmia: Surveying-1, Surveying-2, Laxmi Publication Delhi, 2005
4. N.N.Basak: Surveying &Leveling Tata McGraw Hill Publishing Com. New Delhi


**Reference Books:**


1. B.C.Punmia : Surveying-3, Laxmi Publication Delhi, 2005


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Attendance | 15 Marks |
| 4 | Lab Assessment | 45 Marks |
| | Total | 100 marks |

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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course Outcomes (Surveying Lab) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 2.67 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | **2.75** |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | **2.75** |
| **CO4** | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | **2.67** |
| **Average** | **2** | **2** | **3** | **3** | **3** | **3** | **1** | **2** | **3** | **3** | **2** | **3** | |



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1. Subject Code: 18M1WCE231

Course Title: Planning, Design and Construction of Rural Road

2. Contact Hours: L: 3

3 Evaluation Scheme:

| | | |
|---|---|---|
| Test 1 | 15 Marks | 1 Hour |
| Test 2 | 25 Marks | 1.5 Hours |
| Test 3 (End Semester Exam) | 35 Marks | 2 Hours |
| Course work + Attendance | 20+5=25 Marks | Continuous evaluation |
| Total | 100 Marks | |

4. Objective of Course: To introduce the concepts of Planning, Geometric Design, Pavement Design, Construction and Maintenance of Rural Roads

5. Details of the Course.

| S. No. | Course Description | Contact hours |
|---|---|---|
| 01 | **Planning of Rural Roads**: Classification of Roads, Brief introduction to earlier 20 year Plans, System's Approach, NATPAC Model, Gravity Model, CRRI Model, FBRNP Model, Concepts of PMGSY | 08 |
| 02 | **Geometric Design**: Geometric Design Standards for Rural Roads with special reference to PMGSY, Hill Road Standards. | 04 |
| 03 | **Pavement Design:** Various pavement design methods for Rural roads including Flexible and Rigid pavements using IRC:SP-20, IRC-72, IRC-37, IRC:SP-62, CRRI Nomograms | 04 |
| 04 | **Mix Design Methods:** CRRI Method, Triangular Chart Method, Fuller's Method, Rothfuch method, PI based Method | 06 |
| 05 | **Materials:** Brief introduction toconventional materials, Marginal and Waste Materials including Fly Ash, GBFS, BFS, SMS, Bagasse, CRMB, etc | 06 |
| 06 | **Construction:** Case Studies of Waste Material Utilization in Rural Roads, Low Cost Techniques for Rural Road Construction, Tractor Bound Technology, Special Considerations for Hill Areas | 06 |
| 07 | **Drainage:** Transverse and Longitudinal Drainage, Design of drains, Minor CD Works, Filter Design etc. | 04 |
| 08 | **Maintenance:** Type and Causes of Failures, Remedies | 04 |
| | Total | 42 |

**Suggested Books:**

| S. No. | Authors / Title / / Publisher | Year of publication |
|---|---|---|
| 1 | Rural Roads Manual , SP-20, IRC | 2002 |
| 2 | Document on Rural Road Development, Vol I & II, CRRI | 1990 |
| 3 | PMGSY Operation Manual, NRRDA, Govt of India | 2005 |
| 4 | Specifications for Rural Roads, MoRD, IRC | 2004 |
| 5 | Khanna S.K., Justo C.E.G,, Highway Engineering, Nem Chand & Bros, Roorkee | 2004 |
| 7 | L R Kadiyali, "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi | 1999 |
| 8 | Quality Assurance Handbook for Rural Roads, NRRDA, Govt. of India | 2007 |

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**Patenting in Biotechnology**

**COURSE CODE** 18M11BT114

**COURSE CREDITS: 3**

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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Pre-requisite: Biotechnology

**Course Objectives**

1. To provide an insight and understanding about different aspects of protection of inventions and research developments
2. Learn about procedures for filling and registration of patent and other Intellectual Property Rights.
3. Learn about prerequisites for patenting in Biotechnology.

**Course Outcomes**

| Sr. No. | Course outcomes | Level Attainment |
|---|---|---|
| CO I | To enable students with basic concepts and knowledge of intellectual property rights. | Awareness |
| CO II | Able to learn about procedures of patenting in biotechnology and other biological arenas. | Assessment and technical skills |
| CO III | Able to understand about the mechanisms of different IP protections, registrations and applications | Technical |
| CO IV | To be capable of tackling all issues related to IP, Bioethics and Biosafety wrt. Biotechnology | Assessment |
| CO V | Able to learn the strategies for effective IP management and value addition in biotechnological aspects | Analytical skills |
| CO VI | To understand the procedures for developing safe biotechnological products for the benefit generation and for mass utilization by | Usage |

**Topic Covered**

| S. No. | Contents | Teaching required |
|---|---|---|
| 1 | **Introduction**: Introduction of Intellectual properties and rights conferred . Integration of Intellectual Property, Bioethics and Biosafety for biological and applied sciences in research and academia. | 4 |
| 2 | **Types of IP tools**: Different types of IPR( Patents, copyrights and related rights, Trademark, Tradesecret, Integrated circuit layout, Geographical indications, Traditional knowledge, Industrial designs and PBR)<br>Rationale of different IPR ,their mechanism of protection and provisions in Law | 6 |
| 3 | **Patent** :Drafting Patent Application and Documentations<br>Procedure of filling and its types<br>Revocation of Patent, Litigation and Infringement | 6 |
| 4 | **International Agreements** and Treaties: International IP treaties (Madrid Agreement, Trademark law treaty, Patent Law treaty etc.)<br>WIPO, EPC, WTO, and TRIPS. International agreements relevant to | 8 |



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| | | |
|---|---|---|
| | biotechnology-associated IP | |
| 5 | **Assignment and Licensing**: Types of licensing models and modes to carry out, Assignments and its benefits | 6 |
| 6 | **IP Management:** Strategies for IP Management and commercialization. Intellectual Property in Biotechnology and Bioentreprenuership<br>Commercialization of biotechnology and bioinformatics Patents | 4 |
| 7 | **Biosafety and Bioethics for Biotechnology patents** :Basic guidelines and principles.<br>Biosafety levels and Bioethics tools. Case studies with latest concerns. Litigation and law enforcement for generation of safe biotechnological products. | 8 |
| | **Total Number of Lectures** | **42** |

**Suggested Text Book(s):**

1. Intellectual Property Rights & Copyright By Bouchoux.
2. IPR, Biosafety and Bioethics Book by Deepa Goel and Shomini Parashar

**Suggested Reference Book(s):**

1. Intellectual Property Rights, the WTO and Developing Countries: The TRIPS ...Book by Carlos María Correa
2. Bioethics and Biosafety by M K Sateesh.

**Evaluation Scheme:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Syllabus covered upto T-1 |
| T2 Test | 25 | 1.5 hrs. | Syllabus covered upto T-2 |
| End Term Test | 35 | 2 hrs. | Entire Syllabus |
| Teacher Assessment | 25 | Entire Sem | Based on Assignments, quizzes etc. |

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# Advances in Computational System Biology

**COURSE CODE** 18MIWBT133

**COURSE CREDITS: 3**

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

Pre-requisite: Molecular Biology

**Objective:**

1. To enable students to predict and ultimately control functionalities of complex biological systems

| Sr. No. | Course outcomes | Level Attainment |
|---|---|---|
| CO I | Students will acquire knowledge on system biology | Familiarity |
| CO II | Students will have understanding about gene regulatory network | Familiarity |
| CO III | Students will acquire advance knowledge about metabolic networking | Assessment |
| CO IV | Understanding on Signal transduction | Usage |
| CO V | Students will be able to comprehend system biology | Usage |

**Course Outline**

| Sr. No. | Contents | Hours Allotted |
|---|---|---|
| 1 | Introduction to Systems biology and associated entities. System and its properties. Types of biological networks and their characteristics. Comparison of bioinformatics, and other similar streams with systems biology and its progression towards synthetic biology. | 5 |
| 2 | Gene regulatory networks, Genetic Network Analysis and System Discovery. Modeling Complex Biological Systems , Approaches to *Numerical* Simulation of Regulatory Pathways. | 5 |
| 3 | Metabolic Networks and pathways, Mass/Flux Balance Analysis. Characteristics and applications of metabolic pathways. Partial differential equations for the same. Recent research based developments in metabolic networks. | 6 |
| 4 | XML for Bioinformatics and systems biology, includes BioXML, SBML, CellML and their practical applications towards modelling and simulations of biological systems | 6 |
| 5 | Signal Transduction Networks and Pathways, their characteristics and applications. Recent research based developments in TRNs. | 6 |
| 6 | Systems Approach to Metabolic Networks and Protien-Protein Interaction Networks, Online tools and databases for SYSTEMS BIOLOGY- STRING, BIND, MINT, IPATH, GeneGo, Gypasi, MetaCYC | 6 |
| 7 | Biocircuits: Blocks and Designing; Various case studies along with their applications. Petri Nets and modeling. E-Cell and other bio-electronic Projects | 4 |
| 8 | Research based methods for solving biological network problems for all kind of | 4 |

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| | | |
|---|---|---|
| | biological networks. | |
| | **Total** | **42** |

**Text and Reference Books:**


1. **Systems Modeling in Cellular Biology.** by Zoltan Szallasi, Joerg Stelling, Vipul Periwal, MIT Press,
2. **Systems Biology : Properties of Reconstructed Networks.** by Bernard Palsson, Cambridge Univ. Press
3. **Advances in Systems Biology (Advances in Experimental Medicine and Biology).** Opresko, L., Gephart, J., and Mann, M. (eds.), Plenum US, 2005
4. **Artificial Intelligence Methods and Tools For Systems Biology.** Dubitzky, W. and Azuaje, F. (eds.), Kluwer Academic Publisher
4. **Metabolome Analyses: Strategies for Systems Biology.** Vaidyanathan, S. et al (eds.), Springer-Verlag
5. **Systems Biology in Practice: Concepts, Implementation And Application.** Klipp, E et al., John Wiley & Sons Inc.
6. **Foundations of Systems Biology.** Kitano, H.(ed.); The MIT Press
7. **Systems Biology.** Alberghina L. & Westerhoff, H.V., eds.; Springer Verlag


**Evaluation Scheme:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Syllabus covered upto T-1 |
| T2 Test | 25 | 1.5 hrs. | Syllabus covered upto T-2 |
| End Term Test | 35 | 2 hrs. | Entire Syllabus |
| Teacher Assessment | 25 | Entire Sem | Based on Assignments, quizzes etc. |

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# Cell Biology & Cell Culture Technologies

COURSE CODE:18B11BT411

COURSE CREDITS: 4

ELECTIVE/CORE: CORE

: 3-1-0

**Pre-requisite:** Basic Understanding of Biology

**Course Objectives:**

1. The objective of this course is to introduce the student to basic cell biology, animal & plant tissue culture techniques and their application.
2. In cell biology component, the course is designed to understand fundamental concepts of cell and how it functions at the cellular level.
3. In animal tissue culture component, the course is designed to impart an understanding pertaining to why one needs animal cell cultivation, the basic ATC set-up, the biology of cultured cells, techniques to establish and propagate cell cultures of animal origin.
4. In plant tissue culture component, the course is designed to develop an understanding about the morphology of plant cell and its utilization through different techniques of plant tissue culture for propagation, conservation and production of different plant species and their products

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Successful student will understand fundamental concepts of cellular function. | Familiarity |
| CO-2 | Be able to critically analyze, the scientific evidence underlying current understanding of cellular processes. | Assessment& Analytical Skills |
| CO-3 | To enable students for applying the knowledge about basic techniques of plant tissue culture. | Technical Skills |
| CO-4 | They will learn the strategies for analyzing, upscaling and commercialization of plant based products. | Technical Skills |
| CO-5 | Basic understanding of animal tissue culture, Maintain aseptic condition, primary and continuous culture of cell lines, suspension and adherent cells, cryopreservation and revival of cell lines. | Awareness |
| CO-6 | To understand functional assay at cellular level, cell morphology and survival, immunolabeling. | Analytical & Technical Skills |

**Course Contents:**

| Units | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to the cell Prokaryotic and Eukaryotic cell; Animal and Plant cell, Structure of cell, cellular organelles and their structure and function.<br><br>Biological membranes – Overview of Membrane structure and function - Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, Protein Sorting, Intracellular Vesicular Traffic and regulation of intracellular transport, electrical properties of membranes. | 3 |

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| | | |
|---|---|---|
| 2 | Cell signalling - Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers and regulation of signaling pathways.<br>The Cytoskeleton, Cell Cycle and Programmed Cell Death, Cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.<br>Methods and techniques - Manipulating proteins, DNA and RNA. Visualizing cells. | 8 |
| 3 | Plant structure, growth and development<br>Introduction, definitions and history of plant cell and tissue culture<br>Organization of tissue culture laboratory<br>Cellular totipotency and cell differentiation, factors affecting differentiation | 8 |
| 4 | Isolation of single plant cells, suspension cultures, types of suspension cultures, Measurement of the growth in suspension cultures, Assessment of Viability of the cultured cells, bioreactors used for plant cell cultures | 8 |
| 5 | Type of cultures and their applications: Direct and indirect methods of culture; seed culture, embryo culture, organ culture, callus culture, somaclonal variation and applications | 7 |
| 6 | Somatic embryogenesis<br>Micro-propagation and its applications, Advances in acclimatization of tissue cultured plants.<br>Haploid and triploid production and applications<br>Protoplast isolation and fusion and application<br>Production of virus free plants through cell and tissue culture | 4 |
| 7 | Secondary metabolite production and bioconversions /biotransformation through plant cell cultures and plant stem cells | 4 |
| 8 | Introduction to human anatomy and Physiology, An overview of different Systems, organs and tissues of human body. Basics terms and definitions, historical background, Importance of animal cell culture technology, laboratory facilities-design, equipments and safety parameters, waste disposal in a cell culture set-up. Aseptic techniques for animal cell cultivation. | |
| 9 | Cell culture technology: Basic requirement for growing animal cells - Cell culture reagents, media, media supplements, media preparation and sterilization, Defined-Undefined media, Complete-Incomplete media, Importance of Serum and Serum free Media, culture conditions. Maintenance of cell culture: Culturing, sub- culturing, passaging. | |
| 10 | Studying biological system using cell culture techniques: Functional assays based on cell culture: Cell morphology, Quantitation, Growth pattern, Cytotoxicity assays, Study of Cell Death: senescence, apoptosis and necrosis, Cell proliferation, Cell viability measurements, FISH. Immunolabeling of cells to study molecular expression pattern– Microscopy, Flow cytometry, Immunohistochemistry, etc. Application of Cell culture Technology Hybridoma technology for monoclonal antibody production. | |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**


1. Michael Butler, "Animal Cell Culture and Technology", BIOS Scientific Publishers
2. John R.W. Masters, " Animal Cell Culture-A Practical Approach", Oxford University Press
3. R. Ian Freshney, "Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications".


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4. Introduction to Plant biotechnology H S Chawala
5. Plant tissue culture: theory and Practice S.S.Bhojwani and M K Razadan
6. Plant tissue culture S.S.Bhojwani and M K Razadan
7. Elements of Biotechnology P K Gupta
8. Plant cell and tissue culture Narayan Swamy

**Suggested Reference Book(s)**

1. Molecular Biology of the Cell: by Bruce Alberts, 4th Edition 2002.
2. Lodish, et al. Molecular Cell Biology. 5th ed. New York, NY: W.H. Freeman and Company, 2003.

**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/
2. https://nptel.ac.in/courses/102103012/
3. https://nptel.ac.in/courses/102104059/
4. https://nptel.ac.in/courses/102103016/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Cell Biology & Cell Culture Technologies) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | **1.75** |
| **CO-2** | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | **1.66** |
| **CO-3** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | **2** |
| **CO-4** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | **2** |
| **CO-5** | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | **1.66** |
| **CO-6** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | **2** |
| **Average** | **2.5** | **2.5** | **2.5** | **2.5** | **2** | **1.6** | **1.5** | **1** | **1** | **1** | **2** | **2** | |

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# Cell Biology & Cell Culture Technologies Lab

COURSE CODE: 18B17BT471

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Basic Biology

**Course Objectives:**

4. The objective is to familiarize students with the various Cell biology and cell culture techniques.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand, design, analyze and interpret experiments related to cell biology and link practical knowledge to theoretical. | Familiarity |
| CO2 | To understand, design, analyze and interpret experiments related to Animal cell culture and link practical knowledge to theoretical | Analytical Skills |
| CO3 | To understand, design, analyze and interpret experiments related to Plant tissue Culture and link practical knowledge to theoretical | Analytical Skills |
| CO4 | Able to perform cell count using haemocytometer and maintain aseptic condition. | Technical Skills |
| CO5 | To understand team work, ethics and work discipline. | Use |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Laboratory Safety and To Study various parts of compound microscope | 2 |
| 2 | To prepare and study temporary or permanent slides of mitosis, meiosis, stem and root cells/sections and differentiate the plant cells and animal cells | 2 |
| 3 | To study the effect of salinity on biological membranes of cells | 2 |
| 4 | To prepare the blood smear slides, visualization and cell count of the components of blood using light microscopy | 2 |
| 5 | Introduction to ATC, Fluid Transfer using aseptic technique, Preparation of stock media from powder and filter sterilization | 2 |
| 6 | Sub culturing, Cryopreservation and Revival of Cell culture | 2 |
| 7 | Assessment of cytotoxicity using MTT assay/Biological screening of herbal/synthetic molecules. | 2 |
| 8 | Introduction to various equipments and their working in plant tissue culture lab setup and Preparation of stocks solutions, hormones culture medium | 2 |
| 9 | Establishment of Callus and Suspension cultures and measuring cell | 2 |

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| | | |
|---|---|---|
| | growth | |
| **10** | Plant regeneration from callus and somatic embryogenesis | 2 |
| **11** | Microproapagation of different plant species by axillary shooting | 2 |
| **12** | Hardening or Acclimatization of cultured plantlets to field conditions | 2 |
| **13** | Meristem culture for virus elimination.<br><br>Anther and pollen culture for haploid production | 2 |
| **14** | Protoplast isolation and determining the protoplast viability | 2 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**

1. Lab Manual
2. Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application (Principles and Practice) by: Karl-Hermann Neumann publisher: Springer
3. Tissue Culture for Plant Propagators by R.A. de Fossard
4. Plant Culture Media, Volume 1,Formulations and Uses by E.F. George
5. Micropropagation: Technology and Application by P.C. Debergh and R.H. Zimmerman Kluwer Academic Publishers
6. Virtual Lab. (http://vlab.amrita.edu)

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| **CO4** | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **CO5** | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **Average** | **2.8** | **2.8** | **2.80** | **2.80** | **2.60** | **2.20** | **1.20** | **1.00** | **1.00** | **1.00** | **1.20** | **1.40** | |

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# Industrial Enzymes Technologies

COURSE CODE: 18B1WBT733

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** Enzyme production purification and applications

**Course Objectives:**

1. The objective of the course is to develop an understanding of important aspects of production and purification of industrially important enzyme and their application in industry.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To develop an understanding of basic concepts of enzymes. | Familiarity |
| CO-2 | To understand the basic mechanism of action and working behaviour of enzymes | Assessment |
| CO-3 | To familiarize the students with various applications of enzymes in laboratory as well as Industrial scale. | Assessment |
| CO-4 | To conceptualize about immobilized enzyme technology, and other specific enzymes and their applications. | Usage |
| CO-5 | To familiarize the students with present potential of enzyme in industrial application and improved activity of the enzyme using various molecular biology techniques. | Usage |
| CO-6 | To understand the principle and function of enzyme in various adverse conditions like high temperature and pH(s). | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| | **Enzymes: Basic concepts:** Enzymes as powerful and highly specific catalysts, Classification of enzymes, free energy and enzymes, the formation of the transition state, catalytic strategies. General properties: | 5 |



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| | | |
|---|---|---|
| 1 | Enzyme specificity, stability and structure, Factors affecting enzyme activity; effect of pH and Temperature, Substrate and Enzyme concentration. | |
| 2 | **Enzyme kinetics**: Michaelis-Menten kinetics, evaluation of parameters in the Michaelis-Menten equation, 3-D structure of active site, Kinetics of single and bi-substrate enzyme catalysed reactions, Inhibition & its kinetics. | **5** |
| 3 | **Enzyme preparation techniques:** Sources of enzymes, production,Recovery and purification of intracellular products: cell disruption, chromatographic techniques. Analytical assays of purity level of enzymes. | **3** |
| 4 | **Enzyme preparation and application in industries:** Application of enzymes in leather, glucose syrup production, starch and sugar industry, Dairy and food industry, Beverage industry, Textile industry. Hydrolysis of starch and cellulose. Catalytic functions of Cellulase, lipase, esterase laccase amylase, glucose isomerase, protease, xylanase, invertase, peroxidises. Other applications of enzymes in solution: medical applications of enzymes, non-hydrolytic enzymes in current and developing industrial technology. | **10** |
| 5 | **Enzyme engineering:** Mechanisms and manifestations of protein denaturation. Strategies for enzyme stabilization: Physical and chemical modifications, Selection, directed evolution and Rational design. design and construction of mutant enzymes, Bifunctional and polyfunctional enzyme, Enzyme in organic solvents. | **5** |
| 6 | **Immobilized-enzyme technology**: Introduction, enzyme immobilization method: Entrapment, carrier-binding and cross-linking method. Medical and analytical applications of immobilized enzymes. | **8** |
| 7 | **Specified Enzymes and applications:** Thermozymes, Cold adapted enzymes, Ribozymes, Hybrid enzymes, Diagnostic enzymes, Therapeutic enzymes: Characteristics, principles and applications. | 6 |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**


1. Devasena, T., "Enzymology", 1st ed., Oxford University Press, 2010
2. Berg, J.M., Tymoczko, J.L. and Stryer, L., "Biochemistry", 5th ed., W.H. Freeman and Company, New York, 2002.
3. Nelson D.L., Cox M.M., "Lehninger Principles of Biochemistry", 5th ed., W.H. Freeman and Company, New York, 2008.


**Suggested Reference Book(s):**


1. Pye, E.K. and Wingard, L.B., "Enzyme Engineering II", Plenum Press, 1974.
2. Illanes A, "Enzyme Biocatalysis", Springer Science, 2008.


**Other useful resource(s):**

https://nptel.ac.in/course.php?disciplineId=102

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**EvaluationScheme:**

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| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Industrial Enzymes) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1.9 |
| CO-2 | 1 | 2 | 2 | 2 | 2 | 1 | - | 2 | 2 | 2 | 1 | 3 | 1.8 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | - | 2 | 2 | 1.8 |
| CO-4 | 2 | 3 | 2 | 1 | 2 | 1 | - | 1 | 3 | 2 | - | 2 | 1.9 |
| CO-5 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1.8 |
| CO-6 | 1 | 1 | - | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 1.7 |
| Average | 1.5 | 2.1 | 1.6 | 1.8 | 1.8 | 1.6 | 1 | 1.6 | 2 | 2 | 1.2 | 2.5 | |

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# Nano-Biotechnology

COURSE CODE: 18B1WBT633

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Basic of Physics, Chemistry and Biology

**Course Objectives:**

1. Introduction to Nanomaterial and various material used for obtaining nano-materials
2. Learn various approaches or methods used for nanomaterial synthesis.
3. To learn various analytical techniques used for nanomaterial characterization.
4. Learn various applications of nanomaterial in health care, agriculture and environmental monitoring

**Course Outcomes**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introduction to Nano (Basics to Nanoscience and Nanotechnology) | Familiarity |
| CO-2 | Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterial and fundamental properties of Nano-materials(Nano-effect) | Assessment & Technical |
| CO-3 | Introduction to various technique used for the characterization of nanostructures and nanomaterial. | Assessment & Technical |
| CO-4 | Fundamental understanding of nanomaterial/nano-biotechnological application in health and disease. | Usage |
| CO-5 | Fundamental understanding of nanomaterial/nano-biotechnological application in Environment and food - detection and mitigation | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction, History &Applications:**Various definitions and Concept of Nano-biotechnology & Historical background. Fundamental sciences and broad areas of Nano-biotechnology. Various applications of Nano- biotechnology, Cell – Nanostructure interactions | 6 |
| 2 | **Synthetic methodologies:**Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterials: Lithography method, Electrochemical method, Mechanical Method, Chemical Synthesis, Chemical vapour deposition, Molecular self-assembly, Laser Induced assembly. | 10 |
| 3 | **Techniques used for the characterization of nanoparticles:**Principles of microscopy-light, electron, fluorescent confocal, scanning and transmission microscopes, different fixation and staining techniques for EM. Principles of spectroscopy-UV, visible, CD, FTIR, NMR, and ESR spectroscopy, structure determination using X-ray diffraction, analysis using light scattering. | 13 |
| 4 | **Nano-biotechnologicalapplications in health and disease:**Properties of different types of nanoparticles normally used in health and disease. Diagnostics and theranostics application of nanomaterials in health sciences. | 6 |
| 5 | **Nanobiotechnological applications in Environment andfood - detection and mitigation:**Properties of different types of nanoparticles normally used in environmental and food sciences. Detection and removal of toxic metal ion from polluted sample and detection and removal of pathogen form food sample. | 7 |
| **Total Lectures** | | 42 |

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**Suggested Text Book(s):**

1. C. A. Mirkin and C. M. Niemeyer. Nanobiotechnology - II more concepts and applications. (2007) - Wiley VCH.
2. P. Boisseau, P. Houdy, M. Lahmani, Nanoscience: Nanobiotechnology and Nanobiology

**Suggested Reference Book(s):**

1. A. Nouailhat, An Introduction to Nanoscience and Nanotechnology, Wiley
2. D.A Phoenix, W. Ahmed, Nanobiotechnology, One Central Press Ltd, UK
3. L. Filipponi, D. Sutherland, Nanotechnologies: Principles, Applications, Implications and Hands-on Activities.Directorate- European commission

**Other useful resource(s):**Link to NPTEL course contents

- https://nptel.ac.in/courses/118107015/
- https://onlinecourses.nptel.ac.in/noc17_bt17/preview
- http://videos.gitam.edu/nptel/nano.html

**Evaluation Scheme:**

| S. No. | Exam | Marks | Duration | Coverage/Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3 | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4 | Teaching Assessment | 25 | Entire Semester | Quiz, Assignment, Attendance, etc. |

**Course Outcomes (COs) contribution to the programme Outcomes (POs):**

| Course outcomes (NanoBiotech.) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1.7 |
| CO-2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 2.1 |
| CO-3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 2.2 |
| CO-4 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2.3 |
| CO-5 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2.3 |
| Average | 2.2 | 2.4 | 2.2 | 2.2 | 2.4 | 2.6 | 2.2 | 1.8 | 1.4 | 1.2 | 2.8 | 2.0 | |

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# Phytopharmaceuticals and Biologicals

COURSE CODE: 18B1WBT531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:**Basic understanding of biology

**Course Objectives:**

a. The objective of the course is to develop an understanding and basic knowledge on Indian medicinal herbs, its commercial value, quality control and industrial standards for commercialisation of phytopharmaceuticals and biologicals.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand pharmacopoeial standards of ayurvedic products | Familiarity |
| CO-2 | Able to understand the phytopharmaceuticals, monographs and quality control of medicinal herbs | Usage |
| CO-3 | Able to understand the extraction and evaluation process of phytopharmaceuticals | Technical |
| CO-4 | Able to understand pharmacopoeial standards of Indian Pharmacopoeia | Familiarity |
| CO-5 | Able to understand the monographs, specifications and quality control of biologicals | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Intoduction to phytopharmaceuticals – medicinal herbs & its importance and biologicals. Over view of Ayurvedic and Indian Pharmacopoeia | 4 |
| 2 | Pharmacopoeial standards of Ayurvedic (Used by manufacturers, regulators and other stakeholders for quality control of medicinal herbs and finished products against internationally recommended specifications). | 7 |
| 3 | Monographs of medicinal herbs, specifications and standards for identification, evaluation, processes and clinical applications | 8 |
| 4 | Evaluation of physiochemical parameters of herbal drugs, extraction, Identification & Assay of Herbals Drugs | 6 |
| 5 | Pharmacopoeial standards of Indian Pharmacopoeia (Used by manufacturers, regulators and other stakeholders for quality control of active pharmaceutical ingredients (APIs) and finished products against internationally recommended specifications). | 3 |
| 6 | Monographs on Blood and Blood related products, Monographs on Human Vaccines (The specifications cover the various tests for critical quality parameters of the vaccine, procedures and acceptance criteria) | 7 |
| | Monographs of Erythropoietin Injection, Interferon Injection, streptokinase | |

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|---|---|---|
| 7 | solution, Human Insulin, etc. Bacterial Endotoxin Test, Sterility Test, Test for Microbial Contamination, etc. | 7 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. The Ayurvedic Pharmacopoeia Of India, First Edition, Published By Pharmacopoeia Commission For Indian Medicine & Homoeopathy Ghaziabad (2016)
2. Indian Pharmacopoeia published by the Indian Pharmacopoeia Commission (IPC)

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Phytopharmaceuticals and Biologicals) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1.9 |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1.75 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.75 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1.6 |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1.75 |
| Average | 2.0 | 2.0 | 2 | 2 | 2 | 1.25 | 1.25 | 1.5 | 2.0 | 2 | 1.25 | 2.0 | |

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# Peptide Therapeutics

COURSE CODE: 18B1WBT631

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite**: General Chemistry

**Course Objectives:**

1. To develop an understanding of important concepts and design aspects of peptides
2. To learn various therapeutic applications of peptides.
3. Apply basic knowledge to design peptides for various therapeutic purposes

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand various peptide design consideration and other important structural aspects of peptides | Familiarity |
| CO-2 | Able to understand and learn the concept of solid phase peptides synthesis | Familiarity |
| CO-3 | To develop methods of peptides and proteins for their quality control and apply them in handling Therapeutic peptides and proteins | Assessment |
| CO-4 | To understand the mechanism of action of Antibiotic, Anticancer, Antihypertensive and Opioid peptides | Usage |
| CO-5 | To develop a strong foundation therapeutic peptide design and their applications | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Peptides, synthetic peptides & their classification based on structure, engineering bioactive peptide based therapeutic molecules, | 7 |
| 2 | Principle and practice of solid phase peptide synthesis, solid support, protection scheme, peptide acid and amide, Purification of peptides, quality control of peptides | 7 |
| 3 | Antimicrobial host defense peptides, Anticancer peptides, Opioid Peptides, Antihypertensive Peptides, Peptides in clinical trial ,chemical biology of Oxytocin, valinomycin and enkephalins | 18 |
| 4 | Preformulationstudies, Formulation development, Aggregation in protein formulation, novel formulation approaches, Lyophilization, Pharmaceutical Processing, and Handling of Therapeutic Peptides and Proteins | 6 |
| 5 | Circular dichroism, UV, IR, Mass and fluorescence spectroscopy of peptides | 4 |
| | **Total lecture** | **42** |

**Suggested Text Book(s):**

1. Ajay K Banga, "Therapeutic peptides and protein: formulation processing and delivery system, Second edition, Taylor and Francis.

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2. Lehninger Principles of Biochemistry Cox, M.M. and Nelson, D.L. and Lehninger A. L. 4th edition.
3. Biochemistry- J.M. Berg, J.L.Tymoczko, and LubertStryer; 5th edition W.H. Freeman and Company, New York, USA.

**Suggested Reference Book(s):**

1. Gregory A. Grant, "Synthetic peptides A Users Guide" 2nd ed. W. H. Freeman and Company

**EvaluationScheme:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Syllabus covered upto T-1 |
| T2 Test | 25 | 1.5 hrs. | Syllabus covered upto T-2 |
| End Term Test | 35 | 2 hrs. | Whole Syllabus |
| Teacher Assessment (Based on Assignments, quizzes etc.) | 25 | Whole Sem | Inform class time to time |
| **Total** | **100** | | |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Peptide Therapeutics | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 2 | 2 | 2 | 1 | - | - | 2 | 3 | 3 | 3 | 1.92 |
| CO-2 | 2 | 3 | 3 | 3 | 2 | 2 | - | - | 2 | 3 | 3 | 3 | 2.17 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | 3 | 3 | 3 | 2.33 |
| CO-4 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | 2 | 3 | 3 | 3 | 2.25 |
| CO-5 | 3 | 3 | 2 | 3 | 2 | 2 | - | - | 2 | 3 | 3 | 3 | 2.17 |
| Average | 2.60 | 3.00 | 2.40 | 2.80 | 2.40 | 1.80 | 0.00 | 0.00 | 2.00 | 3.00 | 3.00 | 3.00 | |

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# Infectious diseases

COURSE CODE: 18B1WBT632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Microbiology, Immunology

**Course Objectives:**

1. Learn to define the basic concepts related to infectious diseases, immunology and epidemiology.
2. Able to understand the basic forms, functions, behaviour, and diversity of infectious agents and their interactions with the host
3. Able to analyse the underlying principles of mode of action and resistance towards the agents used to treat infectious diseases

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The students would have knowledge of infectious diseases for practical use in medicine and biotechnology. | Familiarity |
| CO-2 | The students would have in-depth knowledge of basic concepts related to infectious diseases, immunology and epidemiology. | Assessment |
| CO-3 | The students would develop knowledge and understanding of the basic form, function, behavior, and diversity of infectious agents and their interaction with the host. | Assessment |
| CO-4 | The students would develop knowledge and skill about important techniques used to study host –pathogen interactions. | Assessment/Usage |
| CO-5 | The students would have sound knowledge of mode of action and resistance towards the agents used to treat infectious diseases. | Assessment/Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to infectious diseases Infectious and non- infectious diseases, Epidemiology of infectious diseases. Infectious agents, socio economic impact of infectious diseases | 6 |
| 2 | Host response to infections Bacterial, mycobacterial, viral, helminth, fungal | 3 |
| 3 | Biology of infectious agents Morphology, classification, life cycle, pathogenecity, mechanism of replication in bacteria, viruses, protozoa and fungal pathogens | 5 |
| 4 | Pathology of Infectious diseases Pathogenesis, Clinical pathology, Gross pathology, Microscopic pathology. | 4 |
| 5 | Biology of major Infectious diseases HIV/AIDS, Tuberculosis, malaria, dengue, West Nile virus, chikungunya virus, diarrheal diseases, sexually transmitted infections, influenza, viral hepatitis, Ebola | 8 |
| 6 | Diagnostic techniques for infectious diseases Immunohistology, Immunohistochemistry/In situ hybridization, Polymerase chain reaction based methods, Flow Cytometry. | 5 |

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|---|---|---|
| 7 | Antimicrobials against infectious agents Antimicrobial agents, mechanism of action, Antibiotic resistance, various mechanisms of antibiotic resistance | 5 |
| 8 | Emerging infectious diseases and their Social Impact Emergenceof SARS, Zika virus, Ebola and other newly reported diseases along with their Social and Scientific Impact. | 4 |
| 9 | Biological Weapons Introduction, Concept and examples | 2 |
| **Total Lectures** | | 4<br>2 |

**Suggested Text Book(s):**


1. Evolution of infectious disease. Ewald PW. Oxford University Press, New York.1994. ISBN 0-19-511139-7.
2. Emerging Infections 1. Scheld WM, Armstrong D and Hughes JM, Editors. ASM Press, Washinton, DC. 1998. ISBN 1-55581-123-3
3. Emerging Infections 2. Scheld WM, Craig WA and Hughes JM, Editors. ASM Press, Washington, DC. 1998. ISBN 1-55581-141-8.
4. Emerging Viruses. Morse SS, Editor. Oxford University Press, New York. 1993. ISBN 0-19-510-484-6.
5. Modern Infectious Disease Epidemiology: Concepts, Methods, Mathematical Models, and Public Health (Statistics for Biology and Health) Kramer; 2010


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Infectious diseases) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2.6 |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 | 2.9 |
| CO-3 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | - | 3 | 2.5 |
| CO-4 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | - | - | 3 | 2 | 2.4 |
| CO-5 | 1 | 2 | 3 | 3 | - | - | 3 | 3 | 2 | 2 | 2 | 2 | 2.3 |
| Average | 2 | 2.4 | 3 | 3 | 2.5 | 2.5 | 2.8 | 2.6 | 2.5 | 2.25 | 2 | 2.6 | |

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# Genetic Counselling

COURSE CODE: 18B1WBT831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Molecular Biology, Genetics

**Course Objectives:**

1. To provide an understanding of the basis of genetic counseling, diagnostic testing and management for a variety of types of disorders and also the ethical and legal considerations.
2. The students will understand the nature of the non-directive counseling process and the need to educate the patient and family to make informed decisions relating to complex genetic situations.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand basics of genetic counselling, the nature of the directive and non-directive genetic counselling process and to counsel the patients with genetic diseases and help them in decision making. | Familiarity |
| CO-2 | To understandgenetic basis of various diseases (Chromosomal, monogenic and oligogenic disorder). | Assessment |
| CO-3 | To understand gene therapy, its role in genetic disorders and recent developments in gene therapy. | Assessment |
| CO-4 | To understand risk assessment in genetic counseling and ethical issues in genetic counselling. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Genetic Counselling an overview:**Counseling, diagnostic testing and management of genetic disorders. | 2 |
| 2 | **Human chromosomal disorders:** mutations, types of mutations, chromosomal aberrations, quad screen test, Amniocentesis, karyotyping, Down's syndrome, Patau's syndrome, Edward's syndrome, Turner's syndrome, X- chromosome related syndromes. | 6 |
| 3 | **Human allelic diseases (monogenic and oligogenic):** Cystic fybrosis. Glucose-6-phospho dehydrogenase deficiency Bradet- Biedl syndrome and some important autosomal recessive and dominant disorders | 6 |
| 4 | **Muscle disorders:** Duchenne muscular dystrophy, Becker's muscular dystrophy, limb-girdle muscular dystrophies and cardiac muscle disorders. | 4 |

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|---|---|---|
| 5 | **Neurological disorder:** Alzheimer, Hutington, Parkinson, Lewy body dementia and Schizophrenia | 4 |
| 6 | **Genetic basis of neoplastic disorders:** Retinoblastoma, Wilms tumor, Colectral cancer, and Blooms syndrome | 6 |
| 7 | Prenatal Genetic counseling | 2 |
| 8 | **Gene therapy:** Principles of molecular genetic-based therapies and treatment with recombinant proteins or genetically engineered vaccines The technology of classical gene therapy Gene therapy for inherited disorders Gene therapy for neoplastic disorders The ethics of human gene therapy | 7 |
| 9 | **Genetic counseling risk assessment** | 3 |
| 10 | **Genetic counseling and ethical issues** | 2 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**


1. Strachan T and Read AP (2010) Human Molecular Genetics -4, Garland Science, 4th Ed.
2. Pasternak JJ (2005) An introduction to Human Molecular Genetics: Mechanisms of Inherited Diseases. *Hoboken (New Jersey): John Wiley & Sons*, 2nd Ed.
3. Evans C (2006) Genetic Counselling A psychological approach. New York, NY, US: Cambridge, 1St Ed.


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Genetic Counseling) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 3 | 2.1 |
| CO-2 | 2 | 2 | 3 | 2 | 2 | 1 | - | 3 | 2 | 2 | 1 | 3 | 2 |
| CO-3 | 2 | 3 | 2 | 2 | 2 | 1 | - | 3 | 2 | 3 | 1 | 2 | 2 |
| CO-4 | 2 | 3 | 2 | 2 | 2 | 2 | - | 3 | 2 | 3 | 1 | 2 | 2 |
| Average | 2.0 | 2.75 | 2.5 | 2 | 2 | 1.5 | 1 | 3 | 2 | 2.5 | 1 | 2.5 | |

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# Comparative and Functional Genomics

COURSE CODE: 18B1WBT532

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:**Molecular Biology, Biochemistry

**Course Objectives:**

1. The course is intended to provide thorough understanding of the genomics i.e. modern technologies in whole genome sequencing, genome mining, comparative genomics, global gene function technologies, protein structure & function technologies at the genome level, etc.
2. The course will explore that how technological innovations fostered by the Human Genome Project, will lead to significant advances in our understanding of diseases that have a genetic basis and, more importantly, how health care will be delivered from this point forward

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will have a thorough understanding of various genomic technologies such as whole genome mapping & sequencing, genome annotation, global gene cloning and gene expression technologies, comparative genomics, introduction to pharmacogenomics | Familiarity |
| CO-2 | The students will know the vast amount of genome information in publically available databases and how to access and best utilize for practical purposes. | Assessment |
| CO-3 | Able to analyze the gene expression data sets to derive the biologically meaning information | Assessment |
| CO-4 | Able to apply the knowledge of function genomics in public health | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to genomics:**Genome organization of Model organism- E. coli, Yeast, Mice, A. thaliana, Human etc. Genome statistics | 3 |
| 2 | **First and 2nd generation sequencing:**Sanger sequencing and next generation sequencing; Reverse termination sequencing, Single cell RNA sequencing or single cell RNA sequencing and Applications | 8 |
| 3 | **Comparative genomics:**Genome Annotation i.e. Mining Genomic Sequence Data, gene prediction methods, Physical mapping, Metagenomics, evolutionary relationship, Genome Analysis, Functional maps (Transcriptome, proteome, metabolome) Metabolic network maps | 8 |
| 4 | **Functional genomics tools:**Hybridization and sequencing based approaches. Serial Analysis of Gene Expression-SAGE, DNA- Microarray, Application of DNA Microarray, cDNA-PCR, etc. | 8 |
| 5 | **SNP:**SNP Technologies: Platforms & Analysis<br>Haplotyping: Concepts and Applications and relevance in cancer Biology | 7 |
| 6 | **Regulation of gene expression:**Gene Function Technologies (Gene Targeting, Gene Silencing (RNAi), micro RNA-human and Drosophila | 4 |
| | Biomarkers Pharmacogenomics: Concepts and Applications in Healthcare Role | |

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| | | |
|---|---|---|
| 7 | of genotype in drug metabolism Identification & Utilisation of cancer bio-marker | 4 |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**

1. Discovering Genomics, proteomics & bioinformatics. Second edition by A Malcolm Campbell, Davidson College; Laurie J. Heyer Davidson College ; With Foreword by Francis S. Collins
2. Molecular Biology of the Gene (1987) Watson J. D., Hopking N., Robast J. and Steiz, J.
3. BIOINFORMATICS: A Practical Guide to the Analysis of Genes and Proteins (Third edition) Andreas D. Baxevanis& B. F. Francis Ouellette

**Suggested Reference Book(s):**


1 . Ronaghi M. Pyrosequencing sheds light on DNA sequencing. Genome Res. 2001 Jan;11(1):3-11. Review. PubMed PMID: 11156611
2. Schulze A, Downward J. Navigating gene expression using microarrays—a technology review. Nat Cell Biol. 2001 Aug;3(8):E190-5. Review. PubMed PMID: 11483980
3. Kim JB, Porreca GJ, Song L, Greenway SC, Gorham JM, Church GM, Seidman CE, Seidman JG. Polony multiplex analysis of gene expression (PMAGE) in mouse hypertrophic cardiomyopathy. Science. 2007 Jun 8;316(5830):1481-4. PubMed PMID: 17556586
4. MacBeath G, Schreiber SL. Printing proteins as microarrays for high-throughput function determination. Science. 2000 Sep 8;289(5485):1760-3. PubMed PMID: 10976071.
5. Shankar J, Wu TD, Clemons KV, Monteiro JP, Mirels LF, et al. (2011) Influence of 17b-Estradiol on Gene Expression of Paracoccidioides during Mycelia-to- Yeast Transition. PLoS ONE 6(12): e28402. doi:10.1371/journal.pone.0028402
6. Mary V. Relling, William E. Evans Nature. Author manuscript; available in PMC 2016 Jan 13.
7. Published in final edited form as: Nature. 2015 Oct 15; 526(7573): 343–350. doi: 10.1038/nature15817


**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/102104056/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1.9 |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1.75 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1.7 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | - | 2 | 1.7 |
| Average | 2.0 | 2.0 | 2 | 2 | 2 | 1.25 | 1.25 | 1.5 | 2.0 | 2 | 1.33 | 2.0 | |

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# Computational Molecular Evolution

COURSE CODE: 18B1WBI831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Basic knowledge of computational biology, evolutionary biology, and functional genomics

**Course Objectives:**

1. The objective of the course is to develop functional and evolutionary genomic understanding of biological entities for various kinds of lineages for biological data types such as DNA, RNA, Genes, and Proteins etc.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand the holistic approaches of molecular evolution | Familiarity |
| CO-2 | Combining acquisition, integration and management of experimental evolutionary data with computer aided analysis | Assessment |
| CO-3 | Use various methods from computational genomics and proteomics to learn their functional aspects of controlling biological processes by incorporating evolutionary information | Assessment |
| CO-4 | Able to analyze various kind of biological sequence data and identify their limiting factors to propose new design principles for the analysis of biological data | Assessment and Usage |
| CO-5 | Applications of evolutionary analysis through various available approaches | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:**Introduction to molecular evolution and its role in the regulation of various biological processes. Introduction to evolutionary biology, functional genomics, basics of data types for biological sequences their importance and applications in further analysis. | 6 |
| 2 | **Biomolecules:**To understand various entities and their role in evolution: Genes, operons, regulons, stimulons, genomes, proteins, proteomes etc. | 6 |
| 3 | **Codon usage and patterns:**Patterns of base composition and codon usage, gene duplication, pseudogenes, orphan genes, gene gain and gene loss processes, overlapping and nested genes, exonization, intron and RNA editing, functional convergence, hypothetical proteins and their annotations. | 6 |
| 4 | **Mutation and selection:**Various kinds of mutations and selection pressure and related theories. | 6 |
| 5 | **New data and evolution:**Description of models, methods and algorithms that are most useful for analysing the ever-increasing supply of molecular sequence data, with a view to furthering our understanding of the evolution of genes, proteins, and genomes. | 10 |

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|---|---|---|
| 6 | **Models of evolution:**Models of nucleotide substitution, models of amino acid and codon substitution, phylogeny reconstruction: Overview, Maximum Likelihood methods, Bayesian methods, comparison of methods and tests on trees, molecular clock and estimation of species divergence times, neutral and adaptive protein evolution, simulating molecular evolution | 8 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. Molecular Evolution by Dan Graur and Wen-Hsiung Li, Sinauer Associated Inc. Pub., USA .
2. Computational Molecular Evolution by Ziheng Yang, Oxford Series in Ecology and Evolution.
3. Molecular Evolution: A phylogenetic approach Rodric DM Page and Edward C Holmes, Blackwell Science Ltd.

**Suggested Reference Book(s):**

1. Inferring Phylogenies J. Felsenstein, . Sinauer Associated Inc. Pub., USA.
2. Bioinformatics and Molecular Evolution by Paul G Higgs, Blackwell Publishing.
3. Molecular Evolution and Phylogenetics Masatoshi Nei and Sudhir Kumar, Oxford University Press.

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Computational Molecular Evolution) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 3 | 2 | 3 | 2 | 2.17 |
| CO-2 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 | 2 | 2 | 1.89 |
| CO-3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 2.08 |
| CO-4 | 2 | 2 | 3 | 1 | 1 | - | - | - | 2 | 2 | 2 | 1 | 1.78 |
| CO-5 | 3 | 2 | 3 | 2 | 2 | 3 | - | - | - | 2 | - | 1 | 2.25 |
| Average | 2.4 | 2.2 | 2.6 | 2 | 1.8 | 2.67 | 1 | 1 | 2.25 | 1.8 | 2 | 1.8 | |

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# Diagnostics & Vaccine Manufacturing

COURSE CODE: 18B1WBT833

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Immunology

**Course Objectives:**

1. To familiarize the students with the principles & applications of the latest state-of-the-art bio-molecular diagnostic techniques/technology used in laboratories the world over.
2. The safety aspects, quality control, quality assurance and validation of PCR based diagnostics and laboratory safety.
3. Knowledge of various technologies employed in vaccine production and examine their use in developing vaccines against human and animal pathogens. The safety aspects, quality control, quality assurance and validation of vaccine production and will also be covered.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The students would be able to identify and analyze what DNA based approach and methodology should be used for diagnostic purpose in different settings, their comparative advantages and limitations. | Usage |
| CO-2 | The students would be able to identify and analyze what antigen - antibody based approach and methodology should be used for diagnostic purpose in different settings, their comparative advantages and limitations. | Usage |
| CO-3 | The students would have in-depth knowledge of various types of vaccines and approaches used for their production. | Familiarity |
| CO-4 | The students would have in-depth knowledge of quality control and assurance considerations used in the industry for diagnostics. | Assessment & Technical |
| CO-5 | The students would have in-depth knowledge of antimicrobial susceptibility and its application in the industry for diagnostics. | Assessment & Technical |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **General Introduction**: Biotechnology in the diagnosis of infectious diseases and vaccine development, Biotechnology in Vaccine production, Recent developments in vaccine technology. | 2 |
| 2 | **Immunodiagnostics:** Antigen – Antibody Interaction, Lattice Theory, Precipitin Curve, Simple Immunodiffusion (Radial Immunodiffusion Qualitative, Quantitative); Double Diffusion (Mechanism of Reaction of Identity, Partial – | 10 |

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|---|---|---|
| | Identity, and Non- Identity); Immunoelectrophoresis; Rocket Electrophoresis, Western Blot, Immunofluorescence, Agglutination – Antibody titer, Prozone Phenomenon, Direct and Indirect Agglutination, Hemagglutination, ABO Blood typing, Agglutination Inhibition; Immunofluorescence, Radioimmunossay (including advantages and disadvantages). | |
| 3 | **ELISA:** Theory, Designing an ELISA method, Types – Direct, Indirect, Sandwich, Competitive, Dot ELISA. | 2 |
| 4 | **PCR:** concept, protocol, strategy. Types of PCR – Strategy and Applications - Nested, Semi-nested, Real time, RT-PCR, Asymmetric PCR, Inverse PCR, Multiplex PCR. | 3 |
| 5 | **QC & QA of PCR and Real Time based diagnostics**: Theory, Application, and Trouble shooting. Importance of controls. Best Fit Assay, Optimization and Standardization of PCR based diagnostics. | 3 |
| 6 | **AST**: Concept, KB Method. Laboratory methodologies for bacterial antimicrobial susceptibility testing – concepts, antibiotics –, resistance, mechanism. Disk diffusion, tube dilution, microbroth dilution methods. | 4 |
| 7 | Biosafety and biosecurity in the medical microbiology laboratory and animal facilities. | 2 |
| 8 | Different types of vaccines, i.e., sub-unit vaccines, recombinant vaccines, synthetic vaccines, idiotypic based - vaccines, DNA vaccines, glycoconjugate vaccines, deletion vaccines. | 3 |
| 9 | Examples of different vaccines - Rabies vaccines, PPRV vaccines, Chimeric vaccines – JEV/DENV/Westnile, Meningococcal conjugate & protein based vaccines, Oral B subunit + whole cell cholera vaccine, Multicellular Parasite vaccines, Novel Vaccines against *Mycobacterium tuberculosis,* Mycoplasma vaccines, Protozoal &rickettsial vaccines. | 8 |
| 10 | Genetic basis of attenuation, vaccine vectors, large-scale production of vaccines and automation. . Vaccine delivery system and approaches to enhance immunogenicity - immunomodulators and, immunomodulation adjuvant. Delivery of particulate antigens through liposomes, microspheres etc. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Burtis, C. A., Ashwood, E. R.,:Tietz textbook of Clinical Chemistry &Bruns, D. E. Molecular Diagnostics, Saunders, 2006
2. World Organization for: Manual of Diagnostic Tests and Vaccines for Animal Health Terrestrial Animals, Volumes I & II, 6th Edition, 2010.
3. Rao, J. R.:Molecular Diagnostics: current technology and Applications, Horizon Bioscience, U. K., 2006.
4. Review and Research Publications available on-line
5. Immunology: Kuby


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**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Diagnostics & Vaccine Manufacturing) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 | 1 |
| CO-2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 1.33 |
| CO-3 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1.5 |
| CO-4 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 1.75 |
| CO-5 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 |
| Average | 1.6 | 1.8 | 2.2 | 1.8 | 1.2 | 1.4 | 1.4 | 1 | 0.8 | 1.4 | 1.4 | 2.2 | |

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# Traditional Bioprocesses & their upscaling

COURSE CODE: 18B1WBT832

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Microbiology, Bioprocess Engineering, Downstream Processing

**Course Objectives:**

Traditional bioprocess gives the lying fundamentals of the pre-historic bioprocess technologies and its scaleup studies on the industrial sectors. Moreover, these gives insights about the technological developments till the existing industrial bioprocesses. Bioprocessing of biopharmaceuticals and immobilization technology also gives an opportunity to study the recent advancements in this field. By keeping the mentioned points, the course objectives were framed as follows

1. Introduction of traditional bioprocesses and its upscaling
2. Discussion of bioprocessing of biopharmecuticals, recent advances in Immobilization technology and Fermentation technology

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Introduction to Traditional Bioprocesses and its production technologies | Familiarity |
| CO-2 | Bioprocessing of Biopharmaceuticals | Assessment |
| CO-3 | Recent trends in Immobilization technology and bioreactor technology | Assessment |
| CO-4 | Upscaling studies of bioprocess products | Usage |
| CO-5 | Scale up considerations of different bioprocess commodities | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Traditional Bioprocesses: Introduction and Technology Advancemnets:** Industrial production of organic acids (Citric acid; Glutamic acid; Lactic acid; Kojic acid; Ascorbic acid) ; Industrial production of Antibiotics (Pencillins; Cephalosporins; Tetracyclins); Industrial production of Amino acids (Lysine; Threonine; Aspartate) | 14 |
| 2 | **Bioprocessing of Biopharmaceuticals:** Overview of USP and DSP aspects of Biopharmaceuticals; Upstream processing of Mab production; Downstream Processing of Mab's ; Process optimization for Mab production; Protein therapeutics | 6 |
| 3 | **Recent advances in Reactor technology:** Bioreactors for solid state fermentation ; Photobioreactors for microalgal products; Bioreactors for pharmaceuticals | 9 |
| 4 | **Advances of enzyme immobilization techniques:**Sol-gel chemistry and immobilization; Immobilization on nano-particles; Cross-linked Enzyme Aggregates; Surface analysis technology of Immobilized Enzymes | 5 |

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|---|---|---|
| 5 | **Scale up considerations of different bioprocess commodities:** Bioprocess aspects of sugar alcohols; Production of flavours in food industries; Flavour production in fermented foods; Bioprocess aspects of Nutraceuticals; Probiotics, Prebiotics and Synbiotics; | 8 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. Microbial Technology: Microbial processes by Henry J. Peppler, D. Perlman
2. Microbial Biotechnology by Alexander N. Glazer and Hiroshi Nikaido
3. Industrial Biotechnology by Wim Soetaert and Erick J. Vandamme
4. Immobilization of Enzymes and Cells by Jose M.Guisan
5. Biofilms in Medicine, Industry and Environmental Biotechnology by Piet Lens et al.

**Suggested Reference Book(s):**

1. Review / Research articles from Science Direct, Springer, Wiley and Pub Med

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 2.17 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2.42 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2.58 |
| Average | 3.00 | 3.00 | 3.00 | 3.00 | 1.40 | 2.20 | 1.60 | 2.40 | 1.60 | 2.00 | 1.00 | 3.00 | |

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# Structural Bioinformatics

COURSE CODE: 18B1WBI531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:**Structural Biology

**Course Objectives:**

1. To develop the ability to design, predict, analyze and compare the protein structures as well as predict the function of target proteins.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understanding the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.) | Familiarity |
| CO-2 | To Understand and use structural databases and software for structure visualization | Familiarity |
| CO-3 | To understand the algorithms used in Structure determination and quality assessment | Assessment |
| CO-4 | To perform protein structure comparison and the hierarchical nature of biomacromolecular structure classification | Usage |
| CO-5 | To understand the methodology of protein structure prediction and assessment | Assessment |
| CO-6 | To understand the methodology of sequence- and structure-based functional site prediction | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction of protein structure:**Overview of syllabus and protein structure (amino acids and peptide bonds; primary, secondary, super-secondary, tertiary and quaternary structure of proteins). | 3 |
| 2 | **Fundamental concepts of structural biology:**Chemical building blocks, structure, superstructure, folding, etc.; the physical forces that shape macromolecules; structural databases (protein data bank, SCOP database, CATH database and other structure based databases) | 6 |
| 3 | **Secondary structure of protein:**Computational methods for prediction of secondary structure of protein sequences (Chou- Fasmann, GOR and Neural Networks) and reliability (Q3 value and SOV score) | 3 |
| 4 | **Tertiary structure of protein:**Prediction of tertiary structures of protein sequences (Homology and Threading methods); structure quality assessment. | 6 |
| 5 | **Protein structures comparison and alignment:**General approach of alignment and comparison, comparison algorithm & optimization, statistical analysis of results, multiple structural alignment. | 3 |
| | **Analysis of 3D structures:**Secondary structure assignment, assignment of hydrogen bonds, coulomb hydrogen bond calculation, empirical hydrogen | |

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|---|---|---|
| 6 | bond calculation, assignment methods of secondary structure (DSSP, STRIDE, DEFINE, P- Curve) | 3 |
| 7 | **Identifying structural domains in protein:**How structural domains are defined? First and second generation algorithms for domain assignments, domain assignment based on graph theoretical methods, prediction of binding sites and characterization. | 3 |
| 8 | **Ab initio protein structure prediction:**Empirical force field for biomolecular simulations, Potential Energy Function (bond length potential, bond angle potential, torsional potential, van der Waals potential and coulomb potential), classical representations of electrostatics (Poisson-Boltzmann, Generalized Born and Colombic). | 6 |
| 9 | **Energy minimization techniques:**Concept of local and global minima, energy minimization protocol, energy minimization algorithms (steepest descent, conjugate gradient, Newton Raphson) | 3 |
| 10 | **Molecular Dynamics simulations:**Monte Carlo Simulations, Techniques for efficient conformational search: Simulated Annealing, Calculation of Free energy using simulation techniques. | 6 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**


1. Structural Bioinformatics (2nd Edition), Jenny Gu (Editor), Philip E. Bourne (Editor)
2. D.W. Mount Bioinformatics: Genome and Sequence Analysis: (2001) Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Molecular Modeling: Principles & Applications, Andrew R. Leach, Prentice Hall


**Evaluation Scheme:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Syllabus covered up to Test-1 |
| T2 Test | 25 | 1.5 hrs. | Syllabus covered up to Test-2 |
| End Term Test | 35 | 2 hrs. | Whole Syllabus |
| Teacher Assessment (Based on Assignments, quizzes etc.) | 25 | Whole Semester | Inform class time to time |
| **Total** | **100** | | |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Intellectual Property Rights and Commercialization

COURSE CODE: 18B1WBT734

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite: None**

**Course Objectives:**

b. To provide an insight and understanding about different aspects of protection of inventions and research developments
c. Learn about procedures for filling protection through Intellectual Property Rights.
d. To provide scopes of protection of diverse intellectual properties and its commercialization for socio-economic improvement.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To enable students with basic concepts and knowledge of intellectual property rights. | Awarness |
| CO-2 | To apply and execute different types of IP protection in research and academics. | Assessment and technical skills |
| CO-3 | Able to understand about the mechanisms of different IP protections, registrations and applications | Technical |
| CO-4 | To be capable of tackling issues related to IP and its commercialization | Assessment |
| CO-5 | Able to learn the strategies for effective IP management and commercialization | Analytical skills |
| CO-6 | To apply the knowledge of IPR for the benefit generation and for mass utilization | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction**:Introduction of Intellectual properties and rights conferred . Integration of Intellectual Property, Bioethics and Biosafety for biological and applied sciences in research and academia. | 4 |
| 2 | **Types of IP tools**:Different types of IPR( Patents, copyrights and related rights, Trademark, Tradesecret, Integrated circuit layout, Geographical indications, Traditional knowledge, Industrial designs and PBR)Drafting Patent Application and Documentation Revocation of Patent, Litigation and Infringement Rationale of different IPR ,their mechanism of protection and provisions in Law | 10 |
| 3 | **International Agreements** and Treaties:International IP treaties (Madrid Agreement, Trademark law treaty, Patent Law treaty etc.) WIPO, EPC, WTO, and TRIPS. International agreements relevant to biotechnology-associated IP | 8 |
| 4 | **Commercialization**: Methods of commercialization,Impact of commercialization, | 6 |

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| | | |
|---|---|---|
| | Financing | |
| 5 | **IP Management for value addition:** Strategies for IP Management and commercialization. IP audit, IP insurance Bioentreprenuership management | 4 |
| 6 | **Licensing/Assignment** :Types of licensing and modes to carry out, Assignments and its benefits, Compulsory Licensing Commercialization for social and economic prosperity with case studies | 8 |
| **Total lectures** | | **42** |

## Methodology

The course will be covered through lectures, presentations and vedios. Apart from discussions on topics covered through lectures and assignments, students have to carry out research paper analysis.

**Suggested Text Book(s):**

i. Intellectual Property Rights & Copyright By Bouchoux.
ii. Intellectual Property Licensing Strategies by Thompson Reuters

**Suggested Reference Book(s):**

1. Intellectual Property Rights, the WTO and Developing Countries: The TRIPS ...Book by Carlos María Correa
2. Perspectives on Commercializing Innovation by F. Scott Kieff (Editor), Troy A. Paredes (Editor

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Intellectual Property Rights & Commercialization) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | **15** |
| **CO-2** | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | **1.5** |
| **CO-3** | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.7** |
| **CO-4** | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | **1.9** |
| **CO-5** | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | **1.6** |
| **CO-6** | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | **1.8** |
| **Average** | **3.4** | **3.4** | **2** | **2.1** | **2.1** | **1.3** | **1.1** | **1** | **1.5** | **1.6** | **1.5** | **2** | |

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# Genetics

COURSE CODE: 18B11BT311

COURSE CREDITS: 4

ELECTIVE/CORE: CORE

: 3-1-0

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**Pre-requisite:**Knowledge of Biology (10+2)

## Course Objectives

1. Genetics is a core course designed to cover both basic and advanced concepts in classical genetics.
2. A good understanding on this subject will help the students to think analytically on other areas of modern biology and medicine.
3. After completing this course the students would acquire a good understanding of Mendelian analysis, linkage analysis, gene mutation and genetics of model organisms, genetic diseases, ethical issues and population genetics.

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO I | Students will combine their knowledge of probability theory with the rules of inheritance to do pedigree analysis and accurately predict genetic outcomes. | Assessment & Analytical Skills |
| CO II | Students will be able to interpret pedigrees and phenotypic ratios to determine if genes are autosomal or sex-linked, linked or sorting independently, and genotypes of parents | Analytical & Technical Skills |
| CO III | Students will develop an appreciation of how genes work within organisms. | Familiarity |
| CO IV | Students will develop an understanding and ramifications of gene mutations | Awareness |
| CO V | Students will be able to recognize real-world examples of genetics topics and demonstrate the interaction of genetics in society. | Assessment & Analytical Skills |
| CO VI | Students will develop an understanding of the ethical issues related to genetic research and its applications. | Analytical & Technical Skills |

## Course Contents:

| Unit | Contents | Lecture required |
|---|---|---|
| 1 | **Introduction to Genetics**Background and revision of concepts of mitosis &meosis,Terminology and relevance of the subject. | 2 |
| 2 | **Mendelian Genetics** Basic principles of Mendelian experiments. Mendel's laws and its extension, Model systems in genetic analysis – Drosophila, Pea, Arabidopsis. | 6 |
| 3 | **Chromosomes and Chromosome theory of inheritance**Nucleic Acids, Chromosomes, Chromosomal abnormalities: polyploidy, Lampbrush and Polytene chromosomes, The Chromosome Theory of Heredity, Sex Chromosomes and Sex- Linkage | 6 |
| 4 | **Gene interaction**Genes, Alleles, Lethal alleles, Multiple alleles and their interaction, Pleiotropism, Penetrance and expressivity, Transposable | 5 |

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| | Elements | |
|---|---|---|
| 5 | **Linkage and chromosome mapping**The Discovery of Linkage,Linkage and Recombination, Linkage of Genes on the X- chromosome, Linkage maps, Three-Point Testcross, Interference, Calculating Recombinant Frequencies, Examples of Linkage Maps, Chi-square test, The Nature of Crossing-Over, Linkage Mapping by Recombination in Humans. | 6 |
| 6 | **Gene mutation** Somatic versus germinal Mutation, Mutant Types, Mutation Induction, Gene Mutation, The Molecular Basis of Gene Mutations, Spontaneous Mutations, Induced Mutations, Reversion Analysis, The Relationship between Mutagens and Carcinogens, Luria Delbruck fluctuation test, | 6 |
| 7 | **Extra Chromosomal Inheritance**Extra nuclear Inheritance in Higher Plants, Overview of the Mitochondrial Genome, Overview of the Chloroplast Genome | 3 |
| 8 | **Population Genetics**Darwin's Revolution, Variation and Its Modulation, The Effect of Sexual Reproduction on Variation, The Sources of Variation, Selection, balanced Polymorphism, Quantitative genetics | 5 |
| 9 | **Genetic Diseases & Ethics**Genetic Diseases and Protein malfunctioning, ethical issues related to Genetics | 3 |
| **Total Lectures** | | **42** |

**Suggested Text Books:**

1. Concept of genetics by William S Klug and M.R. Cummings
2. Principles of Genetics. D P Snustad, M J Simmons

**Suggested Reference Books:**

1. An Introduction to Genetic Analysis. Griffiths et al.
2. Genetics, from Genes to Genomes L.H. Hartwell et al,
3. Genetics by Strickberger
4. Genetics by Peter J. Russell
5. Principles of Population Genetics by Daniel L. Hartl and Andrew G. Clark

**Other Useful Links:**

1. https://nptel.ac.in/
2. http://www.dnaftb.org/1/bio.html Developed by Cold Spring Harbor Laboratory
3. http://www.dnaftb.org/1/bio.html Developed by Cold Spring Harbor Laboratory

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

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**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Genetics ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 3 | **1.8** |
| CO-2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | **2.2** |
| CO-3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | **2.08** |
| CO-4 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | **1.8** |
| CO-5 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | **1.5** |
| CO-6 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | - | 1 | - | 2 | **1.7** |
| Average | **2.1** | **2.1** | **1.8** | **2.1** | **1.8** | **2** | **1.6** | **2** | **1.3** | **1.5** | **1.1** | **2.1** | |

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# BIOCHEMISTRY

COURSE CODE: 18B11BT312

COURSE CREDITS: 3

ELECTIVE/CORE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Cell Biology, Chemistry

**Course Objectives:**

1. To provide an understanding of the basic bio-molecule structures, their origin and their involvement in life processes.
2. To provide an insight into the main metabolic pathways of living organisms and their integration with other biological pathways.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | to understand the structural fundaments of various biochemical present in organisms. | Familiarity |
| CO-2 | to understand the principles of structural-functional relationship of biomolecules. | Familiarity |
| CO-3 | to understand primary metabolic pathway of energy production in organism. | Assessment |
| CO-4 | to understand the regulation of various metabolic pathway of organism. | Assessment |
| CO-5 | to integrate knowledge of biochemical pathways for understanding the various disorders and their rectification. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Bio-molecules and their bi role in metabolism:** Biological importance structural polysaccharides, Properties and function of lipids in fat metabolis enzymatic regulation in metabolism, Importance of nucleic acids in liv system, | 8 |
| 2 | **Carbohydrate Metabolism:** Introduction to Intermediary metabolism, central role of glucose in metabolism of plants, animals. Glycolysis, reactions of glycolysis. Fermentation: anaerobic fate of pyruvate. Regulation of glycolytic pathway. Overview of TCA, Metabolic sources of Acetyl-Coenzyme A. TCA Cycle inhibitors. Gluconeogenesis and its Regulation, Glyoxalate Cycle reactions. Glycogen metabolism, Synthesis and breakdown, glycogen synthetase and phosphoryllase and their regulation, Glycogen Storage diseases. | 8 |
| 3 | **Lipid Metabolism:** Biosynthesis of lipids, fatty acid synthesis and its regulation, biosynthesis of triacylglycerols, phospholipids. Lipid digestion, absorption and transport. Fatty acids oxidation, oxidation of saturated, unsaturated fattys in mitochondria, transport of fatty acids to mitochondria. Ketone Bodies synthesis and degradation. | 8 |
| 4 | **AminoAcids metabolism:**Overview assimilation of inorganic nitrog in biomolecules.Positive and negative nitrogen balance, Protein calo | 7 |

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| | malnutrition, Kwashiorkor and Marasmus.<br>Glucogenic and ketogenic amino acids, catabolic pathways for the 20 standard amino acids; Metabolism of one-carbon units. Disorders of amino acid metabolism:Phenylketonuria, Alkaptonuria, Maple syrup urine disease etc. | |
| 5 | **Purine andPyrimidinemetabolism:** Biosynthesis of IMP; pathw from IMP to AMP and GMP; conversion to triphosphates; regulation purine nucleotide biosynthesis, salvage pathways.<br>Inhibitors of nucleotide metabolism and their use as anti bacterial / anticancer drugs.Degradation of purine and pyrimidine nucleotides. Disorders of nucleotide metabolism: LeschNyhan syndrome, Gout, SCID, Adenosine deaminase deficiency. | 7 |
| 6 | **Vitamins:**Structure of fat soluble vitamins A, D, E & K. Water soluble vitamins, their co- enzyme forms and deficiency disorders, Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid. | 4 |
| | **Total** | **42** |

**Suggested Text Book(s):**


1. Lehninger Principles of Biochemistry Cox, M.M. and Nelson, D.L. and Lehninger A. L. 4th edition.
2. Biochemistry- J.M. Berg, J.L.Tymoczko, and LubertStryer; 5th edition W.H. Freeman and Company, New York, USA.
3. Voet, D. and Voet, J.G.( 2011), 4th edition. Biochemistry, John Wiley & Sons, Inc. USA.
4. Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Weil Rodwell, (2012) 29th edition. Harper's Illustrated Biochemistry, Lange, McGrawHill.


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 2 | - | 1 | 1 | - | - | 1 | - | 3 | **1.17** |
| CO2 | 2 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | - | 2 | 1 | 3 | **1.58** |
| CO3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | **1.58** |
| CO4 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | - | 2 | 2 | 2 | 2 | **1.75** |
| CO5 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | **1.92** |
| Average | **2.20** | **1.80** | **2.00** | **1.60** | **1.00** | **1.80** | **1.60** | **0.80** | **0.80** | **1.60** | **1.40** | **2.60** | |

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# Thermodynamics and chemical processes

COURSE CODE:18B11BT313

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** General Chemistry and Basic Physics

**Course Objectives:**

1. Learn the concept of thermodynamics, bioenergetics.
2. Learn Reaction kinetics, mass and energy balances as well as fluid flow mechanics.
3. Learn heat transfer and mixing equipments.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Use of correct Thermodynamical terms to describe &analyze phenomena/problems in physico-chemical processes | Familiarity |
| CO-2 | Understanding the concept of thermodynamics for biological processes as in bioenergetics. | Assessment |
| CO-3 | Understanding basic reaction theory and general reaction kinetics for biological systems in terms of Michaelis – Menten Kinetics. | Assessment |
| CO-4 | To familiarize basic principles for macroscopic analysis of cell growth and product formation. Calculation of nutrient and oxygen requirements during various fermentation processes for both material balances and energy balances. | Familiarity and Usage |
| CO-5 | To know the flow behaviour of different fermentation fluids, their Classification, flow curves for Non- Newtonian fluids with examples from biotechnology as well as Rheological properties of fermentations Broths. | Assesment |
| CO-6 | Understanding the principles governing heat transfer with applications in bioprocess design. Modes of heat transfer, Heat - Transfer equipmentsand Heat transfer coefficients. | Familiarity and Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction andfundamentalconceptsofthermodynamics:** Processes, Components (single/multi), Phases(G/L/S), ideality, Concept of continuum for biological processes, Entropy, enthalpy, Gibbs Free energy, Specific heats /heat capacity. Laws of Thermodynamics and its applications. | 3 |
| 2 | **Bioenergetics (Biological Thermodynamics):** Principles of bioenergetics. Energetics of metabolic pathways by metabolic flux, Energy coupling (ATP and NADH), Biological oxidation and reduction reactions. Understanding thequantitative relationships among free energy, enthalpy and entropy. Concept of $G_o$, $G_o'$ to biochemical reactions, Endergonic and exergonic reactions, Catabolic and anabolic mechanisms. | 5 |
| 3 | **Homogenoeus Reactions/Reaction kinetics:** Basic reaction theory, Reaction Thermodynamics, Calculation of reaction rates from | 6 |

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|---|---|---|
| | experimental data, General reaction kinetics for biological systems, Michaelis – Menten Kinetics, Kinetics of enzyme deactivation. | |
| 4 | **MaterialBalances ofBiochemicalProcesses:** Aspects of metabolic stoichiometry, principlesfor macroscopic analysis of cell growth and product formation. Calculation of nutrient and oxygen requirements during various fermentation processes. Analysis of batch culture of growing cells. Stochiometric coefficients for cell growth, Elemental and electron balances, Biomass yield, Product stochiometry, Theoretical oxygen demand, Thermodynamic maximum biomass and product yields. | 7 |
| 5 | **Energy Balancesof BiochemicalProcesses:** Stochiometric and energetic analysis of cell growth and product formation, elemental study of energy flow within the living systems. Enthalpy calculations for reactive and nonreactive biological processes, Heat of reaction for the process of biomass production, Thermodynamics of microbial growth, Energy balance equation for aerobic and anaerobic cell culture and various other fermentation processes. | 7 |
| 6 | **Fluid mechanics:** Flow behavior of different fermentation fluids. Introduction, Classification of fluids, Newton's Law of viscosity, flow curves for Non- Newtonian fluids with examples from biotechnology, Reynolds number, Boundary layer separation, Fluids in motion, flow patterns– Laminar, turbulent and transition flow, Rheological properties of fermentations Broths, properties of Fluids (Viscosity, Surface Tension), Factors affecting broth viscosity, cell morphology. | 7 |
| 7 | **Heat Transfer:** Principles governing heat transfer with applications in bioprocess design. Modes of heat transfer, Heat - Transfer equipments. Analogy between Heat and momentum transfer, Heat transfer between fluids, Heat transfer coefficients, Design equations for heat transfer systems and its application. | 7 |
| | **Total lectures** | 42 |

**Suggested Text Book(s):**


1. Heat Thermodynamics and Statistical Physics: By B. Lal, N. Subramanyam and P. S. Hemne
2. Biochemistry : By Jeremy M. Berg, John L. Tymoczkao, L. Stryer; .
3. Bioprocess Engineering Principles: By P.M. Doran.


**Suggested Reference (s):**


1. Thermodynamics: A Core Course By: R. C. Srivastava, S.K.Saha and A.K.Jain
2. Engineering Thermodynamics, By: Lynn D. Russsell and George A. Adebiyi
3. Lehninger's Principles of Biochemistry 4th Editoin : By D L Nelson, Cox Lehninger
4. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", 6th ed.


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**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/106104019/
2. Link to topics related tocourse:
   i. https://nptel.ac.in/courses/102104063
   ii. https://nptel.ac.in/courses/102106069/
   iii. https://nptel.ac.in/courses/102106026/

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**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | - | 2 | - | 1 | 1 | - | 1 | 2 | - | 1.25 |
| CO2 | - | 2 | - | 2 | 2 | 1 | - | 1 | 2 | 3 | - | - | 1.08 |
| CO3 | 2 | 3 | - | 2 | 3 | 1 | 1 | 1 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 2 | - | 3 | 3 | 3 | 1 | - | 1 | 2 | - | 3 | 2 | 1.66 |
| CO5 | 3 | 2 | 3 | - | 2 | - | 1 | 1 | - | 2 | - | - | 1.16 |
| CO6 | 3 | 3 | - | 3 | 2 | - | 1 | 1 | 3 | 2 | 1 | 3 | 1.91 |
| Average | 2.1 | 2.1 | 1.33 | 1.66 | 2.33 | 0.5 | 0.66 | 1 | 1.66 | 1.8 | 1.5 | 1.1 | |

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# General Chemistry

COURSE CODE:18B11BT314

COURSE CREDITS: 3

CORE/ELECTIVE: Core

: 3-0-0

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**Pre-requisite**: XII$^{TH}$ Standard Chemistry

**Course Objectives:**

1. To develop the chemistry foundation required for understanding the various processes involved in biological system
2. To provide an insight into mechanism of organic reaction.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand the fundamental chemistry of various functional group | Familiarity |
| CO-2 | Able to understand the principles of stereochemistry | Familiarity |
| CO-3 | Able to understand organic reaction mechanisms that impact on biochemical processes. | Assessment |
| CO-4 | Able to recall the characteristics of important bio-molecules and be able to discuss the relationships between structure properties and functions | Usage |
| CO-5 | Able to design experiments and interpret numerical, chemical and general scientific information | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Chemical calculations, mole calculations, Atomic and molecular structure, Chemical bonding, molecular shape and structures, Acid-base chemistry & resonance, pH, buffer solution, Acid base titration, redox titration Organic Functional group and their nomenclature | 6 |
| 2 | Stereochemistry of organic compounds, optical activity; stereoisomerism; specifications of configurations. Bayers strain theory Cyclo hexane and its confirmation, | 8 |
| 3 | alcohols, ethers, epoxide, aldehydes, ketones, enols, enones, carboxylic acid, and aromaticity, Chemistry of carboxylic acid and their derivatives, Chemistry of Nitro group and amines, | 8 |
| 4 | Introduction of chemical thermodyanamics, reaction kinetics, Chemical equilibrium and aqueous equilibria, | 4 |
| 5 | General introduction of structure, function & properties of various bio-molecules of living organisms, Mono-saccharides and their inter relationship, structure of sugar, Important derivatives of monosaccharide, disaccharides and trisaccharides. Building block of lipids - fatty acids, glycerol, sphingosine. Definition and classification of lipids. Classification of fatty acids, physio-chemical properties of fatty acids, saponification and iodine number. Properties of glycerol, fats and oils. Properties and function of phospholipids and Prostaglandins. Structure of sterols with special reference to cholesterol. Classification of amino acids. Physical, chemical and optical properties of amino acids. Introduction to | 12 |

| | | |
|---|---|---|
| | biologically active peptides e.g. Glutathione, Oxytocin, Insulin, basics of enzymes, | |
| 6 | Classification of polymers, mechanism of synthesis of polymerization, application of various polymers, Co-ordination compounds and their biological importance | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Robert Thornton Morrison, Robert Neilson Boyd, SaibalKanti Bhattacharjee "Organic Chemistry" 7th ed., Pearson India, 2011
2. Jonathan Clayden, Nick Geeves, Stuart Warren, "Organic Chemistry" 2nd ed., Oxford University Press, 2012
3. J. D. LEE , "Concise Inorganic Chemistry" 5th ed., Wiley-Blackwell, 2004

**Suggested Reference Book(s):**

1. Peter Sykes, "A Guide Book to Mechanism in Organic Chemistry" 6th ed., Prentice Hall.
2. E.L. Eliel, "Stereochemistry of carbon compounds" 1st ed., Mcgraw-Hill Education, 2001

**EvaluationScheme:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Syllabus covered upto T-1 |
| T2 Test | 25 | 1.5 hrs. | Syllabus covered upto T-2 |
| End Term Test | 35 | 2 hrs. | Entire Syllabus |
| Teacher Assessment | 25 | Entire Sem | Based on Assignments, quizzes etc. |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Chemistry) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | - | 3 | 2 | 2 | 2 | - | 2 | - | 2 | 2 | - | 2 | 2.1 |
| CO-2 | 3 | 3 | 2 | 3 | 3 | - | 2 | - | 3 | 2 | - | - | 2.3 |
| CO-3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | - | 3 | 2 | - | - | 2.3 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | 3 | 1 | - | - | 2.5 |
| CO-5 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 2.3 |
| Average | 3.0 | 3.0 | 2.4 | 2.6 | 2.6 | 2.0 | 2 | 2 | 2.8 | 1.6 | 2.0 | 2.5 | |

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# Genetics Lab

COURSE CODE:18B17BT371

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** Knowledge of Biology (10+2)

## Course Objectives:

1. Genetics is a core course designed to cover both basic and advanced concepts in classical genetics.
2. A good understanding on this subject will help the students to think analytically on other areas of modern biology and medicine.

## Course Outcomes

| S.No. | Course Outcomes | Level ofAttainment |
|---|---|---|
| CO1 | To acquaint the students with methods and techniques used in experimental genetics. | Familiarity |
| CO2 | Obtain hands-on experience in performing fundamental genetics experiment including working safely and efficiently in a modern laboratory setting. | Assessment & Analytical Skills |
| CO3 | Correctly analyze and interpret experimental results within the limitations of the experimental design | Assessment&Analytical Skills |
| CO4 | Students will be trained students with genetics experiments related to Model Organism Drosophila | Assessment & Analytical Skills |
| CO5 | They will develop a statistical analysis of genetic data relevant to forensic, conservation and evolutionary genetics, and summarize and interpret the outcomes along with ethical issues. | Analytical & Technical Skills |
| CO6 | Students will develop an understanding and importance of Virtual Genetics Labs. | Assessment & Analytical Skills |

## List of Experiments

| S.NO. | Description | Hours |
|---|---|---|
| 1 | Course orientation and Lab safety along with a preview of instruments. | 2 |
| 2 | Study of human karyotype – Study of chromosome structure, morphology, number and types. | 2 |
| 3 | Cell division (Mitosis and Meiosis) – Basis of Genetics | 2 |
| 4 | Study of co-dominance using ABO and Rh blood typing and Ishihara test for colourblindness and its associated Genetics. | 2 |
| 5 | Calculation of allelic and genotypic frequencies as per Hardy-Weinberg Law – Free ear lobes, Hitchhikers, Widow's peak, Dimpled chin, Taste allele frequencies | 2 |
| 6 | DNA isolation from *E.coli* strain. Agarose gel formation, PCR basics. | 2 |
| 7 | DNA quantification and amplification. | 2 |
| 8 | Virtual Lab. 1 on Classical Genetics and Mendel's experiments. | 2 |
| 9 | Virtual Lab. 2 on Buffers like TBE, TE, TAE. Relevance of various buffers will be | 2 |

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| | | |
|---|---|---|
| | explained. Their composition and preparation will also be studied. | |
| 10 | Virtual Lab. 3 on Nucleic acid molecules are separated by agarose gel electrophoresis. Factors related to separation and its preparation, loading etc. will be studied through it. | 2 |
| 11 | Handling Drosophila, identifying mutants, and scoring flies. | 2 |
| 12 | Drosophila genetics and recombination Analysis of Drosophila recombinants using probability and Chi-Square test. | 2 |
| 13 | Dissect the Drosophila larvae and bring out the salivary gland and polytene chromosomes from *Drosophila melanogaster* | 2 |
| 14 | Survey of DNA polymorphism using Dominant and Co-dominant molecular markers (RAPD,ISSR and SSR) | 2 |
| **Total Lab Hours28** | | |

**Suggested Reference(s):**

1. Genetics Lab manual
2. http://vlab.amrita.edu
3. https://nptel.ac.in/

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Genetics Lab ) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 1 | - | 2 | 1.8 |
| CO2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2.2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | - | 1 | 2 | 2.1 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 1 | - | 2 | 2 | 1 | - | 2 | 1.7 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 2 | 2 |
| CO6 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2 |
| Average | 1.8 | 2.5 | 2.6 | 2.3 | 2.6 | 1.5 | 1.1 | 1.6 | 2.1 | 1.1 | 1 | 2.3 | |

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# BIOCHEMISTRY LAB

COURSE CODE: 18B17BT372

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Cell biology, basic chemistry

**Course Objectives:**

1. The objective of this course is to familiarize the students with laboratory techniques related to identification and quantification of various biomolecules required to meet the metabolic needs of body.
2. To develop basic practical biochemical skills for the handling and analysis of biomolecules.

**Course Outcomes:**

| S.N. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO I | to familiarize with introduction to basic biochemistry laboratory practices and safety. | Familiarity |
| CO II | to calculate different identities in terms of molarity, normality and independently handle different instruments utilized in a biochemistry lab. | Familiarity |
| CO III | to identify qualitatively the biomolecules in given solution. | Assessment |
| CO IV | to estimate the concentration of a biomolecules in given solution. | Assessment |
| COV | to understand ethics, team work and discipline | Usage |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Basic guidelines for safety measures to avoid hazards in biochemistry lab. | 1 |
| 2 | To prepare buffer solution of varying pH by using Henderson-Hasselbalch equation and pH meter. | 1 |
| 3 | To identify and classify sugars into various categories based upon qualitative methods. | 2 |
| 4 | To determine concentration of carbohydrates by Anthrone method: a quantitative approach. | 2 |
| 5 | To identify a given sample for protein by using qualitative methods. | 2 |
| 6 | To estimate concentration of proteins by quantitative methods: Biuret method, Lowry's method, and Bradford's method. | 2 |
| 7 | To isolate plasma and serum from blood and visualize different proteins present in serum sample by SDS PAGE technique. | 2 |
| 8 | To perform the isoelectric precipitation of casein present in milk. | 2 |
| 9 | To determine presence of lipid in a given sample through qualitative method. | 2 |

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|---|---|---|
| **10** | To estimate the amount of cholesterol present in the serum sample by ZAK's method. | 2 |
| **11** | To quantify the concentration of nucleic acid through spectrophotometer. | 2 |
| **12** | To determine uric concentration in a given serum sample. | 2 |
| **13** | To determine blood sugar concentration in a serum sample. | 2 |
| | **Total Lab hours** | **24** |

**Suggested books /Resources:**

1. Lab manual
2. An Introduction to Practical Biochemistry - David T Plummer
3. Practical Biochemistry, Principles and Techniques - Keith Wilson and John Walker
4. Practical Biochemistry-Geetha Damodaran K
5. E-portal of V-labs by Amrita University (vlab.amrita.edu)

Evaluation Scheme:

| | |
|---|---|
| Mid Term Test | 20 |
| End Term Test | 20 |
| Teacher Assessment (Based on day to day work, performance in experiments, lab notebook etc.) | 60 |
| Total | 100 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs):**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | - | - | 1 | - | 3 | **1.25** |
| CO2 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | - | 2 | 3 | 3 | **1.75** |
| CO3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | **1.67** |
| CO4 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | - | 2 | 2 | 2 | 2 | **1.75** |
| CO5 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 1 | 2 | 2 | 3 | **1.67** |
| **Average** | **2.00** | **1.80** | **2.00** | **1.60** | **1.40** | **1.40** | **1.40** | **1.00** | **0.80** | **1.60** | **1.80** | **2.60** | |

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# Thermodynamics and chemical processes Lab

COURSE CODE:18B17BT373

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. Learn enthalpy calculations
2. Learn to calculate enzyme activity
3. Analyzing the Michael Menton kinetic constants.
4. Measurement of viscosity and surface tension of various biological liquids

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to familiar with the various experiments involved with the flow of heat in terms of water equivalent/heat capacity, enthalpy calculation of various biological compounds as well as energy calculation of different food items. | Familiarity |
| CO2 | Able to correlate the activity with the thermodynamic parameters: ΔH, ΔG, ΔS, and Cp | Assesment |
| CO3 | To understand the variation of activity of enzymes with different physical parameters as pH, Temp. and concentration | Assesment |
| CO4 | Able to correlate the chemical processes with reaction kinetics as well as Michael - Menton kinetics | Usage |
| CO5 | Able to enhance practical skills related to all the measurements of different parameters of liquids as viscosity, surface tension. | Usage |
| CO6 | Able to enhance practical skills related to all the measurements of fluid flow mechanics in order to check the flow patterns with the help of Reynolds number. | Familiarity |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | To determine Heat Capacity or Water equivalent of given thermos/ Dewar flask used as calorimeter | 2 |
| 2 | To determine enthalpy/heat of solution of some biological important compound | 2 |
| 3 | To determine heat of neutralization of strong acid and strong base media | 2 |
| 4 | Determination of the thermodynamic parameters: ΔH, ΔG, ΔS, and Cp of the protein lysozyme | 2 |
| 5 | To measure the energy in different food samples. | 2 |
| 6 | To determine the activity of amylase by spectrophotometric method. | 2 |
| 7 | To study the effect of different temperature on amylase activity | 2 |
| 8 | To study the effect of different pH on amylase activity | 2 |
| 9 | To calculate Km and Vmax of the amylase | 2 |
| 10 | To determine viscosities of various fluids: Glucose, Biological fluids and culture. | 2 |
| 11 | To determine surface tension of various fluids: Glucose, Biological fluids and Culture. | 2 |
| 12 | To study the flow pattern by changing the RPM. | 2 |
| **Total Lab hours** | | **24** |

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**Suggested/Resources:**

1. Lab Manual : \\172.16.73.6/BT/BI
2. https://www.bvrit.ac.in/Freshman_Lab_Manuals/freshman_engineering_chemistry/Engineering%20Chemistry.pdf

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | -- | - | - | 2 | - | 1.16 |
| CO2 | 2 | 3 | 3 | 3 | 3 | - | - | 1 | 2 | 2 | 2 | - | 1.83 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 2 | 3 | 1 | | 2 | 1.9 |
| CO4 | 1 | 3 | 1 | 3 | 1 | - | 1 | 1 | 2 | - | 2 | - | 1.25 |
| CO5 | 1 | 3 | 1 | 1 | 1 | 1 | - | - | 2 | 1 | 2 | - | 1.08 |
| CO6 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 2 | 3 | - | 1.91 |
| Average | 2.5 | 2.83 | 2.83 | 2.83 | 2.83 | 1 | 1 | 1.33 | 2.4 | 1.5 | 2.2 | 2.0 | |

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# General Chemistry Lab

COURSE CODE:18B17BT374

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** XII$^{th}$ Standard practical chemistry

**Course Objectives:**

1. To learn lab safety techniques, importance of personnel protective equipment and Enable students to link the theoretical knowledge of chemistry with the experiments.
2. To learn identification of unknown organic compounds and their purification at small scale using chromatography and crystallization techniques.
3. To learn how to perform assay of inorganic salts

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to understand proper procedures and regulations for safe handling and use of chemicals | Familiarity |
| CO2 | Able to apply knowledge of functional groups in identification of unknown compounds | Assessment |
| CO3 | Able to understand the use of stereo models | Assessment |
| CO4 | Able to do purification at small scale using chromatography and crystallization techniques. | Usage |
| CO5 | Able to do titrations for various analytical purposes | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | A. Lab safety techniques, importance of personnel protective equipment and introduction of chemical apparatus, chemical calculations<br>B. To determine melting point of given organic compound | 1 |
| 2 | Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)<br>**a)** Identify and separate the components of a given mixture of 2 amino acids (Glycine, Aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography | 1 |
| 3 | Purification of organic compounds by crystallization (from water and alcohol). | 1 |
| 4 | To chemical identify following organic functional groups in given organic compounds<br>**a.** Test for aldehydes, ketones, carboxylic acids and phenol<br>**b.** Test for carbohydrates and amino acids<br>**c.** Test for esters, nitro and amines (Primary amines, Secondary amines and tertiary amines) | 2 |
| 5 | To identify functional group present in given unknown organic compounds | 3 |
| 6 | Isolation of caffeine from tea leaves. | 1 |
| 7 | A. To prepare standard solution of 1 M HCl | 2 |

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| | | |
|---|---|---|
| | **B.** To prepare standard solution of 1 M NaOH | |
| 8 | Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture | 2 |
| 9 | To prepare Oxime of 2,4 dinitrophenylhydrazone of aldehyde/ketone | 1 |
| 10 | Virtual lab experiment<br><br>A. To detect the halogens, nitrogen and sulphur in an organic compound<br>B. To separate Organic compounds with the help of Column Chromatographic technique. | 1 |
| **Total Lab hours** | | **14** |

**Suggested/Resources:**


1. A.I Vogel, "Elementary practical organic chemistry" 2nd ed., Prentice Hall 2006
2. D.L. Pavia G. Lampman and G.D. kriz, "Introduction to organic laboratory techniques"2nd ed., Brooks Cole 2004


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 2 | 2 | 1 | 3 | - | 2 | 1 | 3 | 3 | 2.18 |
| CO2 | 3 | 3 | 1 | 2 | 2 | 1 | - | 3 | 1 | 3 | 2 | 3 | 2.18 |
| CO3 | 3 | 3 | 1 | 1 | 2 | 2 | - | 2 | 3 | | 2 | 3 | 2.2 |
| CO4 | 3 | 3 | 1 | 2 | 3 | 1 | - | 1 | 3 | 2 | 2 | 3 | 2.18 |
| CO5 | 3 | 3 | 1 | 1 | 3 | 1 | - | - | 3 | | 2 | 3 | 2.2 |
| Average | 3.0 | 3.0 | 1 | 1.6 | 2.4 | 1.2 | 3.0 | 2.0 | 2.4 | 2.0 | 2.2 | 3.0 | |

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# Molecular Biology

COURSE CODE: 18B11BT412

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Fundamental biology Cell biology, Biochemistry

**Course Objectives:**

1. This course covers the basic principles of molecular biology and its practical applications.
2. The main objective of the course is to equip students with a detailed knowledge of molecular biology in the context of human diseases.
3. To prepare students for future research and also enhance their career prospects in the expanding life sciences sector including public-funded research laboratories or private industry.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand the basic structures of various genetic materials of cells. | Familiarity |
| CO-2 | To understand the structural-functional relationship of genetic material with other biomolecules of cells. | Familiarity |
| CO-3 | To understand foundational genetic processes of molecular biology. | Familiarity |
| CO-4 | To Understand how molecular machines within the cell are regulated so that they can accurately copy, repair, and interpret genomic information. | Assessment |
| CO-5 | To integrate knowledge of molecular biology principles for understanding the various disorders and their rectification. | Usage |

**Course Contents:**

| Units | Contents | Lectures required |
|---|---|---|
| 1 | **Basics of Molecular Biology:** Why Molecular Biology? How molecular biology came about? Major events in molecular biology, Nucleic acids; DNA and RNA and their structure and function in detail, Protein structure, basic functions, DNA-Protein interactions, molecular details of protein purification , DNA structures and their implication in diseases | 4 |
| 2 | **Molecular Biology Techniques and their Applications:**Polymerase chain reaction, DNA sequencing, Western blot Southern and northern blotting, DNA foot-printing, Immuno-fluorescence | 8 |
| 3 | **DNA replication:**Avery Mcleod and Mccarty experiments, Hershey Chase Experiment, Maintenance of DNA sequence, Linking number of DNA, Forces which stabilize the DNA secondary structure, DNA polymerase,Replication process: Initiation, Extension, leading strand, lagging strand, Dynamics at the replication fork, termination, DNA replication protein,DNA replication regulation: Eukaryotes and prokaryotes | 8 |
| 4 | **DNA transcription and RNA processing:**History, RNA polymerases, Major steps in transcription: Pre-initiation, Initiation, promoter, elongation,termination mRNA splicing mechanisms, rRNA modifications | 8 |

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|---|---|---|
| | Reverse transcription, Transcription inhibitor, Post-transcription modification | |
| 5 | **Translation:** Basic mechanism-Eukaryotic and Prokaryotic translations,composition of Ribosomes, Genetic codes; Role of tRNA in translation, mRNA translation mechanisms: initiation, elongation and termination process | 8 |
| 6 | **Gene regulation and Post-translational modification:**Why cells need to regulate genes, control of gene regulation, Operon (TrpOperon,Lac operon), Regulatory proteins; Helix turn-helix, Leucine Zipper, Zinc finger; Post translational modifications, Effects of post-translational modifications, Why protein post-translational modification are made , Types of post-translational modifications, Methods used to study post-translational modifications | 6 |
| **Total Hours** | | **42** |

**Suggested Text books:**

1. Stryer, Lubert (2002). Biochemistry; Fifth edition. W. H. Freeman and Company.
2. Lehninger "Principles of Biochemistry".

**Suggested Reference books:**

1. Lodish H, Berk A, Zipursky LS, Matsudaira P, Baltimore D, Darnell J (2000). *Molecular Cell Biology*. W. H. Freeman and Company
2. Lewin's GENES XI
3. Molecular Cell Biology Damell Jr. J., Lodish, H and Baltimore, D. Scientific American Inc., New York
4. Neill, Campbell (1996). Biology; Fourth edition. The Benjamin/Cummings Publishing Company. p. 309,310. ISBN 0-8053-1940-9.

**EvaluationScheme:**

| Exam | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Unit 1-2 |
| T2 Test | 25 | 1.5 hrs. | Unit 1-4 |
| End Term Test | 35 | 2 hrs. | Whole Syllabus |
| Teacher Assessment(Based on Assignments, quizzes etc.) | 25 | Whole Semester(Quiz, short presentations) | Inform class time to time |
| **Total** | **100** | | |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 | 1.00 |
| CO2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 1.33 |
| CO3 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1.50 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 1.75 |
| CO5 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2.00 |
| Average | 1.60 | 1.80 | 2.20 | 1.80 | 1.20 | 1.40 | 1.40 | 1.00 | 0.80 | 1.40 | 1.40 | 2.20 | |

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# Introduction to Bioinformatics

COURSE CODE:18B11BT413

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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**Pre-requisite:** Molecular Biology, Biochemistry

**Course Objectives:**

1. Background and need for bioinformatics
2. Learn sequence analysis techniques.
3. Learn sequence alignment-pairwise and multiple.
4. Apply phylogenetic analysis.
5. Application of bioinformatics in modern day research.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Knowledge of bioinformatics databases and resources | Familiarity |
| CO-2 | Sequence analysis including pairwise sequence alignment | Assessment |
| CO-3 | Sequence analysis using multiple sequence alignment | Assessment |
| CO-4 | Sequence annotation by identifying motifs, domains, conserved regions, predicting secondary structure of protein sequences | Usage |
| CO-5 | Perform phylogenetic analysis of protein sequences and RNA secondary structure prediction | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Bioinformatics and its role in modern biology, Current scenario of Bioinformatics in India | 3 |
| 2 | **Databases:** Biological databases: classification into different types; sequence retrieval and sequence submission<br>PubMED<br>Nucleic acid sequence database (NCBI, EMBL, DDBJ)<br>Genome database (TIGR)<br>Protein sequence database (SWISSPROT)<br>Databases of metabolic pathways (KEGG)<br>ENTREZ, sequence retrieval system (SRS),<br>Protein identification resource (PIR), Expert<br>Protein Analysis System (ExPASY),<br>Ensembl, sequence formats, Seqin, BankIt | 8 |
| 3 | **Sequence Alignment:** Sequence Alignment: Dot plots, Alignments (Needleman & Wunsch algorithm, Smith-Waterman algorithm-with simple scoring systems), Multiple sequence alignment, Amino acid distance measures (PAM matrices, Blosum matrices) | 8 |
| 4 | **DatabasesearchDatabasesearching** : FASTA, BLAST | 8 |
| 5 | **Fundamental of sequence alignment:** Sequence similarity: Basic concepts, similarity scores | 7 |
| 6 | **Primer design:** Principles, Programs for Primer Design | 4 |

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|---|---|---|
| 7 | **Distance measures:** Nucleotide distance measures (simple counts method, Jukes-Cantor correction, Kimura 2 parameter correction); | 4 |
| 8 | **Phylogenetic reconstruction:** Introduction, distance method (UPGMA, NJ), parsimony method | 7 |
| 9 | **Gene prediction:** Principles and programs for Gene prediction. | 2 |
| 10 | **Molecular modelling:** Homology modeling, docking, energy field calculations, molecular dynamics | 2 |
| 11 | **Protein sequence analysis:** Primary sequence analysis, protein structure visualization and Secondary structure prediction | 7 |
| 12 | **RNA secondary structure prediction:** Principles and programs for RNA secondary structure prediction | 3 |
| | **Total lectures** | 42 |

**Suggested Text Book(s):**

a. Bioinformatics: D.W. Mount
b. Introduction to Bioinformatics by Arthur Lesk
c. Bioinformatics: Databases, tools and Algorithms by OrpitaBosu and Simminder Kaur Thukral
d. Knowledge discovery in Bioinformatics: Xiaouha Hu, Yi Pan

**Suggested Reference (s):**

e. Sousa et al., Bioinformatics Applications in Life Sciences and Technologies, 2016. PubMed PMID: PMC4870335

**Other useful resource(s):**

i. https://www.hindawi.com/journals/isrn/2013/615630/
ii. https://www.sciencedirect.com/science/article/pii/S0888754317300551

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Introduction-to-BI ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1.92 |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1.75 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | - | 2 | 2 | 1.73 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | - | 2 | 1.73 |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | - | - | - | 2 | 1.67 |
| Average | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.25 | 1.25 | 1.4 | 2.0 | 2.0 | 1.33 | 2.0 | |

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# Microbiology

COURSE CODE: 18B11BT414

COURSE CREDITS: 4

ELECTIVE/CORE: CORE

: 3-1-0

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**Pre-requisite:** Knowledge of Biology (10+2)

**Course Objectives:**

1. To provide an understanding of the principles of microbiology and techniques that can serve as a platform for other courses built on microbiological concepts.
2. Scientific evaluation of role of microorganisms in various situations like health, industry, agriculture, environment.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Exhibit competence in fundamental aspects of Microbiology (e.g. Microbial Genetics, Classification, functions | Familiarity |
| CO-2 | Scientifically test the hypothesis provided under a given situation involving microbial world and demonstrate practical skills in basic microbiological techniques | Assessment & Analytical Skills |
| CO-3 | Designate vital role of the microorganisms in the environment and their association with human beings. | Awareness |
| CO-4 | Analyze and interpret the experiments/pathways relevant to Microbes | Analytical & Technical Skills |
| CO-5 | Retrieve and use cotemporary information related to microbial world. | Assessment & Analytical Skills |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **History of Microbiology:** Discovery of microbial world, A timeline with emphasis on Pasteur's experiments disproving spontaneous generation, Koch's postulates. | 3 |
| 2 | **Microbial diversity, taxonomy and phylogeny:** Taxonomic ranks, classificati systems (phonetic, numerical, phylogenetic), major characteristics used for classification (classical and molecular approaches), the three domain syste | 6 |
| 3 | **Methods in microbiology:** Pure culture techniques, theory and practice of sterilization, Principles of microbial nutrition, culture media and types (simple, complex, enriched, enrichment, selective & differential), replica plating techniques, Preservation of Cultures, Microscopy | 6 |
| 4 | **Growth of microorganisms:** Media & their types, Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth. conditions on growth, preservation techniques | 5 |
| 5 | **Microbial metabolism:** Photosynthetic mechanisms, $CO_2$ fixation mechanisms, fermentation, anaerobic respiration | 4 |

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| | | |
|---|---|---|
| 6 | **Microbial Ecology and Extremophiles:** Carbon, sulphur and nitrogen cycles, Thermo & hyperthermophiles, alkaliphiles, acidophiles, halophiles, psychrophiles, radiophiles | 3 |
| 7 | **Pathogenic microbes and Control Measure :**(Bacteria, fungi, protozoa and viruses), host-pathogen interactions - defense mechanisms against microbes, control of microbes, antimicrobial agents (physical, chemical and biological), Bioterrorism | 6 |
| 8 | **Microbial genetics:** Types of mutations; UV and Chemical mutagenesis, Ames test for mutagenesis, Conjugation, Transformation, Transduction, plasmids, transposons, Operon Model, Bacterial genome with special reference to *E. coli* | 5 |
| 9 | **Industrial applications with case studies:** Biofertilizers, Biopesticides, Biofilms, Biosensors, Fermented foods and beverages, Medicines, Single cell protein. | 4 |
| | **Total lectures** | **42** |

**Suggested Text Books:**

1. Prescott, Harley and Klein: Microbiology, 6th Edition, McGraw Hill 2005.
2. Gerard J. Tortura, Berdell R. Funke, and Christine L: Microbiology An Introduction: Case. 8th Ed., Pearson/Benjamin Cummings, 2004.
3. Pelczar, Chan and Krieg: Microbiology by; Tata McGraw Hill.

**Suggested Reference Books:**

1. Madigan, M.T., Martinko, J.M., Parker, J: Brock Biology of Microorganisms. 10th Edition.: Publisher: Prentice Hall 2003
2. Nester : Microbiology Study Guide McGraw Hill.
3. Black : Microbiology : Principles and Applications Prentice Hall

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Microbiology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 2.18 |
| CO-2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2.4 |
| CO-3 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO-4 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2.3 |
| CO-5 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 2.25 |
| Average | 2.2 | 2 | 2.2 | 2.8 | 2.4 | 2.6 | 2.2 | 2.2 | 2.6 | 1.4 | 1.4 | 2.6 | |

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# Molecular Biology Lab

COURSE CODE: 18B17BT472

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Fundamental biology Cell biology, Biochemistry

**Course Objectives:**

1. The objective of this course is to familiarize the students with laboratory techniques related to isolation and quantification of various biomolecules required to maintain the cellular processes at molecular level.
2. To develop basic practical skills for the handling and analysis of biomolecules.

**Course Outcome:**

| S.N. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to understand the fundamental procedures of isolation, visualization of various biomolecules from cellular or tissue organization. | Familiarity |
| CO2 | Able to understand, and perform, molecular biology techniques accurately and safely. | Familiarity |
| CO3 | Able to isolate, quantify and visualize various biomolecules having application in the field of biotechnology. | Assessment |
| CO4 | Able to report experimental results in a standard written format and to write coherently and persuasively about conclusions from such results and their significance. | Assessment |
| CO5 | Able to interpret experimental results and conclusions for their understanding various biological processes and abnormalities. | Usage |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Good Lab Practice and Calculations of molarity and normality of the solutions | 2 |
| 2 | To isolate genomic DNA from *E. coli* (DH5-α) using heat boiling method. | 2 |
| 3 | Quantification of DNA concentration and purity by nanodrop method. | 2 |
| 4 | To perform agarose gel electrophoresis. | 2 |
| 5 | To isolate *E. coli* (DH5-α) genomic DNA using phenol chloroform method. | 2 |
| 6 | Isolation of genomic DNA from human blood sample. | 2 |
| 7 | To isolate plant genomic DNA using CTAB method. | 2 |
| 8 | To isolate *E. coli* (DH5-α) plasmid DNA by alkaline lysis method. | 2 |
| 9 | To isolate RNA from bacterial cell. | 2 |
| 10 | Introduction to Polymerase Chain Reaction and to amplify gene using genomic DNA of *E. coli*. | 2 |
| 11 | To perform restriction digestion using *E. coli* plasmid DNA. | 2 |
| 12 | To separate serum and plasma proteins from human blood. | 2 |
| 13 | To visualize human serum and plasma proteins using SDS-PAGE technique. | 2 |
| | **Total** | **26** |

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**Suggested Resource(s):**

a. Lab manual
b. Michael R. Green and Joseph Sambrook. Molecular Cloning, A Laboratory Manual. fourth edition.
c. Keith Wilson and John Walker (2010).Principles and Techniques of Biochemistry and Molecular Biology, seventh edition.

Evaluation Scheme:

| | |
|---|---|
| Mid Term Test | 20 |
| End Term Test | 20 |
| Teacher Assessment (Based on day to day work, performance in experiments, lab notebook etc.) | 60 |
| Total | 100 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Molecular Biology Lab) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 3 | **2.4** |
| CO2 | 3 | 2 | 2 | 3 | 2 | 1 | - | 2 | 3 | 2 | 2 | 2 | **2.18** |
| CO3 | 3 | 3 | 1 | 3 | 3 | 1 | - | 1 | 3 | 1 | 3 | 3 | **2.27** |
| CO4 | 2 | 2 | 1 | 3 | 2 | 1 | - | 1 | 3 | 1 | 2 | 2 | **1.8** |
| CO5 | 2 | 1 | 1 | 2 | 2 | 1 | - | 1 | 3 | 1 | 2 | 2 | **1.6** |
| Average | **2.6** | **2** | **1.6** | **2.6** | **2.4** | **1** | **1** | **1.6** | **3** | **1.4** | **2.4** | **2.4** | |

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# Introduction to Bioinformatics Lab

COURSE CODE:18B17BT473

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. Understand the importance of bioinformatics
2. Application of various bioinformatics tools
3. Understand the connection of bioinformatics and biotechnology

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand the use of common bioinformatics resources (NCBI) | Usage and familiarity |
| CO2 | Understand various databases and tools in NCBI (PubMed, Nucleotide, gene) | Assessment |
| CO3 | Understand various databases and tools in Expasy (Swissprot, PROSITE) | Assessment |
| CO4 | Hands-on of pairwise sequence alignment tools-global and local | Assessment |
| CO5 | Hands-on of multiple sequence alignment tools-global and local | Assessment |
| CO6 | Hands-on of phylogenetic analysis tools and visualization | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Retrieval of sequences from NCBI and hands-on of EMBOSS software for various types of sequence analysis | 2 |
| 2 | BLAST program in online page and standalone package | 2 |
| 3 | Use of expasy resource for sequence retrieval and analysis | 2 |
| 4 | Multiple sequence alignment (MSA) programs and viewers: ClustalW, Jalview in online mode | 2 |
| 5 | Use of MSA programs (ClustalW) as a standalone package | 2 |
| 6 | Use of structural databases like PDB and structure visualization using Pymol and Rasmol | 2 |
| 7 | Use of structural classification databases like SCOP, CATH, FSSP | 2 |
| 8 | Gene prediction methods- GENPRED, GenePred | 2 |
| 9 | Phylogenetic analysis methods and tree viewers: Phylip and Archaeopteryx | 2 |
| 10 | Use of Phylip software as standalone package, MrBayes etc. | 2 |
| 11 | KEGG and GO database | 2 |
| 12 | Homology modeling in MODELLER, Docking in PatchDock | 2 |
| 13 | Prediction of RNA secondary structure | 2 |
| 14 | EMBOSS, STADEN and STAMP packages for sequence analyses | 2 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**

1. Pevsner J.:Bioinformatics and Functional Genomics, Cold Spring Harbor Laboratory Press,

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New York.
2. Baxevanis AD &Oulette BFF: Bioinformatics – A practical guide to the Analysis of Genes and Proteins, Willey International publishers.

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Microbiology lab

COURSE CODE: 18B11BT414

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. To gain experience in microbiological techniques used in study of microbes
2. To familiarize the students with basics of methods with experimental analysis

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To familiarize the students with basic microbiology instruments in the lab and basic precautions to be taken. | Familiarity |
| CO2 | To aware the students about basic microbiological techniques to study the microorganisms. | Assessment |
| CO3 | Able to analyze bacterial growth kinetics (homogeneous reaction) in the laboratory | Assessment |
| CO4 | Able to understand the basis of microbial resistance against antibiotics and growth of pathogenic organisms. | Usage |
| CO5 | To develop a strong foundation about microbes and their applications | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | **Microscopy and Instrumentation**<br>**1.** To study the construction and working of compound microscope. | 2 |
| | **2.** Study of microbiology-lab instruments.<br>(Operation of autoclave, LAF, hot air oven, Culture room fumigation using formalin). | 2 |
| 2 | **Staining techniques**<br>**3.** Gram's staining and test for differentiation of bacteria. | |
| | **4.** To perform acid fast staining. | 2 |
| | **5.** To perform Lacto phenol Cotton Blue slide mounts for fungal culture. | 2<br>2 |
| 3 | **6.** Preparation and sterilization of bacterial and fungal culture media (Nutrient broth, nutrient agar slant, potato dextrose agar) | 2 |
| 4 | 7. Streaking and plating methods for isolation of axenic culture of bacteria. | 2 |
| | 8. Isolation and enumeration of bacteria from soil, water and air using serial dilution technique | 2 |

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| | | |
|---|---|---|
| 5 | **9.** Study of bacterial growth kinetics using Turbidometry,<br>**10.** Cell count using haemocytometer.<br>**11.** Effects of various environmental factors such as the presence or absence of oxygen, temperature and pH on growth of microbes.<br>**12.** Physical and chemical methods used to control the growth of microbes and the growth of microbes on various selective and differential media.<br>**13.** Filter paper disc method for evaluation of antibiotic resistant activity of bacteria.<br>Antimicrobial Sensitivity Testing – The Kirby-Bauer Method | 2<br>2<br>2<br>2<br>2 |
| 6 | **14.** Preparation of nutrient agar slants and glycerol stocks for preservation.<br>**15.** Lyophilization and Glycerol stock of bacteria for long term preservation | 2<br>2 |
| **Total Lab hours** | | 30 |

**Suggested/Resources:**


1. Introduction to Microbiology : A Case-History Study Approach by John L. Ingraham, Catherine A. Ingraham, Hardcover: 816 pages, Publisher: Brooks Cole
2. Microbiology : A Laboratory Manual (7th Edition) by James Cappuccino, Natalie Sherman, Paperback: 544 pages, Publisher: Benjamin Cummings
3. Microbiology: A Laboratory Experience; Holly Ahern
4. Creative Commons License: Attribution-NonCommercial-ShareAlike CC BY-NC-SA
5. Willey, Joanne, Linda Sherwood, Chris Woolverton. Prescott's Microbiology, 8th edition. New York: McGraw Hill, 2011. Print.
6. Willey, Joanne, Linda Sherwood, Chris Woolverton. Lab Excercises in Microbiology, 8th edition. New York: McGraw Hill, 2011. Print
7. James G. Cappuccino and Natalie Sherman. Microbiology: A Laboratory Manual, 7th edition. Benjamin Cummings, 2004. Print.


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | | 2 | 3 | 3 | 3 | | 1 | 3 | 1.83 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | | 2 | 3 | 2.00 |
| CO3 | 2 | 3 | | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 2 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | | 2 | 2 | 2 | 2 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | | 3 | 3 | | 1.83 |
| Average | 2.4 | 2.6 | 2.2 | 2.6 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.6 | 2.6 | |

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# Bioprocess Engineering

COURSE CODE:18B11BT511

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** Thermodynamics and Chemical Processes, Microbiology, Biochemistry

**Course Objectives:**

1. Learn various bioprocess related terms and principles
2. Learn about microbial growth kinetics in various mode of fermentation
3. Learn about the principles and application of Mass transfer and Sterilization
4. Develop an understanding of important concepts and design aspects of bioreactors
5. Learn about the functioning of various bioreactors
6. Learn about the principle of scaling up and scaling down of bioprocesses

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to use correct biological terms to describe & analyze phenomena/ problems in bioprocesses | Familiarity |
| CO-2 | Able to apply engineering principles to address issues in various bioprocesses | Assessment |
| CO-3 | Able to analyze bacterial growth kinetics (homogeneous reaction) in batch /continuous/ Fed-batch reactor and sterilization | Assessment |
| CO-4 | Able to understand and to solve problems related to bioprocess phenomena including mixing, Mass transfer and sterilization | Assessment |
| CO-5 | To develop a strong foundation about bioreactor designs and their applications | Usage |
| CO-6 | Able to understand the basis of bioprocess scale up and the related basic design calculations | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:**Role of bioprocess engineer, Microbial process development, Quality control management, Fermentation Economics | 3 |
| 2 | **Kinetics of Microbial growth:**Batch culture, Kinetic implications of endogenous and maintenance metabolism. Continuous culture, Modifying continuous reactors: Chemostat with recycle and multistage Chemostat Systems. Modifying batch reactors: Fed- batch operation, Perfusion systems. | 7 |
| 3 | **Sterilization:**Design of batch and continuous sterilization processes, kinetics of thermal death of cells and spores. | 2 |
| 4 | **Mixing:**Mixingequipments, flow patterns in reactors, mixing mechanism, power consumption and shear properties of sparged and agitated vessels and various mixing agitators. | 4 |
| | **Mass Transfer:**Role of diffusion in bioprocessing, film theory, convective | |

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| | | |
|---|---|---|
| 5 | mass transfer, oxygen uptake in cell cultures. Oxygen transfer in fermenters: measuring dissolved-oxygen concentration, estimating oxygen solubility, mass transfer correlation, measurement of $k_La$, oxygen transfer in large vessels. | 7 |
| 6 | **Strain Improvement and Media Formulation:**Strain improvement of industrially important microorganisms, Media formulation industrial fermentations. | 5 |
| 7 | **Immobilized Cell Systems (ICS):** Immobilization and its limitations, Active and passive immobilization, applications of immobilized cell biocatalysts. Diffusional limitations in ICS. Bioreactor considerations. | 3 |
| 8 | **Bioreactor design and analysis:**Bioreactor configurations and its utilities, Analysis of ideal and non-ideal reactors. Multiphase reactors: packed-bed reactors, bubble-column bioreactors, fluidized bed bioreactors, trickle-bed reactors. Practical considerations for bioreactor construction, Bioreactors instrumentation and control.<br>Bioprocess Considerations: Animal cell cultures & plant cell cultures | 6 |
| 9 | **Scale up and Scale down:**Scale up of bioprocesses and its difficulties. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed. Scale down. | 5 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**


1. Pauline M. Doran, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.
2. M.L. Shuler and F. Kargi, "Bioprocess Engineering--basic Concepts", 2nd Edn. Prentice-hall Of India Pvt Ltd (2008).
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Â Elsevier India Pvt Ltd. (2007).


**Suggested Reference (s):**


1. KlaasVan't Riet, Johannes Tramper, "Basic Bioreactor Design", 2nd ed., Marcel Dekker, Inc., New York, 1991.
2. Bailey and Ollis, "Biochemical Engineering Fundamentals", 2nd ed., McGraw-Hill Book Company, New York, 1986.
3. MccabeL.Warren, Smith C. Julian and Peter Harriott, "Unit Operations of Chemical Engineering", 6th ed., McGraw Hill International Edition, New York, 2001.
4. Abhilasha S. Mathuriya, "Industrial Biochnology" 1st ed., Ane Books Pvt. Ltd., New Delhi, 2009.


**Other useful resource(s):**

1. NPTEL Course Content:
   - i) Bioreactors by Prof. Suraish Kumar, IIT Madras https://nptel.ac.in/courses/102106053/
   - ii) Industrial Biotechnology by Prof. Debabrata Das, IIT Kharagpur…. https://nptel.ac.in/courses/102105058/
   - iii) Aspects of Biochemical Engineering by Prof. Debabrata Das, IIT Kharagpur https://nptel.ac.in/courses/102105064/
2. Link to topics related tocourse:
   - i) Mass Transfer by Prof. Bishnupada Mandal, IIT Guwahati https://nptel.ac.in/courses/103103034/13#

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**EvaluationScheme:**

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| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Unit 1-2 |
| 2 | T-2 | 25 | 1.5 Hours | Unit 1-5 |
| 3. | T-3 | 35 | 2 Hours | Whole Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Inform class time to time (Quizzes, Presentation, Assignments) |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Bioprocess Engineering ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | - | 1 | 1 | 1 | - | - | 2 | 1 | 3 | 2 | - | 3 | 1.75 |
| CO-2 | 3 | 2 | 2 | 1 | - | - | - | 1 | | 1 | - | 3 | 1.86 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 1 | 2 | 1 | - | 2 | 2.20 |
| CO-4 | 3 | 3 | 3 | 1 | - | - | - | 1 | 2 | 1 | - | 1 | 1.88 |
| CO-5 | 3 | 1 | 2 | 1 | 2 | 2 | - | 1 | - | 2 | - | 1 | 1.67 |
| CO-6 | 3 | 3 | 3 | 3 | - | 2 | 2 | 1 | 3 | 1 | 2 | 2 | 2.27 |
| Average | 3.00 | 2.17 | 2.33 | 1.67 | 2.00 | 2.00 | 2.00 | 1.00 | 2.50 | 1.33 | 2.00 | 2.00 | |

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# Genetic Engineering

COURSE CODE: 18B11BT512

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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**Pre-requisite:** Genetics, Molecular Biology

**Course Objectives:**

1. Familiarize the students with the basic concepts in genetic engineering;
2. Acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology
3. Apprise students about applications genetic engineering

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will become aware of concept of genetic engineering and its applications | Familiarity and Basics |
| CO-2 | Students will have knowledge of tools and strategies used in genetic engineering | Technical and strategies |
| CO-3 | Student will acquire knowledge about gene libraries and isolation of genes, DNA and genome sequencing technologies | Technical and application |
| CO-4 | Student will have acquaintance about protein expression hosts and genetic manipulation of plants and animals | Familiarity and Basics |
| CO-5 | Can use and apply the knowledge of genetic engineering in problem solving and in practice from academic and industrial perspective | Application |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Genetic engineering, Recombinant DNA technology: gene cloning - concept and basic steps - rDNA Glossary | 2 |
| 2 | **DNA modifying enzymes and cloning techniques:** Restriction Endonucleases, DNA Ligation Enzymes and, DNA, Gene cloning methods and strategies: Cloning of PCR products, TA and TOPO TA cloning, Gateway cloning, DNA Modifying Enzymes: Nucleases, Kinases, phosphatases, Reverse transcriptase, RFLP and AFLP | 8 |
| 3 | **Cloning and Expression Vectors:** Plasmid Vectors, Vectors based on Lambda Bacteriophage, Cosmids, M13 Vectors, Vectors for Cloning | 10 |
| | Large DNA Molecules, Expression Vectors, Transcriptional & Translational Fusions, Adding Tags and Signals overproducing Proteins. | |
| 4 | **Construction & Screening of genomic libraries:** Genomic library, cDNA library, Growing& Storing Libraries, cDNA Cloning (5'&3' RACE) | 5 |
| 5 | **Identification and isolation of genes:** Screening Libraries with Gene Probes, Screening Expression Libraries with Antibodies, Susbtacrtive hybridization, DDRT-PCR, Positional Gene Cloning, Functional Complementation | 4 |
| 6 | **DNA and Genome Sequencing:** Basics fo DNA Sequencing, Next generation sequencing technologies, Whole genome sequencing | 6 |

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|---|---|---|
| 7 | **Gene Expression in Microbial and Eukaryotic Systems:** Microbial, Yeast *Saccharomyces Cerevisiae* and Other Fungi as heterologoues protein expression platforms | 3 |
| 8 | **Genetic Manipulation of Plants and Animals:** Gene transfer methods, Application of Genetically Engineered Strains of Plants and Animals | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

a. Principles of Gene Manipulation and Genomics SEVENTH EDITION S.B. Primrose and R.M. Twyman.

b. Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz.

c. Genetic Engineering :Amita Rastogi and Neelam Pathak

**Suggested Reference Book(s):**

1. From Genes to Genomes: Concepts and Applications of DNA Technology by JW Dale and M Schantz
2. Molecular Biotechnology: Principles & Applications of Recombinant DNA Glick BR and Pasternak JJ
3. Genetic Engineering :Amita Rastogi and Neelam Pathak

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Genetic Engineering) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **CO-2** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **CO-3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **CO-4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **CO-5** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **Average** | **3.00** | **3.00** | **3.00** | **3.00** | **3.00** | **2.00** | **2.00** | **2.00** | **3.00** | **3.00** | **2.00** | **3.00** | |

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# Immunology

COURSE CODE:18B11BT513

COURSE CREDITS: 4

CORE COURSE

L-T-P: 3-1-0

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**Pre-requisite:** Basic Biology

**Course Objectives:**

1. Basics of Immunology: types of immunity, T-cells and B-cells, antigen-antibody reaction and major histocompatibility complex (MHC).
2. Mechanisms of regulation of immune responses and immunological tolerance.
3. Role played by immune response in: infectious diseases, autoimmunity, hypersensitivity reactions, immunodeficiency diseases and vaccines.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To understand and apply basic concepts of immunology. | Familiarity |
| CO-2 | To understand the role of immune cells, major histocompatibility complex, antigen-antibody interactions in diagnostics. | Assessment |
| CO-3 | To understand the mechanisms of regulation of immune responses and immunological tolerance. | Assessment |
| CO-4 | To understand the roles played by immune response in: infectious diseases, autoimmunity. | Assessment/ Usage |
| CO-5 | To understand hypersensitivity reactions, immunodeficiency diseases and vaccines. | Assessment/Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Basic immunology:** Historical perspectives, Cells and organs of the immune system | 3 |
| 2 | **Types of immunity:** innate and acquired immunity | 3 |
| 3 | **Antigens:** Immunogenicity, antigenicity, epitopes, haptens, mitogens | 2 |
| 4 | **Immunoglobins : structure and function:** Basic structure and fine structure of Igs, immunoglobin classes, hybridoma technology, antibody engineering | 4 |
| 5 | **Antigen- antibody interactions:** Theory, cross reactivity, precipitation reactions, agglutination reactions, RIA, ELISA, Western blotting, immunofluorescence | 4 |
| 6 | **B cell and T cell receptor:** Organization and expression of | 4 |
| | immunoglobulin genes : Generation of antibody diversity, class switching, T cell receptor complex, TCR coupled signaling pathways, co-stimulatory signals | |
| 7 | **Major histocpmatibility complex (MHC) and HLA:** General organization and inheritance of MHC, structure of MHC class I and II molecules, peptide binding by MHC molecules, MHC and susceptibility to | 3 |

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|---|---|---|
| | disease, Tissue and organ transplantation | |
| 8 | **Regulation of immune response and immunological tolerance:** Cytosolic and endocytic pathway, Responses in humoral and cell mediated branch and immunological tolerance | 2 |
| 9 | **Immune effector mechanisms:**Complement system, Cytokines | 3 |
| 10 | **Autoimmunity:** Types of autoimmune diseases (organ specific and systemic), Mechanisms of autoimmunity. | 2 |
| 11 | **Hypersensitivity reactions:** Type I, II, II and IV, hypersensitivity reactions | 2 |
| 12 | **Tumor immunity:** Malignant transformation of cells and immune responses, tumor antigens, tumor evasion of the immune system, cancer immunotherapy. | 2 |
| 13 | **Vaccines:** Types, active and passive immunization | 3 |
| 14 | **Immune response to infectious diseases and tumor immunity:** Viral, bacterial, protozoan diseases, parasitic infections | 3 |
| 15 | **Immunodeficiency diseases:** Primary and secondary immunodeficiency diseases, Acquired immunodeficiency syndrome (AIDS) | 2 |
| | **Total lectures** | 42 |

**Suggested Text Book(s):**


1. Kindt TJ, Goldsby RA and Osborne BA (2007) KubyImmunology .W.H. Freeman and Co., New York, 6th Ed.
2. Abbas AK, Lichtman AH and Pillai S (2011) Cellular and Molecular Immunology. Elsevier, USA, 7th Ed.
3. Coico R and Sunshine G (2009) Immunology: A Short Course. Wiley – Liss, 6th Ed.
4. Delves PJ, Martin SJ, Burton DR and Roitt IM (2011) Roitt's Essential Immunology. Wiley-Blackwell, 12th Ed.


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Immunology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 2.25 |
| CO-2 | 2 | 2 | 3 | 2 | 2 | 1 | - | 2 | 2 | 2 | 1 | 3 | 2.0 |
| CO-3 | 2 | 1 | 2 | 3 | 1 | 1 | - | 2 | 2 | 2 | 1 | 2 | 1.72 |
| CO-4 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1.6 |
| CO-5 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 1 | 1 | 3 | 2.0 |
| Average | 2.2 | 2 | 2.6 | 2.4 | 1.4 | 1.6 | 2 | 2.4 | 1.6 | 1.6 | 1 | 2.6 | |

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# Bioprocess Engineering Lab

COURSE CODE:18B17BT571

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Microbiology Lab, Biochemistry Lab

**Course Objectives:**

1. Provide exposure to the students with hands on experience on various practices in Bioprocess Engineering.
2. Enable students to link the theoretical knowledge of bioprocess engineering with the experiments.
3. Learn how to operate bench scale fermentor
4. Learn how to determine various Monod's Kinetics parameter

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to apply practical knowledge to understand the various important process engineering aspects involved in biotechnology industries | Familiarity |
| CO2 | Able to design experiments and analyze various data related to various practices in bioprocess engineering | Assessment |
| CO3 | Ability to apply theoretical concepts for data analysis and interpretation and their documentation | Assessment and Usage |
| CO4 | Able to run fermenter and also to analyze their results | Usage |
| CO5 | Able to understand and determine various growth kinetics parameters in a batch culture | Assessment and Usage |
| CO6 | Able to work in a team to accomplish the experiments and to document the experiments properly in lab note books | Assessment |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Introduction of Lab and lab safety | 1 |
| 2 | Describe the various parts of the bench-top fermenter (bioreactor) along with their functions. | 1 |
| 3 | To determine the thermal death point of a microbial culture. | 2 |
| 4 | To determine the thermal death time of a microbial culture. | 2 |
| 5 | To estimate the reducing sugar concentration in a given sample using DNS method. | 2 |
| 6 | To estimate the sugar concentration in fresh and spent media using DNS method. | 2 |
| 7 | To establish the correlation between OD and dry cell weight. | 2 |
| 8 | To study the different phase of microbial growth. | 2 |
| 9 | To study growth kinetics parameters of *E. coli*.<br>a) Specific growth rate ($\mu$) $h^{-1}$ | 4 |

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| | | |
|---|---|---|
| | b) Maximum specific growth rate ($\mu_m$) $h^{-1}$<br>c) Saturation constant ($K_s$) gm/l<br>d) Growth yield coefficient ($Y_{x/s}$) gm cell/gm substrate.<br>e) Productivity of biomass gm cell/litre/h. | |
| 10 | To study the effect of varying carbon substrate on specific growth rate | 2 |
| 11 | Determination of Volumetric mass transfer coefficient ($K_La$) using dynamic gassing out method (Virtual Lab) | 2 |
| 12 | Preparation of Immobilized yeast cells in calcium alginate beads | 2 |
| **Total Lab hours** | | **24** |

**Suggested/Resources:**


1. M.L. Shuler and F. Kargi, "Bioprocess Engineering--basic Concepts", 2nd Edn. Prentice-hall Of India Pvt Ltd (2008).
2. Lab Manual
3. Pauline M. Doran, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Â Elsevier India Pvt Ltd. (2007).
5. http://iitd.vlab.co.in/?sub=63


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs):**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 2.17 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2.42 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2.58 |
| CO6 | - | - | - | - | - | - | - | - | 3 | 3 | 1 | 3 | 2.5 |
| Average | 3.00 | 3.00 | 3.00 | 3.00 | 1.40 | 2.20 | 1.60 | 2.40 | 1.83 | 2.17 | 1.50 | 3.00 | |

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# Genetic Engineering Lab

COURSE CODE:18B17BT572

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. The objective of the course is to give practical exposure to student about basic tools and techniques employed in recombinant DNA technology and genetic engineering.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Students will be able to isolate and analyze plasmid vectors. | Technical |
| CO2 | Students will be cut and ligate DNA fragments/vectors with help of restriction enzymes and ligase. | Technical |
| CO3 | The students will be able to prepare competent cells and demonstrate bacterial transformation with given vectors | Technical |
| CO4 | The students will be able to amplify specific DNA fragment and cloning it in T vectors demonstrate bacterial transformation. | Technical |
| CO5 | Student will acquire proficiency in designing and conducting experiments involving genetic manipulation. | Strategies and Application |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| Lab-I | Introduction to rDNA laboratory, w.r.t. working bench, types of instruments and their handling, lab. Preparation of stock solutions of buffers for use in gel running, gel loading, their autoclaving; preparation of working buffers, antibiotic stocks, and storage of buffers required in rDNA practicals with detailed methodology. (Theory and Virtual) | 4 |
| Lab 2-3 | Plasmid DNA Preparation: Preparation of LB medium with and without antibiotics for the growth of bacterial cultures, Growth of *E. coli*, Isolation of Plasmid DNA, Electrtrophoresis of Plasmid DNA and Interpretation of results | 4 |
| Lab 4 | Restriction of given plasmid or λ DNA with the restriction enzyme *Eco*RI and HindIII or any other Restriction Enzymes, | 4 |
| Lab 4 -5 | To perform ligationof λ/*Eco*R I digest using T4 DNA Ligase Electrophoresis of the uncut and digested DNA and Interpretation of the results Electrophoresis of ligated samples by agarose gel electrophoresis, Interpretation of the results | 4 |
| Lab 6 | Setting up a PCR reaction to amplify a gene or a DNA fragment using gene specific primers | 2 |
| Lab 7 | Preparation of competent cells of *E. coli* transformation | 4 |
| Lab 8 | To insert the PCR product into T vector by TA-cloning, and confirmation | 4 |
| Lab 9-10 | Transformation of E.coli. DH5 α cells with Empty puc/ pcambia1301/and Confirmation of transformed cells by scoring the expression of LacZ gene. | 4 |
| Lab 10-11 | Transformation of E.coli. DH5 α cells with Recombinant T- vector/puc vector Confirmation of transformed cells by scoring the expression of LacZ gene. | 4 |

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| | | |
|---|---|---|
| Lab 12-13 | RNA isolation and to synthesize cDNA from total RNA preparation using reverse transcriptase and oligod T primer (Virtual) | 2 |
| Lab 12-14 | Mini Project for lab evaluation and Exam | 4 |
| **Total Lab hours**<br>Total Contact Hours (Students are required to devote some extra time for some experiments | | **40** |

**Suggested/Resources:**

1. Lab Manual
2. Molecular Cloning: A Laboratory Manual 2nd Edition Cold Spring Harbour Laboratory Press
3. Virtual Lab

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 2.67 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2.75 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2.75 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2.75 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2.75 |
| Average | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 2.00 | 2.80 | 3.00 | 3.00 | 2.00 | 3.00 | |

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# Immunology Lab

COURSE CODE:18B17BT573
COURSE CREDITS: 1
CORE/ELECTIVE: CORE
: 0-0-2

**Pre-requisite:** Immunology/Basic Biology

**Course Objectives:**

1. The objective is to familiarize students with the various immunological techniques that include antigen-antibody interactions, quantitation of antigens or antibody, ELISA, agglutination reactions etc.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand, design, analyze and interpret experiments related to immunology and link practical knowledge to theoretical. | Familiarity |
| CO2 | To detect antigen and check quality of antigen. | Assessment |
| CO3 | To quantitate antigen using techniques various techniques. | Assessment |
| CO4 | To check changes in the number of leucocytes and their isolation from the blood. | Assessment |
| CO5 | To understand team work, ethics and work discipline. | Usage |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | To perform Radial Immunodiffusion (RID) by Mancini's technique. | 2 |
| 2 | To perform Double Immunodiffusion (DID) by using Ouchterlony method. | 2 |
| 3 | To perform the Quantitative precipitation assay-test. | 2 |
| 4 | To perform hemagglutination assay for ABO blood group typing determination of and Rh factor. | 2 |
| 5 | To perform Immuno-electrophoresis of given sample. | 2 |
| 6 | To perform Immuno-electrophoresis of given sample. | 2 |
| 7 | To determine the concentration of antigen by sandwich ELISA method. | 2 |
| 8 | To determine Total Leukocytes Count (TLC) of the given sample. | 2 |
| 9 | To determine Differential Leukocytes Count (DLC) of the given sample. | 2 |
| 10 | Isolation of lymphocytes from peripheral blood by ficoll method and check the viability of isolated lymphocytes. | 2 |
| 11 | Amplification of Interleukin-28b gene using Polymerase Chain Reaction assay. | 2 |
| 12 | Lysis of red blood cells (hypotonic lysis with $H_2O$ and ammonium chloride) | 2 |
| 13 | To isolate the lymphocyte from whole blood by density gradient centrifugation method. (Virtual Lab) | 2 |
| 14 | To understand the concepts of mouse Euthanasia. To learn the basic procedures involved in rodent dissection and how to identify and remove lymphoid organs. (Virtual Lab) | 2 |
| **Total Lab hours** | | 28 |

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**Suggested/Resources:**

1. Lab Manual

2. Hay FC and Westwood OMR (2003) Practical Immunology, 4th Ed., Blackwell Publishing.
3. Virtual Lab. (http://vlab.amrita.edu/?sub=3&brch=70)

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 2.4 |
| CO2 | 3 | 1 | 2 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 | 2 | 1.5 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 1 | - | 2 | 1 | 1 | 1 | 2 | 1.7 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 1 | - | 2 | 1 | 1 | 1 | 2 | 1.7 |
| CO5 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 1.9 |
| Average | 2.6 | 1.8 | 2.2 | 2 | 1.6 | 1.4 | 1 | 2.2 | 1.8 | 1.6 | 1.4 | 2.4 | |

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# Downstream Processing

COURSE CODE:18B11BT611

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** Thermodynamics and Chemical Processes, Biochemistry, Bioprocess Engineering

**Course Objectives:**

1. Learn about the financial importance of Downstream Processing of bioproducts
2. Learn about the differences in recovery processes of intracellular and extracellular products
3. Learn about the principles and application of various separation techniques involved in bioproducts recovery
4. Learn about the recovery of various products through case studies

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to understand the importance and financial considerations of downstream processing in compare to upstream processing | Familiarity |
| CO-2 | Conceptually sound in understanding about the difference between the downstream processing of intracellular and extracellular products | Assessment |
| CO-3 | Able to understand various separation techniques used in downstream processes | Assessment |
| CO-4 | Able to apply principles of various unit operations in designing and optimization of downstream processes | Assessment |
| CO-5 | Able to understand the requirements for successful operation of downstream processes | Usage |
| CO-6 | Able to apply the principles of major unit operations used in downstream processing for the purification and formulation of final products obtained from Fermentation Technology. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Scope of Downstream processing:** Importance of DSP in biotechnology, characteristics of bioproducts, Criteria for selection of bio-separation techniques, Role of DSP methods in bioprocess economics | 4 |
| 2 | **Cell Disruption:** Various cell disruption methods: Mechanical viz; sonicators, dyno mill, homogenizer, chemical and biological methods. | 4 |
| 3 | **Solid-Liquid Separation:** Centrifugation: Principles, Centrifuges viz; basket centrifuge, tubular centrifuge, disc-bowl centrifuge. Filtration: Principles, Filter units viz; filter press, Applications. | 6 |
| 4 | **Membrane Technology:** Merits and Demerits, Reverse osmosis, Ultrafiltration, Microfiltration, Dialysis, Electrodialysis | |
| | **Separation of soluble products:** Liquid-liquid extraction, Aqueous two- | |

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| | | |
|---|---|---|
| 5 | phase extraction, Adsorption, Precipitation | 6 |
| 6 | **Chromatographic Techniques:** Gel filtration, Ion-exchange, Hydrophobic Interaction and Affinity Chromatography, HPLC, FPLC, Applications | 5 |
| 7 | **Finishing steps for purification:** Crystallization, Drying, Lyophilization | 4 |
| 8 | **Stabilization of bioproducts:** Formulation. Integration of reaction and separation | 2 |
| 9 | **Case-Studies:**Process design of Industrial Bio-products<br>**Anaerobic bioprocesses:** Ethanol, Lactic acid production | 4 |
| | **Aerobic bioprocesses:** Citric acid, Gluconic acid, Penicillin production | 4 |
| | **Total lectures** | 42 |

**Suggested Text Book(s):**


1. Raja Ghosh, "Principles of Bioseparation Engineering", World Scientific Publishing Co. Pte. Ltd., Singapore, 2006.
2. Pauline M. Doran, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Â Elsevier India Pvt Ltd. (2007).
4. Wulf Crueger, Anneliese Crueger, K.R. Aneja, "A Textbook of Industrial Microbiology", Medtech,Scientific International Pvt. Ltd. 3rd Ed. (2017)
5. M.L. Shuler and F. Kargi, "Bioprocess Engineering--basic Concepts", 2nd Edn. Prentice-hall Of India Pvt Ltd (2008).


**Suggested Reference (s):**


1. P.A. Belter, E. L. Cussler, and W.S. Hu, "Bioseparations: Downstream Processing in Biotechnology", John Wiley and Sons, New York, 1998.
2. B. Sivasankar, "Bioseparations : Principles and Techniques", PHI Learning Private Limited, New Delhi, 2009.
3. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri Petrides, "Bioseparations Science and Engineering", 1stEdn. Oxford University Press, 2002
4. Abhilasha S. Mathuriya, "Industrial Biochnology" 1sted., Ane Books Pvt. Ltd., New Delhi, 2009.


**Other useful resource(s):**

1. NPTEL Course Content:

iv) Downstream Processing by Prof. Mukesh Doble, IIT Madras
https://nptel.ac.in/courses/102106022/

v) Industrial Biotechnology by Prof. Debabrata Das, IIT Kharagpur
https://nptel.ac.in/courses/102105058/

vi) Principles of Downstream Techniques in Bioprocess by Prof. Mukesh Doble, IIT Madras
https://nptel.ac.in/courses/102106048/

2. Link to topics related tocourse:

ii) Aspects of Biochemical Engineering by Prof. Debabrata Das, IIT Kharagpur
https://nptel.ac.in/courses/102105064/

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**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Unit 1-2 |

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| | | | | |
|---|---|---|---|---|
| 2 | T-2 | 25 | 1.5 Hours | Unit 1-5 |
| 3. | T-3 | 35 | 2 Hours | Whole Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Inform class time to time (Quizzes, Presentation, Assignments) |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Bioprocess Engineering ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | | 2 | 1 | 1 | | | 2 | 1 | | 1 | 3 | 3 | 1.75 |
| CO-2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | | 2 | | 3 | 1.80 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | | 3 | 1.91 |
| CO-4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | | 3 | 2.27 |
| CO-5 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 1.92 |
| CO-6 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2.33 |
| Average | 2.40 | 2.50 | 2.33 | 1.83 | 2.00 | 1.60 | 1.83 | 1.00 | 1.75 | 1.67 | 2.33 | 3.00 | |

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# Food and Agricultural Biotechnology

COURSE CODE: 18B11BT612

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Molecular Biology, Biochemistry

**Course Objectives:**

1. Learn about different processes employed in the manufacture of food products.
2. Learn about different techniques used for the production and improvement of agricultural crops.
3. Apply basic knowledge for developing food and agricultural products through biotechnological interventions.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to learn the mechanisms of preservation methods applied to different food products. | Familiarity |
| CO-2 | To understand different bioprocesses involved in food production. | Technical skills |
| CO-3 | To provide knowledge of different streams of agriculture having biotechnological interventions. | Assessment and Analytical skills |
| CO-4 | Able to apply knowledge and analyze the problems associated with food and agricultural biotechnology | Usage |
| CO-5 | Able to apply these methodologies and techniques for developing modified crops and agricultural products | Technical skills |
| CO-6 | To provide insight about ethical ,legal and public aspects associated with food and agricultural biotechnology. | Assessment and Analytical skills |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Basics of food components:** Macronutrients and micronutrients, Composition and metabolism of Carbohydrates, proteins and fats. Phytochemicals in foods: Occurrence and characteristics of dietary fibres, polyphenols in foods | 5 |
| 2 | **Food Preservation Technology :**<br><br>Role and significance of microorganisms in foods: Intrinsic and Extrinsic Parameters of Foods that affect microbial growth<br>Hurdle Technology: Principles and applications<br>Physical methods of sterilization: Heat treatments (Pasteurization, blanching, canning), Low temperature, dehydration, ultrafiltration, sterilization, irradiation<br>Chemical methods of sterilization: Salting, Smoking, Curing, preservatives<br><br>Biological methods of sterilization: Biopreservation, Fermentation. | 8 |
| 3 | **Food Production technology:** | |

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| | | |
|---|---|---|
| | Concept of Starter cultures,<br>Microorganisms as foods: Single cell protein, baker's yeast, mushroom, Production of Fermented Foods: Indigenous fermented foods, Lactic acid fermented foods,<br>Production of food additives: Organic acids, Vitamins, Pigments, Flavors | 8 |
| 4 | **Recent advances in Food Biotechnology:**<br>Nutraceuticals and Probiotics: concepts and application in foods, Food packaging systems | 4 |
| 5 | **Quality assurance in Food Industries:**<br>Food Standards and Specifications, GMP, HACCP, Quality systems. | 3 |
| 6 | **Introduction Agricultural Biotechnology:**<br>Agricultural Biotechnology, Conventional method of crop improvements vs. Biotechnological interventions, Prospects of Agricultural biotechnologies | 4 |
| 7 | **Techniques of crop improvement:**<br>Different Crop improvement by genetic manipulation taking case studies for herbicide tolerance ,pest resistance etc.<br>Production of phytochemicals and foreign compounds<br>Plant disease resistance ,natural Disease resistance pathways, Biotechnological approaches to disease resistance Case studies | 6 |
| 8. | **Agroindustrial resources:**<br>Transgenic livestocks<br>Transgenic fish technology and products from Macro –Micro algae in agro industry<br>Important crops with their pattern of harvesting and Organic farming | 6 |
| 9 | **Microbial Agro- Biotechnology:**<br>Bio fertilization and Bioremediation of pesticides and agricultural chemicals | 2 |
| 10 | **Ethical Legal and public aspects:**<br>Cartagena protocol ,CBD and Plant Varieties and Farmer's Right Act 2001<br>Prospects and limitations of Agricultural Biotechnology | 3 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Plant Biotechnology- Adrian Slater, Nigel W. Scott and Mark R. Fowler (Text Book).
2. Biotechnology- Expanding Horizons by B.D. Singh.
3. Food Microbiology: Fundamentals and frontiers - M.P. Doyle

**Suggested Reference Book(s):**

1. Agricultural Biotechnology by Arie Altman.
2. Modern Food Micro-Biology - James M. Jay.

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**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

## Course Outcomes (COs) contribution to the Programme Outcomes(POs)

| Course outcomes (Food and Agricultural Biotechnology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | **1.9** |
| CO-2 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | **1.6** |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.7** |
| CO-4 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | **1.8** |
| CO-5 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | **1.2** |
| CO-6 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | **1.6** |
| Average | **3.4** | **2.8** | **1.6** | **2** | **2.1** | **1.3** | **1.1** | **1** | **1.6** | **1.6** | **1.5** | **1.8** | |

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# Downstream Processing Lab

COURSE CODE:18B17BT671

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Microbiology Lab, Biochemistry Lab, Bioprocess Engineering

**Course Objectives:**

1. Provide exposure to the students with hands on experience on various practices in Fermentation Technology.
2. Enable students to link the theoretical knowledge of Downstream Processing with the experiments.
3. Learn how to recover the various bioproduct after their production
4. Learn how to characterize the products after their recovery

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to set up of different kind of fermentation processes for biomass and product production | Familiarity |
| CO2 | Able to describe and to apply the principles of various unit operations such as sonication, centrifugation, filtration, precipitation etc. used in DSP | Assessment |
| CO3 | Able to strategize the downstream processes for the purification of various bioproducts such as enzymes, wine etc. | Assessment and Usage |
| CO4 | Able to design experiments and analyze various data related to various practices in DSP | Usage |
| CO5 | Able to analyze and characterize the synthesized bioproducts for further applications | Assessment and Usage |
| CO6 | Able to work in a team to accomplish the experiments and to make proper documentation of lab experiments carried out in the lab | Assessment |

**List of Experiments**

| S.No. | Description | Hours |
|---|---|---|
| 1 | Introduction to DSP Lab and related lab safety | 2 |
| 2 | Setting up of yeast fermentation processes using fruit juice | 2 |
| 3 | Downstream processing of the yeast fermented product (Sedimentation, Filtration, Bottling, Pasteurization) | 2 |
| 4 | Quality analysis of the yeast fermented product<br>i) pH, TSS content<br>ii) Sugar content using DNS method<br>iii) Anti-oxidant content<br>iv) Phenolic content<br>v) Alcohol content using alcoholometer | 2 |

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| | | |
|---|---|---|
| 5 | To determine the effect of speed and time of exposure over the settling of the cells during centrifugation | 2 |
| 6 | Disruption of yeast cells using sonication to recover intracellular Invertase enzyme | 2 |
| 7 | Determination of protein and enzyme content in the cell lysate after the cell disruption | 2 |
| 8 | Setting up of a fermentation process for production of extracellular industrial enzyme (Amylase) from *Bacillus licheniformis* | 2 |
| 9 | Clarification of the fermentation broth & Estimation of the yield of the industrial enzyme produced by the fermentation process. | 2 |
| 10 | Concentration of invertase/amylase using salt-induced precipitation | 2 |
| 11 | Organic Solvent Precipitation | 2 |
| 12 | Set up of dialysis to remove the additional salt from the enzyme solution | 2 |
| **Total Lab hours** | | **24** |

**Suggested/Resources:**


1. Keith Wilson, John Walker, "Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, Singapore, 2010.
2. Lab Manual
3. Raja Ghosh, "Principles of Bioseparation Engineering", World Scientific Publishing Co. Pte. Ltd., Singapore, 2006.
4. Pauline M. Doran, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.
5. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Â Elsevier India Pvt Ltd. (2007).
6. Downstream Processing by Dr. Mukesh Doble, IIT Madras

https://nptel.ac.in/courses/102106022/


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |


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**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 2.17 |
| CO2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 2.17 |
| CO3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2.33 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2.33 |
| CO5 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2.17 |
| CO6 | | | | | | 1 | 1 | 2 | 3 | 3 | 1 | 3 | 2.00 |
| Average | 2 | 2.20 | 2.60 | 2.60 | 2.20 | 1.83 | 2.00 | 2.00 | 2.17 | 2.17 | 1.83 | 3.00 | |

# Food and Agricultural Biotechnology Lab

COURSE CODE:18B17BT672

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Microbiology, Agriculture Science

**Course Objectives:**

1. To gain experience in manufacturing and preservation techniques used in food manufacturing units
2. To familiarize the students with basics of biotechnological interventions in food and agricultural sector linked with experimental analysis

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To enable students for apply basic knowledge of techniques used for food and agricultural biotechnology | Awareness |
| CO2 | Apply practical knowledge to understand the various important parameters involved in food production and preservation | Technical skills |
| CO3 | Able to conceptualize experimental setups related to various practices in food and agriculture | Technical and Analytical skills |
| CO4 | To enable students for exploring their avenues for entrepreneurship and social welfare through projects | Usage |
| CO5 | Able to use different techniques for the development of different food and agricultural products | Technical skills |
| CO6 | Able to apply biotechnological techniques for the development of improved products | Analytical and Technical skills |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Basic guidelines for safety measures to avoid hazard in laboratory. | 2 |
| 2 | To determine the quality of a milk sample by methylene blue reduction test (MBRT) | 2 |
| 3 | To estimate total phenolic content by a modified Folin-Ciocalteu assay | 2 |
| 4 | Preparation of Mozzarella cheese using direct acidification method | 2 |
| 5 | To estimate antioxidant activity in foods by DPPH and ABTS assay | 3 |
| 6 | To estimate the reducing sugars in the given food samples. | 2 |
| 7 | Effect of physical parameters on food spoiling microorganisms | 2 |
| 8 | Preparation of Yoghurt using defined strain starters | 3 |
| 9 | To study different concentrations of kanamycin/ hygromycin sensitivity test on selected plant leaf discs | 3 |
| 10 | To perform method of *Agrobacterium tumefaceins* transformation by using toacco leaf disc or seedimbibitions technique, along with molecular analysis. | 3 |

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|---|---|---|
| | of putative transformed plants by GUS assays | |
| 11 | Demonstration of suspension cell cultures for metabolites production and HPLC Quantification | 3 |
| 12 | Artificial seed production through somatic embryos of medicinal plants, cryopreservation and regeneration into plants. | 3 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**

1. Lab manual
2. Plant Biotechnology- Adrian Slater, Nigel W. Scott and Mark R. Fowler (Text Book)
3. Biotechnology- Expanding Horizons by B.D. Singh
4. Agricultural Biotechnology by Arie Altman ,Israel
5. Modern Food Micro-Biology - James M. Jay, (2000), An Aspen Publication, Maryland, USA.

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.7 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1.8 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1.8 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.7 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.6 | 2.6 | 2.60 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Fundamental Biology

COURSE CODE: 18B11BT111
COURSE CREDITS: 3
CORE/ELECTIVE: CORE
L-T-P:3-0-0

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**Pre-requisite:** $X^{th}$ Class Biology

**Course Objectives:**

1. This is basic foundation biology course for the students having mathematics background.
2. The objectives are to familiarize students with basics of biology.
3. Learn about various living organism.
4. Learn about different biological at molecular or celluar level.

**Course Outcomes:**

| S. No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Overview of living system, different life forms and Maintenance of Life. | Familiarity |
| CO-2 | Fundamental understanding of Bio-molecules: Building blocks of living system | Assessment |
| CO-3 | Understanding of structure and function of cell: Prokaryotic and Eukaryotic cells system. | Assessment |
| CO-4 | Understanding the Basic of cellular transport system and cellular inheritance. | Assessment |
| CO-5 | Flow of information in biological system- Central Dogma, DNA replication, Transcription, and Translation | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **General Biology:** The nature of life, Characteristics of living organisms, Concept and use of a classification system, brief of five Kingdome and three domain classification system.Concepts of species and hierarchical taxa, biological nomenclature, classical and quantititative methods of taxonomy of plants, animals and microorganisms. | 5 |
| 2 | **Introduction to bio-molecule: Structure and function relationship:** Structure, chemical reactions and biological functions of carbohydrate, lipid, protein and nucleotides.Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc | 8 |
| 3 | **Cell: Basic structure and functions:** Unicellular, colonial and multicellular forms; levels of organization of tissues systems; comparative anatomy. Structural and biochemical organization of cell. Prokaryotic and Eukaryotic cells. Cell organelles, their molecular composition, structure and functions. | 6 |

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|---|---|---|
| 4 | **Basic of cellular transport system:**Diffusion , Osmosis, Active transport | 4 |
| 5 | **Cellular inheritance:**Cell division, cell cycle, Mitosis, Meiosis and Inheritance | 6 |
| 6 | **Flow of genetic information:**The DNA, Search for Genetic Material, RNA World, Genetic Code, Central Dogma, replication, transcription and translation, (initiation, elongation and termination). | 8 |
| 7 | **Maintenance of Life:Adjustment and control:** Homeostasis, thermoregulation, and osmoregulation, Speciation and selection. | 5 |
| | **Total Lectures** | **42** |

**Suggested Text Book(s):**

1. Stryer, Lubert (2002). Biochemistry; Fifth edition. W. H. Freeman and Company.
2. Principles of Biochemistry [5th edition], Lehninger.
3. NCERT –XII class Biology

**Suggested Reference Book(s):**

1. Neill, Campbell (1996). Biology; Fourth edition.The Benjamin/Cummings Publishing Company. p. 309,310. ISBN 0-8053-1940-9.
2. A. W. Haupt, Fundamental of Biology, 3rd ed. McGRAW-HILL

**Other useful resource(s):**

1. https://nptel.ac.in/courses/122103039/
2. https://nptel.ac.in/syllabus/122103039/

**Evaluation Scheme:**

| S. No. | Exam | Marks | Duration | Coverage/Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3 | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4 | Teaching Assessment | 25 | Entire Semester | Quiz, Assignment, Attendance, etc. |

**Course Outcomes (COs) contribution to the programme Outcomes (POs):**

| Course outcomes (Fundamental Biology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | **1.8** |
| CO-2 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | - | 1 | 2 | 1 | 3 | 3 | 2 | **1.8** |
| CO-3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 2 | 3 | 3 | 2 | **1.8** |
| CO-4 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | - | 1 | 2 | 3 | 3 | 2 | **2.0** |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 3 | **2.5** |
| Average | **2.6** | **2.4** | **2.6** | **2.2** | **2.0** | **2.6** | **2.4** | **1.8** | **1.6** | **1.8** | **1.8** | **2.8** | **2.8** | **2.2** | |

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# Fundamental Biology Lab

COURSE CODE: 18B17BT171
COURSE CREDITS: 1
CORE/ELECTIVE: CORE
L-T-P:0-0-2

**Pre-requisite:** X$^{th}$ class biology

**Course Objectives:**

1. The objective of this course is to familiarize the students with basic biology laboratory techniques specifically used in modern biotechnology area.
2. Learn handling of microorganism
3. To learn about safe laboratory practices
4. To learn ethics, team work and discipline

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Introduction to basic laboratory practices, microscopy, Bio- safety cabinet and sterilization. | Familiarity |
| CO2 | Fundamental understanding of Biological buffers preparation and application. | Familiarity |
| CO3 | Introduction to microscopic examination of different biological system. | Assessment |
| CO4 | Introduction to analytical technique and application in macromolecular estimation. | Assessment |
| CO5 | Able to understand ethics, team work and discipline. | Usage |

**List of Experiments**

| S. No. | Description | Hours |
|---|---|---|
| 1 | **Laboratory safety and basic laboratory Instrumentation** Basic laboratory operation: safety procedure, general safety practice and awareness. (personal safety, eye safety, handling of biologically hazardous material, handling of needles, sharps and chemicals) | 2 |
| | To study the different parts and application of simple and compound microscope | 2 |
| | To study the fundamental component and application of the Bio-safety cabinet (BSL) in biotechnology. | 2 |
| | To study the fundamental of different sterilization method in laboratory practices (Autoclave, Radiation sterilization) | 2 |
| 2 | **Biological buffers: (Preparation and application)**Hands on training on different buffer preparation, purification and pH measurement. | 2 |
| | Application of purified buffer in different biotechnology experiment. | 2 |
| | Collect water from two different water bodies around you and study them for pH, clarity and presence of any living organism. | 2 |

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| | | |
| 3 | **Microscopic Analysis of biological sample** To perform simple and differential staining of given microorganism and classify them ( gram staining)<br>Isolation and identification of microbe from given sample: Microscopic examination and motility test.<br>To perform microscopic examination of unicellular eukaryote organism: identification and characterization | 2<br>2<br>2 |
| 4 | **Analytical estimation of bio-molecule** Estimation of Different macromolecules by visible spectrophotometer.<br>To study the basic of standard curve preparations and application in biotechnology experiments. | 2<br>2 |
| **Total Lab hours** | | 24 |

**Suggested/Resources:**

1 Lab manual
2 Laboratory exercises in Microbiology – Harley Prescott
3 Biotechnology Lab Course: Jeffery M.Becker, Guy A. Caldwell, Eve Ann Zachgo
4 Biology 6th edition : Raven - Johnson

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 2.3 |
| CO2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | - | 1 | 1 | 1.9 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2.1 |
| CO4 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.3 |
| CO5 | 1 | 1 | 1 | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 | 3 | 1.8 |
| Average | 2.0 | 2.2 | 2.0 | 2.6 | 1.8 | 2.0 | 2.0 | 2.0 | 2.0 | 1.6 | 2.0 | 2.2 | |

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# Cell and Molecular Biology

COURSE CODE:18B11BI311

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

**Pre-requisite:** Knowledge of Biology (10+2)

## Course Objectives:

1. The objective of the course is to equip students with a detailed knowledge of molecular structure and components of the cell and to understand howmolecules interact within the cell to promote proper growth, division, and development

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to describe the chemical components of the macromolecules of life and their functions and the structural differences between prokaryotic and eukaryotic cells or between plant and animal cells. | Familiarity |
| CO-2 | Understand how molecular machines within the cell are constructed and regulated so that they can accurately copy, repair, and interpret genomic information. | Assessment |
| CO-3 | Write, discuss or critique about emerging biology-related topics individually or in groups. | Application |

## Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Biological Classification:** Introduction to the organization of eukaryotic and prokaryotic cells. | 3 |
| 2 | **Biomolecules:**Carbohydrates: Chemical structures, nature, properties, Classification and Importance in Biological Systems.Lipids: Structure, Classification, Properties and Function. | 2+3 |
| 3 | Amino acids: Classification, properties, structure, nature. Proteins: Classification, Structure and Function. Enzymes: Classification, Characteristics | 3+2 |
| 4 | Molecular details of the Cell (Cells and Genomes, Cell Chemistry and Biosynthesis, Proteins) | 2+2 |
| 5 | Structural functional significance of sub-cellular organelles (Mitochondria, chloroplast, Endoplasmic reticulum, Golgi apparatus, etc.). | 3 |

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| | | |
|---|---|---|
| 6 | Nucleic acids:Bases, nucleosides and nucleotides, DNA & RNA structure, rRNA, tRNA and mRNA. Structural organization of DNA and Chromosomes, DNA Replication and Repair. | 6 |
| 7 | Protein trafficking, Protein synthesis; Protein sorting, transport and secretion. | 5 |
| 8 | Flow of information in biology (Central Dogma). DNA replication, DNA polymerases, Transcription | 6 |
| 9 | Cellular transport across membranes; Exocytosis, Endocytosis and Receptor mediated endocytosis. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. De Robertis, E. D. P. and De Robertis, Jr. E. N. F. "Cell and Molecular Biology". Lea and Febiger, New York
2. Karp, J. "Cell and Molecular Biology, Concepts and Experiments" Jhon Wiley and Sons Inc. USA
3. Stryer, Lubert (2002). Biochemistry; Fifth edition. W. H. Freeman and Company.
4. Lehninger "Principles of Biochemistry"

**Suggested Reference Book(s):**

1. Lodish H, Berk A, Zipursky LS, Matsudaira P, Baltimore D, Darnell J (2000). *Molecular Cell Biology*. W. H. Freeman and Company
2. Molecular Biology of the Cell Alberts, B., et al. 4th edition (2002) Garland Science
3. Essential Cell Biology Alberts, B., et al; 3rd edition (2010) Garland Science
4. Molecular Cell Biology Damell Jr. J., Lodish, H and Baltimore, D. Scientific American Inc., New York
5. Neill, Campbell (1996). Biology; Fourth edition. The Benjamin/Cummings Publishing Company. p. 309,310. ISBN 0-8053-1940-9.

**Other useful resource(s):**

1.Link to NPTEL course contents: https://nptel.ac.in/courses/102104056/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

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| Course outcomes (Cell and Molecular Biology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | **1.9** |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | **1.8** |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | - | 2 | 2 | **1.5** |
| Average | **2.0** | **2.0** | **2** | **2** | **2** | **1.3** | **1.3** | **1.6** | **2.0** | **1.3** | **1.33** | **2.0** | |

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# Microbiology and Immune System

COURSE CODE:18B11BI312

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

**Pre-requisite:** None

**Course Objectives:**

1. The objective of the course is to develop an understanding of basic microbiological and immunological principles and be able to understand different classes of disease causing microorganisms and how they activate and counter-act the host immune system.
2. To provide an understanding of the principles of microbiology and immunology and techniques that can serve as a platform for other courses built on biological concepts.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Usage of scientific terminologies to describe & express fundamental concepts in Microbiology and Immunology. | Familiarity |
| CO-2 | Able to apply basic principles to understand host-microbe relationship in different Infectious diseases. | Assessment |
| CO-3 | Able to connect and integrate the knowledge obtained for applications related to Microbes, their tools and database. | Usage |
| CO-4 | Able to connect and integrate the knowledge obtained for and applications related to Immunology, Vaccines related informatics. | Usage |
| CO-5 | Able to connect and integrate the knowledge of microbiology and immunology from the perspective of a bioinformatician with special emphasis on microbe-immune interface. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **History and Introduction to Microbial World**: Brief history, contributions of important microbiologists, immunologists. Origin of life and the microbial world, different classes of microbes, good and the bad microbes. | 3 |
| 2 | **Forms of microorganisms:**<br>Prokaryotes: Archaea & Bacteria, Cyanobacteria Eukaryotes: Fungi,<br>Algae, Protozoa<br>Viruses – structure, classification, Viral Replication (Lytic and Lysogenis cycle) | 3 |
| 3 | **Morphology and cell structure of microorganisms:**<br>Morphological features and characteristics of microorganisms, Gram positive and Gram negative bacteria. | 2 |

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| | | |
|---|---|---|
| 4 | **Methods in microbiology**: Pure culture techniques, Principles of microbial nutrition, culture media and types (simple, complex, enriched, enrichment, selective & differential), replica plating techniques | 4 |
| 5 | **Growth of microorganisms**: Growth curve of microbes, binary fission, enumeration techniques, effect of environmental conditions on growth, extremophiles, preservation techniques | 3 |
| 6 | **Microbial Control:** Theory and practice of sterilization, Antibiotics and Concept of Resistance, Physical and chemical control methods in practice. | 4 |
| 7 | **Genetics and Resistance** –Plasmids, Bacterial Conjugation, Transformation, Transduction, and Mutation | 4 |
| 8 | **Introduction to Fundamental Concepts in Immunology:** Immunology-Specificity, memory, discrimination of self from non- self, Innate and Acquired immunity, Humoral and cell-mediated immune responsePhagocytes and antimicrobial peptide effectors.<br>Cells of the immune system, cytokines, complement system | 4 |
| 9 | **Antibody, Antigens and Immune receptors:** Immunoglobins: structure and function, immunoglobin classes and functions, monoclonal and polyclonal antibody, types of vaccines, active and passive immunization | 4 |
| 10 | **Antigens:** Immunogenicity, antigenicity, epitopes-B cell epitopes, T cell epitopes, haptens, Antigen Recognition by immune system: recognition of antigens by T and B Cells: Antigen processing and presentation, MHCs, role of MHC molecules in antigen presentation<br>and co-stimulatory signals. | 4 |
| 11 | **Antigen- antibody interactions:** Concept, precipitation – double diffusion, radial immunodiffussion, immunoelectrophoresis, agglutination, ABO blood typing. | 4 |
| 12 | **Bioinformatics-Immunology and Infectious diseases:** Bioinformatics Resources and tools for Human Microbiota and Infectious Agents, Immunoinformatics. | 2 |
| 13 | **Failure of Host Defence Mechanisms:** Bacterial Persistence and survival strategies, Autoimmunity, Hypersensitivity | 1 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Madigan, M.T., Martinko, J.M., Parker, J: Brock Biology of Microorganisms. 10th Edition.: Publisher: Prentice Hall 2003
2. Prescott, Harley and Klein: Microbiology, 6th Edition, McGraw Hill 2005.
3. Pelczar, Chan and Krieg: Microbiology by; Tata McGraw Hill.
4. Roger Y. Stanier,: General Microbiology
5. R. Ananthanarayan and CK JayaramPaniker: Textbook of Microbiology
6. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. (2007). KubyImmunology. W.H. Freeman and Co., New York, 7th Ed.



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7. Roit, I. (2012). Essential Immunology. Blackwell Scientific Publications, Oxford, 12th Ed.
8. Pathogenomics: Genome analysis of pathogenic microbes by Hacker J and Dorbindt U. ed. Wiley-VCH

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Microbiology and Immune System) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 2 | 1 | 3 | 3 | - | 1 | - | 2 | 2 | **1.9** |
| CO-2 | 2 | 2 | 1 | 2 | 1 | 3 | 3 | - | 2 | 1 | 2 | 2 | **1.90** |
| CO-3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | - | 2 | - | 2 | 2 | **1.8** |
| CO-4 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | - | - | - | 2 | 2 | **2** |
| CO-5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | - | 2 | 2 | 2 | 2 | **2.54** |
| Average | **2.4** | **2.4** | **1.4** | **2.0** | **1.4** | **2.6** | **2.6** | **0.0** | **1.8** | **1.5** | **2.0** | **2.0** | |

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# Biological Computation

COURSE CODE:18B11BI313

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

**Pre-requisite:** Introduction to Bioinformatics

**Course Objectives:**

1. To use & develop tools to curate (compare &analyze) biological data.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Basic algorithms used in Pairwise and Multiple alignments. | Usage |
| CO-2 | Understanding the methodologies used for database searching, and determining the accuracies of database search. | Usage |
| CO-3 | Application of probabilistic model to determine important patterns. | Familiarity |
| CO-4 | Prediction of structure from sequence and subsequently testing the accuracy of predicted structures. | Usage |
| CO-5 | Determine the protein function from sequence through analyzing data. | Usage |
| CO-6 | Analysis and development of models for better interpretation of biological data to extract knowledge. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction** Meaning of sequence, sequence similarity, homology, meaning of alignment. | 1 |
| 2 | **Pairwise Sequence Alignment**Different scoring models, Substitution matrices (PAM and BLOSUM), Pairwise Alignment: Concept of Global and Local Alignment, Dot matrix method, Dynamic programming (Needleman-Wunsch algorithm, Smith-Waterman algorithm, Choosing of best scoring matrix, gap penalties, Significance of score, EVD, FASTA and BLAST algorithms, Information theory and Shanon Entropy. | 13 |
| 3 | **Multiple Sequence alignment**Multiple Sequence Alignment methods (MSA), Scoring of a MSA, Progressive (CLUSTALW and PILEUP), Iterative (Genetic) and Hidden Markov Model (HMM) methods of MSA, Local MSA (Profile and BLOCK analysis, and Pattern searching, and Expectation Maximization (EM) Algorithm (MEME) and Gibbs Sampler. | 6 |
| 4 | **Structural Alignment Tools and Protein Tertiary Structure Prediction** Structure alignment algorithms & Homology modeling. | 3 |

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| | | |
|---|---|---|
| 5 | **Markov Chains and HMM** Frequent words in DNA, Consensus word analysis, Transaction and emission matrix, Development of training set, CpG island prediction using HMM, Application of HMM in gene finding, and Multiple sequence alignment by HMM method. | 7 |
| 6 | **Phylogenetic Analysis** Phylogenetic tree and terminology, different methods of Phylogenetic tree prediction: maximum parsimony, distance (UPGMA, NJ), maximum likelihood methods, bootstrapping, Jacknifing and Phylogenetic analysis by using Bayesian Network. | 7 |
| 7 | **RNA Structure Analysis** Terminology of RNA secondary structure, inferring structure by comparative sequence analysis, RNA secondary structure prediction, Nussinov folding algorithm, energy minimization and Zuker folding algorithm. | 5 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. D.W. Mount *Bioinformatics: Genome and Sequence Analysis*: (2001) Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
2. Ian Korf, Mark &Josaph: *BLAST*, Oreilly Publisher, 2003
3. R. Durbin, S. Eddy, A. Krogh and G. Mitchison, *Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids.* Cambridge University Press.
4. A.D. Baxevanis& B.F.F. Oulette*Bioinformatics – A practical guide to the Analysis of Genes and Proteins*,2002, Willey International publishers.
5. M.J. Bishop and C.J. Rawlings (editors), *DNA and Protein Sequence Analysis---A Practical Approach* IRL Press at Oxford University Press, ISBN 0 19 963464 7 (Pbk)
6. J. Pevsner (2002) Bioinformatics and Functional Genomics; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York


**Suggested Reference Book(s):**


6. J. Setubal and J. Meidanis(1997) *Introduction to Computational Molecular Biology,* PWS Publishing Co.
7. J. Pevsner (2002) Bioinformatics and Functional Genomics; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.


**Other useful resource(s):**

1. https://onlinecourses.nptel.ac.in/noc19_bt01/preview


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**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |

| | | | | |
|---|---|---|---|---|
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Biological Computation) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| CO-6 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 1 | 1 | 1 | 3 | **1.9** |
| Average | **3** | **3** | **3** | **3** | **3** | **1** | **1** | **-** | **1** | **1** | **1** | **3** | |

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# Cell and Molecular Biology lab

COURSE CODE: 18B17BI3731

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

**Pre-requisite:** Knowledge of Biology (10+2)

**Course Objectives:**

1. The objective of this course is to familiarize the students with laboratory techniques specifically in microbiology and molecular biology
2. At the end of the course, the student will be able to identify and analyze various applications in the field of microbiology and biotechnology.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Students will learn the basic laboratory practices | Introductory |
| CO2 | Students will learn use and handling microscope | Technical |
| CO3 | The students will be able demonstrate isolation of single bacterial colony through serial dilution | Technical |
| CO4 | Students will able to prepare buffer and extraction of genomic DNA from *E. coli* | Technical/ Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | laboratory practices | 2 |
| 2 | Introduction to Microscope | 2 |
| 3 | To prepare slides of prokaryotic and eukaryotic cell to observe under microscope. | 2 |
| 4 | Calculation of Molarity, Normality | 2 |
| 5 | Carbohydrate estimation | 2 |
| 6 | To study the biosafety cabinet used in microbiology lab | 2 |
| 7 | Preparation of isolated single bacterial colony through serial dilution. | 2 |
| 8 | To observe difference in cultured plate prepared in laminar air flow and open air | 2 |
| 9 | General Instrumentations for lab. Practices; 1. pH meter | 2 |
| 10 | 2. Spectrophotometer | 2 |
| 11 | Introduction to agarose gel electrophoresis | 2 |
| 12 | Preparation of buffer for genomic DNA extraction and | 2 |
| 13 | Isolation of genomic DNA | 2 |
| 14 | Isolation of genomic DNA (continued) | 2 |
| **Total Lab hours** | | **28** |

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**Suggested Books/Resources:**

1. Harley – Prescott Laboratory exercises in Microbiology
2. Biotechnology Lab course : Jeffery M.Becker, Guy A. Caldwell, Eve Ann Zachgo
3. Biology 6th edition : Raven – Johnson
4. Campbell --- Biology 7th edition
5. NPTL
6. Laboratory Manuals

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1.9 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1.75 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | - | 2 | 2 | 1.72 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | - | 2 | 1.72 |
| Average | 2.0 | 2.0 | 2 | 2 | 2 | 1.25 | 1.25 | 1.5 | 2.0 | 2 | 1.33 | 2.0 | |

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# Microbiology and Immune System Lab

COURSE CODE: 18B17BI372

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** Good Laboratory Practices

**Course Objectives:**

1. The objective of this course is to demonstrate basic microbiological and immunological principles, approaches that enable study of microbe-host immune- interface and enable students to translate the theoretical foundation in the subject into practical understanding.
2. Techniques and methods to study different classes of microbes, immune system related molecules will be performed.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Students will be able to understand and apply basic microbiological techniques and correlate them with their fundamental concepts in the subject. | Introductory |
| CO2 | Students will be able to understand and apply basic immunological techniques and correlate them with their fundamental concepts in the subject. | Introductory |
| CO3 | At the end of the course, students are expected to gain a broad appreciation of the basic methods and their application in the field of microbiology, handle microbial cultures independently, to study applied aspects of microbiology. | Technical |
| CO4 | At the end of the course, students are expected to gain a broad appreciation of the basic methods and their application in the field of immunology along with applied aspects of immunology. | Technical |
| CO5 | At the end of the course, students are expected to gain a broad appreciation of the basic methods and their application in the field of microbiology and immunology along with handle microbial cultures independently, to study applied aspects of microbiology. | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| | | |

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| | | |
|---|---|---|
| **1.** | **Culture Techniques for Microorganisms:**<br><br>General microbiology procedures and Equipments - use and Safety Considerations, GLP.<br><br>**a.** Preparation of culture media for different classes of microbes (bacteria and fungi)<br><br>**b.** Bacterial growth curve: Spectrophotometry<br><br>**c.** Culture and Isolation of microorganisms – soil, air, water<br>**d.** Quantification, Purification of microorganisms | **10** |
| **2.** | **Microscopy and Staining:**<br><br>Handling, microscopic examination of different classes of microorganisms: Bacteria, fungi<br><br>***a.*** Simple and differential staining of different shapes and sizes of bacteria – *acid fast, gram staining*<br>**b.** Microscopic examination of specific fungi using Lactophenol cotton blue staining | **4** |
| **3.** | **Identification/Characterization Techniques for Microorganisms:**<br><br>**a.** Preservation techniques<br><br>**b.** Biochemical characterization<br><br>**c.** Antimicrobial Susceptibility (Disk-diffusion) Test | **6** |
| **4.** | **Antigen – Antibody Interactions:**<br><br>**a.** Double diffusion<br><br>**b.** Radial Immunodiffusion<br><br>**c.** Rocket Immunoelectrophoresis<br><br>**d.** ABO Blood typing | **8** |
| **Total Lab hours** | | **28** |

**Suggested Books/Resources:**


1. Benson, Harold J: Microbiological Applications: Laboratory Manual in General Microbiology, McGraw-Hill Higher Education, 2007.
2. Cappuccino, James G.: Microbiology: A Laboratory Manual, Pearson Education Sherman, Natalie Asia, 2004.
3. Harley, John P.: Laboratory Exercises in Microbiology, Tata McGraw Hill, 2003.
4. Dubey, R.C., Maheshwari, D.K.: Practical microbiology, S. Chand and Company Ltd, New Delhi, 2003


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |


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**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | - | 2 | 3 | 3 | 3 | - | 1 | 3 | 2.2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | - | 2 | 3 | 2.18 |
| CO3 | 2 | 3 | - | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2.18 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | - | 2 | 2 | 2 | 3 | 2.36 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | - | 3 | 3 | 3 | 2.63 |
| Average | 2.4 | 2.4 | 2.5 | 2 | 2 | 2 | 2.2 | 2.75 | 2.75 | 2.33 | 1.8 | 2.8 | |

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# Biological Computation Lab

COURSE CODE: 18B11BI373

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** Basic Programming Skills

**Course Objectives:**

3. To use and develop bioinformatics programs for comparing &analyzing biological sequence data to identify probable function.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Basic algorithms used in Pairwise and Multiple alignments. | Assessment |
| CO2 | Understanding the methodologies used for database searching, and determining the accuracies of database search. | Assessment |
| CO3 | Application of probabilistic model to determine important patterns. | Assessment |
| CO4 | Prediction of structure from sequence and subsequently testing the accuracy of predicted structures. | Assessment |
| CO5 | Determine the protein function from sequence through analysis of data. | Assessment |
| CO6 | Analysis and development of models for better interpretation of biological data to extract knowledge. | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1. | Overview of Practical classes conducted in the IInd Semester course of "Structural Biology" on RCSB, Visualization softwares, and tools related to secondary and tertiary structure predictions. | 4 |
| 2. | Different sequence formats such as FASTA, PIR, EMBL, PDB, etc. Different sequence databases, retrieval of sequences from those databases and different ways to store the sequences.<br>Calculation of the score of a pairwise alignment by using a scoring pattern (Take Home). | 4 |
| 3. | Select a protein family for your mini-project and find out its superfamily. Also select another protein family which belongs to above superfamily and closer to your protein family. | 4 |
| 4. | Find out structural and functional information about above protein families and superfamily. | 4 |
| 5. | Write a program to align two sequences using Needleman-Wunsch algorithm? | 4 |
| 6. | Use EBI (European Bioinformatics Institute) Needle sequence alignment tool to align above two sequences and compare your result with that of Needle tool | 4 |
| 7. | Use of BLAST on line server to retrieve sequences from a database<br>Develop a program based on BLAST algorithm to carry out database search? | 4 |
| 8. | Use Clustaw software or on line server to align sequences from a family. | 4 |

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| | | |
|---|---|---|
| **9.** | Develop a Multiple Sequence Alignment (MSA) program based on ClustalW algorithm. | 4 |
| **10.** | Develop a program to identify motif from a set of sequences.<br>Use on-line motif identification tools to predict motif in a set of sequences. | 4 |
| **11** | Use of Phylip package to infer phylogenetic tree in distance, maximum parsimony (MP) and maximum likelihood (ML) methods. | 4 |
| **12** | Use of Phylip package to determine robustness of inferred tree determined by each method. | 4 |
| **Total Lab hours** | | **48** |

**Suggested Books/Resources:**


1. http://hmmer.org/.
2. https://blast.ncbi.nlm.nih.gov/Blast.cgi
3. https://www.genome.jp/tools-bin/clustalw
4. http://meme-suite.org/
5. http://evolution.genetics.washington.edu/phylip.html
6. https://www.rcsb.org/
7. Mount D.W. : Bioinformatics: Genome and Sequence Analysis: (2001), Cold Spring Harbor Laboratory Press, New York.
8. Korf Ian &JosaphMark : BLAST, Oreilly Publisher, 2003
9. Durbin R., Eddy S., Krogh A. and G. Mitchison : Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press
10. Pevsner J. : Bioinformatics and Functional Genomics; Cold Spring Harbor Laboratory Press, New York.
11. Baxevanis AD &OuletteBFF : Bioinformatics – A practical guide to the Analysis of Genes and Proteins, Willey International publishers


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **CO6** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | 2 | 1 | 1 | 3 | **2.00** |
| **Average** | **3** | **3** | **3** | **3** | **3** | **1** | **1** | - | **2** | **1** | **1** | **3** | |

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# Linux Lab

COURSE CODE: XXXXXXXX 18B17BI374

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:**None

**Course Objectives:**

6. To Understand and master Linux and UNIX based OS environment and understanding to various Linux flavors.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand Unix environment | Familiarity |
| CO2 | Familiarize with Unix and Linux commands. | Familiarity |
| CO3 | To learn and master Bash and Shell scripting | Usage |
| CO4 | To learn automating script-based job scheduling in Unix | Usage |
| CO5 | To learn and master administrating and managing superuser-based managing accounts. | Usage |
| CO6 | To run command line scripts of Perl and Python | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1. | Introduction to Unix and Shell | 2 |
| 2. | Installing Fedora | 2 |
| 3. | Unix directories and pathnames and Rules for entering unix commands | 2 |
| 4. | Configuring your Linux environment | 2 |
| 5. | Working with Hard drives, Listing and Finding Directories and Files | 2 |
| 6. | Manipulating Files in Unix | 2 |
| 7. | Comparing, Sorting, Modifying, Combining, and Splitting Files, Searching for Lines in a File or Pipeline | 2 |
| 8. | Replacing or Removing Text From a File or Pipeline | 2 |
| 9. | Using vi to Edit a Text File and Command-Line Editing in the Korn Shell | 2 |
| 10. | Writing Bourne Shell Scripts and awk scripts | 2 |
| 11. | Additional commands | 2 |
| 12. | Network commands | 2 |

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| Total Lab hours | 24 |
|---|---|

**Suggested Books/Resources:**


1. Practical Linux, Drew Streib et al Que, Indianapolis, 2000
2. Practical Unix, Steve Moritsugu et al, Que, Indianapolis, 2000
3. Linux: a practical approach , B. Mohamed Ibrahim 2006


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Genetic Engineering and Genomics

COURSE CODE:18B11BI412

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** Molecular Genetics

**Course Objectives:**

4. Familiarize the students with the basic concepts in genetic engineering.
5. Acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
6. To make the students familiar with basic concepts of technologies.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will become aware of concept of genetic engineering and genomics and its applications. | Familiarity and Basics |
| CO-2 | Students will have knowledge of tools and strategies used in genetic engineering. | Technical and strategies |
| CO-3 | Student will acquire knowledge about gene libraries and isolation of genes. | Technical and application |
| CO-4 | Student will develop understanding of DNA and genome sequencing technologies. | Technical and strategies |
| CO-5 | Student will be able to explore domains of genomic technologies. | Application |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Genetic engineering, Recombinant DNA technology: gene cloning - concept and basic steps - rDNA Glossary, Genomics Concept scope and applications | 3 |
| 2 | **DNA modifying enzymes and cloning techniques:** Restriction Endonucleases, DNA Ligation Enzymes and, DNA, Gene cloning methods and strategies: Cloning of PCR products, TA cloning, DNA Modifying Enzymes: Nucleases, Kinases, phosphatases, Reverse transcriptase | 6 |
| 3 | **Cloning and Expression Vectors:** Plasmid Vectors, Vectors based on Lambda Bacteriophage, Cosmids, M13 Vectors, Vectors for Cloning Large DNA Molecules, Expression Vectors | 6 |
| 4 | **Construction & Screening of genomic libraries:** Genomic library, cDNA library, Growing& Storing Libraries, cDNA Cloning (5'&3' RACE) | 4 |

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| | | |
|---|---|---|
| 5 | **Gene transfer Methods**: Gene Transfer methods plants and animal cells, Transgenic plants and animals and their applications | 4 |
| 6 | **Structural genomics:** Genome Analysis, Genomics: Organization and structure of Genomes, genome complexity Sequencing genes and short stretches of DNA: Basic DNA Sequencing, Next generation sequencing technologies | 7 |
| 7 | **Mapping and sequencing genomes**: Introduction, Molecular Markers Genetic and Physical Mapping of Genomes, *Sequencing of whole genomes,* Sequence analysis of genomic DNA for identification of genes and other features data and molecular phylogenetics | 6 |
| 8 | **Functional Genomics:** RNA expression analysis Comparative genomics | 4 |
| 9 | **Application domains of genome technologies**: Genomics and Medicine, Genomics and Agriculture | 2 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Principles of Gene Manipulation and Genomics SEVENTH EDITION S.B. Primrose and R.M. Twyman.
2. Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz.
3. Discovering Genomics, proteomics & bioinformatics. Second edition by A Malcolm Campbell, Davidson College; Laurie J. Heyer Davidson College ; With Foreword by Francis S. Collins

**Suggested Reference Book(s):**

1. From Genes to Genomes: Concepts and Applications of DNA Technology by JW Dale and M Schantz
2. Molecular Biotechnology: Principles & Applications of Recombinant DNA Glick BR and Pasternak JJ
3. Genetic Engineering :Amita Rastogi and Neelam Pathak

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (Cos) contribution to the ProgrammeOutcomes(Pos)**

| Course outcomes (Genetic Engineering and Genomics) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| CO-2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| Average | **3.00** | **3.00** | **3.00** | **3.00** | **3.00** | **2.00** | **2.00** | **2.00** | **3.00** | **3.00** | **2.00** | **3.00** | |

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# Structural Biology

COURSE CODE:18B11BI413

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

7. To visualize, analyze and compare structures of proteins and nucleic acids (DNA), and their subunits. To identify and understand similar structural units (folds and domains) in proteins those have different functions.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the relationship between protein structure and its function. | Familiarity |
| CO-2 | Understand the methods of characterizing protein's structure using X-ray and NMR methods | Familiarity |
| CO-3 | Implementation of bioinformatics tools in understanding protein structures. Understanding the classification of protein databases. | Usage |
| CO-4 | Introduction to protein engineering | Familiarity |
| CO-5 | Understand the structural diversity in nucleic acids. | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Structural biology and its significance, Overview of amino acids and their various groups. Unnatural amino acids | 1 |
| 2 | **Protein structure:** Primary and Secondary Structure | 2 |
| 3 | **Motifs &Supersecondary Structure, Tertiary Structure & Fold Types:** Different types of secondary structures, Super-secondary structure and their classes, structural and functional domain, tertiary structures of proteins and their classes and sub-classes, Quaternary structures and cooperativity | 2 |
| 4 | **Covalent and Non-covalent Forces:** H-bonding, base stacking & hydrophobic interaction, paired interaction, torsion angle, solvent interaction in Protein, Role of free energy in Random and Natural states of polypeptide chain | 4 |
| 5 | **Mechanisms of Protein Folding:** Characterization of Folding Pathways and Mutagenesis Studies | 2 |
| 6 | Interactions of small molecule: Protein-Protein, Protein-DNA and Protein-RNA Interactions | 2 |
| 7 | **Types of protein:** Membrane Proteins, Fibrous Proteins, Metalloproteins, Carbohydrate Binding Proteins and Metalloenzymes: Structure and Function. | 4 |

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| | | |
|---|---|---|
| 8 | **Protein Structure Determination by X-ray diffraction:** Isolation, purification & crystallization of proteins, Basic principles of X-ray diffraction studies, Phase determination, calculation of Electron Density Map, Interpretation of Electron Density Map, Refinement of the Structures | 4 |
| 9 | **Techniques:** Circular Dichroism and Optical Rotation, Fluctuation Spectroscopy, Mass Spectrometry | 2 |
| 10 | **NMR Techniques for protein structure determination:** 1D NMR, 2D NMR (COSY & NOSY) Basic NMR Principles and Parameters, Vector & Product Operator Formalisms, Heteronuclear Correlation Experiments, Resonance Assignment Strategies, Protein Structure Determination | 2 |
| 11 | **Protein secondary structure prediction:** Principles of secondary structure prediction, Various secondary structure prediction tools (Chou-Fasman, GOR-IV, Neural network), Comparisons of various secondary structure prediction tools | 4 |
| 12 | **Structural Classification of Proteins:** Principle of protein structure classification (VAST, DALI, SSP), Protein structure classification Database (SCOP, CATH, DSSP), Profiles and Protein Families | 3 |
| 13 | **Protein Design:** Structural Scaffolds and Enzymatic Function. Introduction to protein engineering, examples and applications of industrially important enzymes | 3 |
| 14 | Nucleic Acid Structures: DNA Tertiary structure(A- and B- DNA, Major and Minor Grooves of DNA, Z-DNA, Mechanism of specific base sequence recognization in B-DNA, Triple helix DNA, Tetraplex DNA, Introduction to RNA secondary structure | 3 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Introduction to Protein Structure, Carl Branden and John Tooze, Garland Publishing Inc., New York
2. Bioinformatics: sequence and Genome Analysis, DW Mount, Cold Spring Harbor Laboratory Press, 200
3. Creighton T.E. ed. Protein structure. A practical approach. (2004) Oxford University Press


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes &Attendance |

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**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Structural Biology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | **1.75** |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **2** |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.75** |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2** |
| CO-5 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2** |
| Average | **2** | **2.6** | **2.6** | **2.6** | **2.6** | **1** | **1** | **1** | **2** | **2.4** | **0.6** | **2** | |

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# Programming Languages for Bioinformatics

COURSE CODE:18B11BI414

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To familiarize and master the programming skills in Perl and Python.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Write and execute a script in Perl. | Usage |
| CO-2 | Enable routine and module calls and their implementation using Bioperl. | Familiarity |
| CO-3 | Able to formulate stepwise implementation of a Perl script (from developing a pseudo-code to execute a successful bug-free code) for a given problem in Bioinformatics. | Usage |
| CO-4 | Write and execute a script in Python. | Usage |
| CO-5 | Enable routine and module calls and their implementation using Biopython. | Familiarity |
| CO-6 | Able to formulate stepwise implementation of a Python script (from developing a pseudo-code to execute a successful bug-free code) for a given problem in Bioinformatics. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Crash course in C | 2 |
| 2 | Programming basics | 1 |
| 3 | Sequences and Strings: Storing a DNA sequence, Concatenation, Transcription, Translation | 2 |
| 4 | Arrays and Scalar list, Strings to Array, Operations on Strings | 2 |
| 5 | Subroutines and Command line arguments | 3 |
| 6 | Modules, Calling modules | 2 |
| 7 | Hashes, Data Structures in Perl | 4 |
| 8 | Reading files and writing output formats | 3 |
| 9 | Regular expressions and Perl Operations | 3 |
| 10 | Parsing genbank, PDB, BLAST, and other file formats | 3 |
| 11 | Object-oriented programming, Complex Data Structures, Relational Databases | 4 |

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| | | |
|---|---|---|
| 12 | BioPerl | 3 |
| 13 | Introduction to Python | 3 |
| 14 | BioPython | 4 |
| 15 | Applications of Python and BioPython | 3 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

a. Beginning Perl for Bioinformatics By James Tisdall, O'Reilly Media (2001)
b. Mastering Perl for Bioinformatics By James Tisdall, O'Reilly Media (2003)
c. Python For Bioinformatics By Sebastian Bassi, Chapman and Hall (2010)

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **2.25** |
| **Average** | **2.67** | **2.83** | **2.80** | **2.80** | **2.60** | **2.20** | **1.20** | **1.00** | **1.00** | **1.00** | **1.20** | **1.40** | |

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# Genetic Engineering and Genomics Lab

COURSE CODE: 18B17BI472

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

7. The objective of the course is to give practical exposure to student about basic tools and techniques employed in recombinant DNA technology and genomics.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Students will be able to isolate and analyze plasmid vectors. | Technical |
| CO2 | Students will be cut and ligate DNA fragments/vectors with help of restriction enzymes and ligase. | Technical |
| CO3 | The students will be able to prepare competent cells | Technical |
| CO4 | The students will be able demonstrate bacterial transformation with given vectors | Technical |
| CO5 | Students will be able to perform genome annotations, gene and molecular marker prediction | Technical |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to rDNA laboratory, w.r.t. working bench, types of instruments and their handling, lab. Preparation of stock solutions of buffers for use in gel running, gel loading, their autoclaving; preparation of working buffers, antibiotic stocks, and storage of buffers required in rDNA practicals with detailed methodology | 4 |
| 2 | Plasmid DNA Preparation: Preparation of LB medium with and without antibiotics for the growth of bacterial cultures, Growth of *E. coli*, Isolation of Plasmid DNA, Electrtrophoresis of Plasmid DNA and Interpretation of results | 4 |
| 3 | Restriction of given plasmid or λ DNA with the restriction enzyme *Eco*RI and HindIII or any other Restriction Enzymes | 4 |
| 4 | To perform ligationof λ/*Eco*R I digest using T4 DNA Ligase Electrophoresis of the uncut and digested DNA and Interpretation of the results<br><br>Electrophoresis of ligated samples by agarose gel electrophoresis, Interpretation of the results | 4 |
| 5 | Preparation of competent cells of *E. coli* transformation | 4 |

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|---|---|---|
| **6** | Transformation of E.coli. DH5 α cells with Empty puc/ pcambia1301/and Confirmation of transformed cells by scoring the expression of LacZ gene. | 4 |
| **7** | DNASTAR MODULES | 4 |
| **8** | PRIMER Designing | 4 |
| **9** | Unknown Gene Prediction Tools and Packages | 4 |
| **10** | Molecular Markers Prediction (SSR and SNP) | 4 |
| **11** | Overview of Genomic Resources: Data retrieval and analysis | 4 |
| **12** | Tools for expression data analysis | 4 |
| **Total Lab hours** | | **48** |

**Suggested Books/Resources:**

1. Lab Manual.
2. Discovering Genomics, proteomics & bioinformatics. Second edition by A Malcolm Campbell, Davidson College; Laurie J. Heyer Davidson College ; With Foreword by Francis S. Collins
3. Virtual Lab

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (Cos) contribution to the ProgrammeOutcomes(Pos)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | **2.67** |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | **2.75** |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | **2.75** |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | **2.75** |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | **2.75** |
| **Average** | **3.00** | **3.00** | **3.00** | **3.00** | **3.00** | **2.00** | **2.00** | **2.80** | **3.00** | **3.00** | **2.00** | **3.00** | |

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# Structural Biology Lab

COURSE CODE: 18B17BI473

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** Thermodynamics and Chemical Processes, Microbiology

## Course Objectives:

1. To visualize, analyze and compare structures of proteins and nucleic acids (DNA), and their subunits.
2. To develop the ability to design, predict, analyze and compare the protein structures.

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understand the relationship between protein structure and its function. | Familiarity |
| CO2 | Understand the methods of characterizing protein's structure using X-ray and NMR methods | Familiarity |
| CO3 | Implementation of bioinformatics tools in understanding protein structures. Understanding the classification of protein databases. | Usage |
| CO4 | Introduction to protein engineering | Familiarity |
| CO5 | Understand the structural diversity in nucleic acids. | Familiarity |

## List of Experiments

| S.No | Description | Hours |
|---|---|---|
| 1 | Understanding Protein structures and Visualization | 2 |
| 2 | Drawing helical wheel for alpha helix | 2 |
| 3 | Using Rasmol and PyMOL for 3-D visualization | 2 |
| 4 | Analysis of protein-protein interaction and protein-DNA interaction | 2 |
| 5 | Advanced PyMOL usage | 2 |
| 6 | Use of PDBsum for structural analysis | 2 |
| 7 | Protein-Ligand interactions: LIGPLOT | 2 |
| 8 | Secondary structure prediction methods | 2 |
| 9 | PROSITE - Protein signature patterns | 2 |
| 10 | Understanding Ramachandran plots and X-Ray Crystallography | 2 |
| 11 | RNA secondary structure visualization | 2 |
| **Total Lab hours** | | **22** |

## Suggested Books/Resources:


1. Introduction to Protein Structure, Carl Branden and John Tooze, Garland Publishing Inc., New York
2. Bioinformatics: sequence and Genome Analysis, DW Mount, Cold Spring Harbor Laboratory Press,


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3. Creighton T.E. ed. Protein structure. A practical approach. (2004) Oxford University Press

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Structural Biology) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | **1.75** |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **2** |
| CO3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.75** |
| CO4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2** |
| CO5 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2** |
| Average | **2** | **2.6** | **2.6** | **2.6** | **2.6** | **1** | **1** | **1** | **2** | **2.4** | **0.6** | **2** | |

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# Programming Languages for Bioinformatics Lab

COURSE CODE: 18B17BI474

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** C, Object-oriented data structures.

**Course Objectives:**

1. To master programming skills in Perl and Python and implement those skills using BioPerl and BioPython.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Write and execute a script in Perl. | Usage |
| CO2 | Enable routine and module calls and their implementation using Bioperl. | Familiarity |
| CO3 | Able to formulate stepwise implementation of a Perl script (from developing a pseudo-code to execute a successful bug- free code) for a given problem in Bioinformatics | Usage |
| CO4 | Write and execute a script in Python. | Usage |
| CO5 | Enable routine and module calls and their implementation using Biopython. | Familiarity |
| CO6 | Able to formulate stepwise implementation of a Python script (from developing a pseudo-code to execute a successful bug- free code) for a given problem in Bioinformatics | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1. | Installing and learning how to run Perl, Good programming practices | 2 |
| 2. | File Handling | 2 |
| 3. | Understanding Sequences and Strings, Operation on Strings - Motif finding | 2 |
| 4. | Writing a subroutine and calling, Translation of DNA to Protein Sequences | 2 |
| 5. | Mutating a DNA sequence and generating a random DNA sequence | 2 |
| 6. | Reading from various file formats | 2 |
| 7. | Installing Bioperl, Translation of DNA to Protein Sequences using Bioperl | 2 |
| 8. | Reading and Parsing PDB files using Bioperl | 2 |
| 9. | Automating BLAST and Parsing BLAST Output using Bioperl | 2 |
| 10. | Python File handling | 2 |
| 11 | Gene Expression Analysis with Python | 2 |
| 12 | Using BioPython – Part I | 2 |
| 13 | Using BioPython – Part II | 2 |

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| Total Lab hours | 26 |
|---|---|

**Suggested Books/Resources:**


1. Pauline M. Doran, "Bioprocess Engineering Principles" 8th ed., Academic press, New York, 2003.
2. M.L. Shuler and F. Kargi, "Bioprocess Engineering--basic Concepts", 2nd Edn. Prentice-hall Of India Pvt Ltd (2008).
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Â Elsevier India Pvt Ltd. (2007).


**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Scripting Language for Bioinformatics

COURSE CODE: 18B11BI512

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

**Pre-requisite:** Basic programming principal

## Course Objectives:

1. To apply, and develop scripting languages codes and implement them towards the analysis of biological data. Additionally to Develop web based applications for the problems in biology. All students will be able to develop their own websites.

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Able to apply design principles to develop web based applications specially for biological data analysis | Familiarity |
| CO-2 | To understand working on world wide web through implementations | Familiarity and Assessment |
| CO-3 | Use various methods from computational biology to implement their programmatic versions | Assessment |
| CO-4 | Able to design new web pages and web sites | Assessment and Usage |
| CO-5 | Able to developed programs to describe and analyze problems in biology | Assessment and Usage |

## Course Contents:

| Unit | Contents | Lecture Hours |
|---|---|---|
| 1 | Introduction to Internet and World Wide Web. An overview of scripting languages, with applications towards biological data and sequence analysis. Complexity of DNA problems and their computational implications and applications. Introduction to HTML, DHTML, XML. accessing different objects of the HTML page, Dynamic page generation, Cascading Style Sheets (CSS). | 12 |
| 2 | JAVASCRIPT: Document object model, Elements of the document object model, basic principles of JS, object based programming using JavaScript; data types and structures, array and string handling, function implementations, XML: DTD, XML schemas, XML document structure, retrieving data from database in XML format; various bio based versions of XML. | 10 |
| 3 | PHP: PHP beginning to advanced level, data types, array and string handling, mathematical expressions and functions in PHP, PHP programming (implementation of object model), Database connectivity using PHP. | 12 |

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| | | |
|---|---|---|
| 4 | Hands-on practice on above mentioned programming languages. Implementation of programming skills for solving problems in biology. Development of bioinformatics based small applications and web based applications. | 8 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. HTML the complete reference, 2004, TMH.
2. Beginning PHP and Professional PHP, 2009, Wrox, Wiley Dreamtech.
3. JavaScript: The complete Reference, 2004, TMH.

**Suggested Reference Book(s):**

1. Biological Sequence Analysis: Probabistic models of proteins and nucleic acids (1998) Durbin R., et al, Cambridge University press.
2. Many other reference and text books on these scripting languages available in the library.

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Scripting Languages for Bioinformatics) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 2 | **2.08** |
| CO-2 | 3 | 2 | 2 | 2 | - | - | - | 1 | - | 1 | 2 | 2 | **1.88** |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | - | 2 | **2.09** |
| CO-4 | 3 | 3 | 3 | 1 | - | - | - | - | 2 | 2 | 2 | 1 | **2.13** |
| CO-5 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | - | 1 | **2.00** |
| Average | **2.8** | **2.4** | **2.2** | **2.2** | **2** | **2** | **1.5** | **1** | **2.33** | **1.6** | **2.33** | **1.6** | |

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# Scripting Language for Bioinformatics Lab

COURSE CODE:18B17BI572

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Basic concepts in programming

**Course Objectives:**

1. To apply, and develop scripting languages codes and implement them towards the analysis of biological data.
2. Additionally to develop web based applications.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | To understand working on world wide web through implementations for client and server side programming | Familiarity |
| CO2 | Able to developed programs to describe and analyze problems in biology. | Assessment |
| CO3 | Able to design new web pages and web sites. | Assessment |
| CO4 | To understand coordination of HTML, Java Script and PHP. | Assessment |
| CO5 | Able to develop web based applications especially for biological data analysis. | Assessment and Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction to HTML, DHTML, XML and accessing different objects of the HTML page and dynamic page generation. | 2 |
| 2 | HTML code for basic understanding of the syntax including the use of nesting of lists. | 2 |
| 3 | HTML code for creating a webpage including hyperlinks and images. | 2 |
| 4 | Construction of DTD schema,a sample xml document to represent evolutionary tree. | 2 |
| 5 | Construction of XML schema, a sample xml document to represent a pathway. | 2 |
| 6 | Implementation of Session, request, report objects in an ASP application. | 2 |
| 7 | Create a MySql/ MSacessesdatabase tables and execute all SQL queries. | 2 |
| 8 | Development of a PHP program to take set of sequences and find out conserved sequences. | 2 |
| 9 | Write a PHP program to construct a pathway. | 2 |
| 10 | Write a PHP program to connect mysql database and execute all SQL commands. | 2 |
| 11 | Construct a PHP interface for a given ER model. | 2 |
| 12 | Write a PHP program to find out ORFs existing in a given genomic sequence. | 2 |

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| | | |
|---|---|---|
| 13 | Write a PHP program to find out annotation and sequence from a fasta file | 2 |
| **Total Lab hours** | | **26** |

**Suggested/Resources:**


a. A P Thomas: HTML the complete reference, 2nd Edition, TMH, 2004.
b. A P Thomas, F Schneider: JavaScript: The complete Reference, 2nd Edition, TMH, 2004.
c. D W Mercer *et al*: Beginning PHP and Professional PHP, Wrox, Wiley Dreamtech, 2009.
d. R Durbin *et al*: Biological Sequence Analysis: Probabistic models of proteins and nucleic acids, Cambridge University press, 1998.


**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assesment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 2 | **2.08** |
| CO2 | 3 | 2 | 3 | 2 | 1 | - | - | 1 | - | 1 | 2 | 3 | **2.00** |
| CO3 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | - | 2 | **2.09** |
| CO4 | 3 | 3 | 3 | 1 | - | 1 | - | - | 2 | 2 | 2 | 2 | **2.11** |
| CO5 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | - | 1 | **2.00** |
| **Average** | **2.6** | **2.4** | **2.2** | **2.2** | **2** | **1.75** | **1.5** | **1** | **2.33** | **1.8** | **2.33** | **2** | |

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# Structural Bioinformatics Lab

COURSE CODE:18B17BI573

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

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**Pre-requisite:** Structural Biology

**Course Objectives:**

To develop the ability to design, predict, analyze and compare the protein structures as well as predict the function of target proteins.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Understanding the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.) | Familiarity |
| CO2 | To Understand and use structural databases and software for structure visualization | Familiarity |
| CO3 | To understand the algorithms used in Structure determination and quality assessment | Assessment |
| CO4 | To perform protein structure comparison and the hierarchical nature of biomacromolecular structure classification | Usage |
| CO5 | To understand the methodology of protein structure prediction and assessment | Assessment |
| CO6 | To understand the methodology of sequence- and structure-based functional site prediction | Assessment |

**List of Experiments:**

| S.No | Description | Hours |
|---|---|---|
| 1 | Homology modeling using Swiss-Modeller and Modeler standalone software | 2 |
| 2 | Searching and analyzing SCOP and CATH database; analysis of protein structure (protein ligand and protein-protein complexes) using pdbsum, ligplot and dimplot | 2 |
| 3 | Prediction protein secondary structure using above methods and comparison, calculating Q3 value and SOV score. | 2 |
| 4 | Prediction of tertiary structure of protein sequences (using Modeller and GenThreader) | 2 |
| 5 | Error estimation and precison of predicted protein structures (Procheck, What IF, Errat, Verify3D, etc.) | 2 |
| 6 | Comparing protein structures (using CE, DALI, Comparer, SARF2, SSAP, VAST) and statistical analysis of results | 2 |
| 7 | Secondary structure assignment of protein structure using DSSP, STRIDE, DEFINE and P-Curve and statistical analysis of results | 2 |

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| | | |
|---|---|---|
| 8 | Predicting structural domains (using PRODOM) and binding sites (acSite, SiteMatch, SiteFinder, etc.) | 2 |
| 9 | Ab initio prediction of various energy components of protein structure and validation of structure | 2 |
| 10 | Prediction of PBSA and GBSA energy components using molecular simulation technique | 2 |
| 11 | Filling of gaps in protein structure, energy minization and validation of protein structure | 2 |
| 12 | Setting of MD simulation job of protein structure, interpretation of results and refinement of structure. | 2 |
| **Total Lab hours** | | **24** |

**Suggested/Resources:**

1. Structural Bioinformatics (2nd Edition), Jenny Gu (Editor), Philip E. Bourne (Editor)
2. D.W. Mount Bioinformatics: Genome and Sequence Analysis: (2001) Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Molecular Modeling: Principles & Applications, Andrew R. Leach, Prentice Hall

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **2.25** |
| **Average** | **2.67** | **2.83** | **2.80** | **2.80** | **2.60** | **2.20** | **1.20** | **1.00** | **1.00** | **1.00** | **1.20** | **1.40** | |

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# Machine learning for Bioinformatics

COURSE CODE:18B11BI611

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Molecular biology, Python

**Course Objectives:**

1. Learn what is machine learning
2. Learn algorithms used in machine learning.
3. Learn how to implement machine learning for biological problems.
4. Apply machine learning to practical projects.
5. Use machine learning and data mining in one project.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Different types of machine learning and its utility in bioinformatics | Familiarity |
| CO-2 | Application of Hidden Markov Model and Artificial neural networks to different types of bioinformatics data | Assessment |
| CO-3 | Determination of Bayesian Network (BN) from expression data. | Assessment |
| CO-4 | Application of symbolic machine learning (SML) methods to predict cleavage site of HIV- protease from training data of positive and negative cases. | Assessment |
| CO-5 | Optimization of weights in a supervised and unsupervised neural network, and application of supervised learning to predict sub- cellular localization of a protein. | Assessment |
| CO-6 | Application of stochastic context-free grammar (SCFG) to predict RNA secondary structure. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Overview of intelligent systems and machine learning | 1 |
| 2 | **Hidden Markov Model (HMM):** Viterbi algorithm, Forward algorithm, | 10 |
| | Backward algorithm, Profile-HMM, Baum-Welch algorithm to optimize HMM-profile, Multiple alignment and database searching using profile- HMM | |
| 3 | **Symbolic Machine Learning:** Nearest neighbour approach to predict secondary structure, Decision tree methods, Identification tree methods | 6 |
| 4 | **Bayesian Network (BN):**Calculation of statistical significance by using Bayesian methods, Factorization and Markov blanket rule, d-separation, Equivalence classes, Learning of Bayesian network, Learning of Gaussian network | 9 |
| 5 | **Artificial Intelligence (AI):**Search strategies, logic, deduction, and pathways comparison | 4 |

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| | | |
|---|---|---|
| 6 | **Artificial Neural Network (ANN):**Basics and introduction to terminologies, Supervised and non-supervised learning, Feed forward back propagation error method, Application of ANN methods: Protein sub-cellular localization and secondary structure prediction | 7 |
| 7 | **Stochastic Context Free Grammar (SCFG):**Transformational grammar, Parsing, Chomsky hierarchy (regular, context-free, context-sensitive, and unrestricted grammar), Automata, Context-free grammar, Application of SCFG for prediction of secondary structure of RNA | 5 |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**

a. R. Durbin, S. Eddy, A. Krogh, and G. Mitchison (1998), Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press
b. Edward Keedwell and Ajit Narayanan (2005), Intelligent Bioinformatics: The Application of Artificial Intelligence Techniques to Bioinformatics Problems, Wiley
c. P Baldiand S Brunak, BIOINFORMATICS: The Machine Learning Approach

**Suggested Reference Book(s):**


1. Olson et al., 2018. Data-driven advice for applying machine learning to bioinformatics problems
2. Husmeier D, Dybowski R, and Roberts S (2005), Probabilistic Modeling in Bioinformatics and Medical Informatics, Springer
3. Nat Cell Biol. 2001 Aug;3(8):E190-5. Review. PubMed PMID: 11483980
4. Kim JB, Porreca GJ, Song L, Greenway SC, Gorham JM, Church GM, Seidman CE, Seidman JG. Polony multiplex analysis of gene expression (PMAGE) in mouse hypertrophic cardiomyopathy. Science. 2007 Jun 8;316(5830):1481-4. PubMed PMID: 17556586
5. MacBeath G, Schreiber SL. Printing proteins as microarrays for high-throughput function determination. Science. 2000 Sep 8;289(5485):1760-3. PubMed PMID: 10976071.
6. Shankar J, Wu TD, Clemons KV, Monteiro JP, Mirels LF, et al. (2011) Influence of 17b-Estradiol on Gene Expression of Paracoccidioides during Mycelia-to- Yeast Transition. PLoS ONE 6(12): e28402. doi:10.1371/journal.pone.0028402
7. Mary V. Relling, William E. Evans Nature. Author manuscript; available in PMC 2016 Jan 13.
8. Published in final edited form as: Nature. 2015 Oct 15; 526(7573): 343–350. doi: 10.1038/nature15817


**Other useful resource(s):**

1. Link to NPTEL course contents:https://nptel.ac.in/courses/106104019/
2. Link to topics related tocourse:
   i. https://www.advancedsciencenews.com/machine-learning-for-bioinformatics-and-neuroimaging/
   ii. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_neural_networks.htm
   iii. https://www.analyticsvidhya.com/blog/2017/09/understaing-support-vector-machine-example-code/

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

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**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| Course outcomes (Machine learning for Bioinformatics) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | **1.92** |
| CO-2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | **1.75** |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | - | 2 | 2 | **1.73** |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | - | 2 | **1.73** |
| CO-5 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | - | - | 2 | **1.7** |
| CO-6 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | - | - | - | 2 | **1.67** |
| Average | **2.0** | **2.0** | **2.0** | **2.0** | **2.0** | **1.16** | **1.16** | **1.33** | **2.0** | **2.0** | **1.33** | **2.0** | |

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# Computer Aided Drug Design

COURSE CODE: 18B11BI612

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To design potential lead molecules against any disease that may be explored further as a potential candidate for the drug development.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Feasibility study of a drug development project | Familiarity |
| CO-2 | Design and optimize lead molecules against drug target, and using ligand-basedapproach | Usage |
| CO-3 | Determination of pharmacophore from lead molecules and active sites and use ofpharmacophore for lead discovery | Usage |
| CO-4 | Development of potential drug molecule and pharmacophore databases for virtualscreening | Assessment |
| CO-5 | Use of molecular fragments for lead discovery and implementation of statisticalapproaches for lead molecule discovery | Usage |
| CO-6 | Bioavailability prediction of a drug and working capability in drug designing softwarelike, Discovery Studio and molecular dynamics software like AMBER 8.0, On-line tools, etc. | Assessment |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Drug design: A billion dollar baby and drug design techniquesteam work, Economic factors involved in drug design, Irrational vs. | 4 |
| | rational approaches, Drug target identification & computer-aided drug design processes, Case study related to drug target identification (Viral Targets -HIV Example) | |
| 2 | **Computational Approaches to Drug Design:** Structure-based (receptor fitting)and ligand-based (receptor mapping) molecule design, lead molecules design in a research environment (crossing the barriers), tools used in both environments | 3 |
| 3 | **Receptor Fitting (Lead discovery& refinement)**: Utility, Binding-site predictions: Stereoelectronic factors, receptor flexibility, tight binding; Docking: Introduction, search algorithms, scoring (MM, Grid, etc.), validation of results, comparisons of search and scoring methods; Docking processes and analysis of results; *De novo* design, database searching & high throughput virtual screening(HTVS); and applications. Introductions to docking & molecular modeling packages (DS Studio; Schrodinger Inc, Ligbuilder, etc.) | 9 |
| 4 | **Receptor Fitting (Lead optimization)**: Molecular simulation methods used for binding and free energy calculation, Calculation on Free Energy Perturbation(FEP) of 1. Thermolysin with 2 ligands, Molecular mechanics Poisson-Boltzmann surface area methods: molecular basis of HIV protease drug | 4 |

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| | | |
|---|---|---|
| | resistance | |
| 5 | **Receptor Mapping (Pharmacophore)**: The pharmacophore concept, Determination of pharmacophore from a set of active molecules, Design of pharmacophore using various algorithms, Creating pharmacophore model from active site, Practical utility (searching compound databases) and A case study of new lead design | 5 |
| 6 | **Chemoinformatics:** Introduction, representing 2D & 3D structures, 2D chemical database applications & molecular descriptors and their classifications, database searching and applications in CADD | 4 |
| 7 | **Receptor Mapping (Quantitative structure activity relationship (QSAR))**: QSAR methodology, biological and physicochemical parameters, feature selection(PLS, PCA, MLR, etc.), model building and validation, QSAR applications in drug design, Quantitative structure-property relationships (QSPR), CoMFA, 3D and nD-QSAR methods | 6 |
| 8 | **Fragment-based Lead Discovery**: Fragment and substructure discovery and evaluation, virtual fragment scanning (trends, applications and web-based tools) & capture methods for fragment-based discovery | 4 |
| 9 | **ADMET**: Oral bioavailability, drug half-life in the bloodstream, BBB permeability, toxicity, Lipinski rule of five, The impact of physiochemical properties on the control of drug-like properties. | 4 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**


1. David C Young : Computational Drug Design (A guide for computational and medicinal chemists) Wiley & Sons, Inc., New Jersey, USA
2. Holtje H.-D, Sippl W., Rognan D. and FolkersG. : Molecular Modeling, Basic Principles and Applications Wiley-VCHGmbH& Co. KGaA
3. Leach AR : Molecular Modeling: Principles and Applications: Prentice Hall, Edinburg UK.
4. Zartler ER & Shapiro MJ : Fragment-based Drug Discovery (A practical approach), Wiley & Sons, Inc., West Sussex, UK Flower DR : Drug design: cutting edge approaches, RSC publication, Cambrige, UK


**Suggested Reference Book(s):**


1. Merz KM, D Ringe, : Drug Design: Structure and Ligand-based Approaches. Reynolds CH Cambridge University Press
2. Opera TI :Chemoinformatics in Drug Discovery, Wiley-VCH, GMBH
3. Hubbard RE : Structure-based drug discovery (An overview), RSC publication, Cambrige, UK


**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes & Attendance |

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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| C06 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Machine learning for Bioinformatics Lab

COURSE CODE:18B17BI671

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. Develop an understanding of important concepts and their implementation in machine learning in the context of biological problems.
2. Implementation in machine learning in the context of biological problems

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Implementation of KNN using Perl/Python | Assessment |
| CO2 | Implementation of ANN using Perl/Python | Assessment |
| CO2 | Application of Hidden Markov Model for CpG island prediction | Assessment |
| CO3 | Application of HMMER package and Pfam database | Assessment |
| CO4 | Application of Transformational Grammars in bioinformatics | Assessment |
| CO5 | Application of SVM in bioinformatics | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Calculation of sensitivity, specificity, accuracy for a given classifier | 2 |
| 2 | Implementation of crisp KNN for a microarray file | 2 |
| 3 | Implementation of fuzzy KNN for a microarray file | 2 |
| 4 | Identification tree construction using See5 and Weka | 2 |
| 5 | Implementation of perceptron on LOGIC GATES | 2 |
| 6 | Calculation of AAC and DPC for SVM and ANN input files | 2 |
| 7 | Calculation of pseudo amino acid composition | 2 |
| 8 | Implementation of ANN using SNNS software | 2 |
| 9 | Implemenation of SVM using SVM-light, LIBSVM and Weka | 2 |
| 10 | Implementation of HMM for prediction of CpG islands | 2 |
| 11 | HMM using HMMER package | 2 |
| 12 | Stochastic context free grammar | 2 |
| **Total Lab hours** | | **24** |

**Suggested/Resources:**

1. http://hmmer.org/.
2. https://www.cs.waikato.ac.nz/ml/weka/https://nptel.ac.in/courses/106104019/26
3. https://www.rulequest.com/download.html

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**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | **2.00** |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | **2.00** |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | **1.83** |
| **Average** | **2.67** | **2.83** | **2.80** | **2.80** | **2.60** | **2.20** | **1.20** | **1.00** | **1.00** | **1.00** | **1.20** | **1.40** | |

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# Computer Aided Drug Design Lab

COURSE CODE: 18B17BI672

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. To design potential lead molecules against any disease that may be explored further as a potential candidate for the drug development.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Feasibility study of a drug development project | Familiarity |
| CO2 | Design and optimize lead molecules against drug target, and using ligand-basedapproach | Usage |
| CO3 | Determination of pharmacophore from lead molecules and active sites and use ofpharmacophore for lead discovery | Usage |
| CO4 | Development of potential drug molecule and pharmacophore databases for virtualscreening | Assessment |
| CO5 | Use of molecular fragments for lead discovery and implementation of statisticalapproaches for lead molecule discovery | Usage |
| CO6 | Bioavailability prediction of a drug and working capability in drug designing softwarelike, Discovery Studio and molecular dynamics software like AMBER 8.0, On-line tools, etc. | Assessment |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Installation of various drug design software and assignment 'Project' | 2 |
| 2 | Generation of 3D optimized structure of a "Ligand" molecule | 2 |
| 3 | Preparation of target and ligand molecules for docking | 2 |
| 4 | "Virtual library Preparation" of lead molecules | 2 |
| 5 | Docking of ligands into a receptor (active site) | 2 |
| 6 | Flexible docking of ligand with target | 2 |
| 7 | Fragment docking using '*De Novo*' Receptor and '*De Novo*' Links (LUDI algorithm) | 2 |
| 8 | Pharmacophore modeling of ligands | 2 |
| 9 | Pharmacophore-based database searching and *de novo* design of ligand against an active site | 2 |
| 10 | Development of 3D QSAR model by using "Discovery Studio" | 2 |
| 11 | ADME property and toxicity predictions of lead molecule (using TOPKAT) | 2 |
| 12 | Energy minimization and molecular dynamics (MD) target molecule by using"Simulation" module of "Discovery Studio" | 2 |
| 13 | Estimates binding free energy of ligands and receptor using CHARMmimplicitsolvation models | 2 |
| **Total Lab hours** | | 26 |

**Suggested Books/Resources:**

1. David C Young : Computational Drug Design (A guide for computational and medicinal chemists) Wiley & Sons, Inc., New Jersey, USA.

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2. Holtje H.-D, Sippl W., Rognan D. and FolkersG. : Molecular Modeling, Basic Principles and Applications Wiley-VCHGmbH& Co. KGaA
3. Leach AR : Molecular Modeling: Principles and Applications: Prentice Hall, Edinburg UK.
4. Accelrys: User Manuals Discovery Studio.
5. AMBER : AMBER 11 Users' Manual, Scripps Research Institute, USA
6. GROMACS:Gromacs User Manual

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2.00 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2.00 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| CO6 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.25 |
| Average | 2.67 | 2.83 | 2.80 | 2.80 | 2.60 | 2.20 | 1.20 | 1.00 | 1.00 | 1.00 | 1.20 | 1.40 | |

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# Advanced Algorithms for Bioinformatics Lab

COURSE CODE:18B17BI673

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Basics of algorithms and programming, data structures. Some knowledge of object-oriented technology and is also desirable

**Course Objectives:**

1. Develop the ability to design, implement and manipulate algorithms.
2. Develop computer programs for Bioinformatics solutions to life and health science problems.
3. Apply programming concepts to various biological examples and real life applications.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | Able to understand algorithmic principles | Familiarity |
| CO2 | To write programs for specific computational biology problems | Assessment |
| CO3 | Analyze problems in biology and able to design new protocols and algorithms for biological data analysis | Assessment |
| CO4 | Able to analyze biological data through programs | Assessment |
| CO5 | Implement algorithms for bioinformatics problems and their assessments | Assessment and Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Program to solve the US change problem. | 2 |
| 2 | Program to deal with Tower of Hanoi problem. | 2 |
| 3 | Program to generate Fibonacci series using recursive algorithm and few other programs. | 2 |
| 4 | Program to generate distinct sub-strings in a given DNA sequence using combinatorial and other methods. | 2 |
| 5 | Program to generate palindrome of a string and for a nucleotide sequence, translation and reverse translation, find out the GC content in a sequence. | 2 |
| 6 | Program to implement dynamic programming to solve local, semi-global, and global alignment of biological sequences. | 2 |
| 7 | Program to generate redundant nucleotide sequences from given amino acid sequence using standard genetic code system and ambiguous character codes. | 2 |
| 8 | Implementation of fragment assembly algorithms to make contigs. | 2 |
| 9 | Program to predict genes using statistical approaches. | 2 |
| 10 | Program to predict genes using similarity based approaches. | 2 |
| 11 | Program to generate restriction map of DNA sequence using Brute force algorithm. | 2 |

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| | | |
|---|---|---|
| 12 | Program to generate restriction map of DNA sequence using PDP (Partial Digest Problem) algorithm. | 2 |
| 13 | Motif finding algorithms implementations in DNA and Protein sequences. | 2 |
| 14 | RNA structure algorithms and their implementations. | 2 |
| **Total Lab hours** | | **28** |

**Suggested/Resources:**


a. P A Pevzner: Computational Molecular Biology: An algorithmic approach,PHI, 2004.
b. N C Jones and P A Pevzner: An Introduction to Bioinformatics Algorithms, Ane Books, 2004.
c. G. Benson and R. Page: Algorithms in Bioinformatics, Springer Verlag, 2004.
d. C J Date: An Introduction to Database Systems, Addison-Wesley Longman Publishing Co., USA, 1990.
e. I IMandoiu and A Zelikovsky: Bioinformatics Algorithms: Techniques and Applications, Wiley Interscience Press, 2008.
f. R Durbin*et al*: Biological Sequence Analysis: Probabistic models of proteins and nucleic acids, Cambridge University press, 1998.


**EvaluationScheme:**

| | | |
|---|---|---|
| 1. | Mid Sem. Evaluation | 20 Marks |
| 2. | End Sem. Evaluation | 20 Marks |
| 3. | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | **2.17** |
| CO2 | 3 | 2 | 3 | 2 | 1 | - | - | - | 1 | 1 | 2 | 3 | **2.00** |
| CO3 | 2 | 2 | 2 | 2 | 3 | 2 | - | 1 | 2 | 3 | - | 1 | **2.00** |
| CO4 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | - | 2 | 2 | 2 | 2 | **1.91** |
| CO5 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 1 | **2.00** |
| **Average** | **2.4** | **2.2** | **2.2** | **2.2** | **1.8** | **1.75** | **1.5** | **1** | **2** | **2** | **2.25** | **2** | |

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# R Language Lab

COURSE CODE:18B17BI674

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** Basic concepts in programming

**Course Objectives:**

1. Students will learn how to program in R and how to use R for effective data analysis.
2. Students will learn how to install and configure software/packages necessary for a statistical programming environment; discuss generic programming language concepts as they are implemented in a high-level statistical language.
3. The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, and organizing and commenting R code.
4. Topics in statistical data analysis and optimization will provide working biological and real life examples.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO 1 | Able to apply various approaches in R Software and tools to understand concept of Statistics | Familiarity |
| CO 2 | Use various programming techniques in R to implement algorithmic methods from computational biology to describe and analyze problems in biology | Familiarity and Assessment |
| CO 3 | Implement various packages of R for their application in bioinformatics | Assessment |
| CO 4 | To understand Bioconductor and its association with Bioinformatics | Assessment |
| CO 5 | To apply R with universal features through available packages | Usage |

**List of Experiments**

| S.No | Description | Hours |
|---|---|---|
| 1 | Introduction of R and R-studio, overview and History of R. | 2 |
| 2 | R-console input and evaluation, Data Types, Basic Arithmetic operation. | 2 |
| 3 | Reading Tabular data and large tables: File handling. | 2 |
| 4 | Textual data formats, Connection: interface to outside world. | 2 |
| 5 | Sub setting- Basics, lists, Matrices, Partial matching, Removing missing values | 2 |
| 6 | Vectorized operations. | 2 |
| 7 | Control structure- introduction, if-else, for loops, while loops, Repeat, Next, Break. | 2 |
| 8 | R-functions, Loop function and debugging. | 2 |
| 9 | Scoping Rules- Symbol binding, rules and optimizing examples, Coding standardDates and times. | 2 |
| 10 | Bioconductors: Introduction. | 2 |
| 11 | Simulation in R- str function, Generate random numbers, Simulating linearModels, Random sampling. | 2 |
| 12 | R-profiler- collect detailed information on how your R functions are running and to identify bottlenecks that can be addressed. The profilers is a key tool in helpingYou optimize your programs. | 2 |
| 13 | Bioconductors package usage for analysis of genomic data - I | 2 |
| 14 | Bioconductors package usage for analysis of genomic data - II | 2 |
| Total Lab hours | | 28 |

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**Suggested/Resources:**

1. An Introduction to R
2. Quick-R
3. R for Beginners
4. Kim Seefeld's R-introduction for Biostatistics
5. P Dalgaard:Introductory Statistics with R, 2nd Edition, Springer Nature, 2008.
6. W P Krijnen: Applied Statistics for Bioinformatics using R, 2009.
7. R Gentlemen: R programming for Bioinformatics, CRC Press, 2008.

**EvaluationScheme:**

| | | |
|---|---|---|
| 1 | Mid Sem. Evaluation | 20 Marks |
| 2 | End Sem. Evaluation | 20 Marks |
| 3 | Lab Assessment | 60 Marks |
| | Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 2.33 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | - | - | 1 | 1 | 2 | 3 | 2.00 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 2 | 2.08 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 3 | 3 | 2 | 2.27 |
| CO5 | 3 | 2 | 2 | 2 | 2 | 2 | - | 1 | 1 | 2 | 2 | 3 | 2.00 |
| Average | 2.8 | 2.4 | 2.4 | 2.4 | 2 | 1.6 | 1.33 | 1 | 2 | 2.2 | 2.2 | 2.6 | |

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# Bioenergy and Biofuels

COURSE CODE: 18B1WBT634

COURSE CREDITS: 3

~~CORE/ELECTIVE: ELECTIVE~~

L-T-P: 3-0-0

**Pre-requisite:** Microbiology, Bioprocess Engineering, Downstream Processing, Bioresource Technology

**Course Objectives:**

The shortage of fossil fuels and its environmental consequences, Bioenery and Biofuel technology seems to be a alternative for generation of energy and fuels. This sector facing various technical, process and social problems for implementation. Based on these aspects the objectives of the course are framed as

1. Introduction of existing and possible Bioenergy and Biofuels technoloies
2. Discussion of technical, process and economic issues related to first, second and third generation biofuels along with Physico chemical techniques

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Advantages and disadvantages of Bioenergy and Biofuels over fossil fuels | Familiarity |
| CO-2 | Technical barriers in Bioenergy and Biofuel Technology | Assessment |
| CO-3 | Whole biorefinery approaches for economical implementation into the market | Usage |
| CO-4 | Conversion technologies of waste to Biofuels, Bioproducts, and Bioenergy | Usage |
| CO-5 | Conversion of waste and Mixed feedstock to Biofuels, Bioenergy and Bioproducts | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Biofuels and Bioenergy:** Definition, Global Energy Outlook, Sustainability, Biomass Feedstocks, Processes and Technologies, Environment and Ecology | 4 |
| 2 | **Crop Oils, Biodiesel, and Algae Fuels:** Vegetable Oils, Algae Oil Extraction of Straight Vegetable Oil, Manufacture of Biodiesel | 12 |
| 3 | **Ethanol from Corn and Lignocellulosics:** Fuel Ethanol from Corn, Corn Ethanol as Oxygenated Fuel, Chemistry of Ethanol Fermentation, Corn-to-Ethanol Process Technology, By- Products/Coproducts of Corn Ethanol, Ethanol as Oxygenated and Renewable Fuel, Ethanol Vehicles, Lignocellulose and Its Utilization, Lignocellulose Conversion, Agricultural Lignocellulosic Feedstock, Cellulosic Ethanol Technology; Energy Balance for Ethanol Production from Biomass, Process Economics and Strategic Direction. | 12 |
| 4 | **Fast Pyrolysis and Gasification of Biomass:** Biomass and Its Utilization, Analysis and Composition of Biomass, Chemistry of Biomass Gasification, Fast | 7 |

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| | | |
|---|---|---|
| | Pyrolysis of Biomass, Biomass Gasification Processes, Utilization of Biomass Synthesis Gas | |
| 5 | **Conversion of Waste to Biofuels, Bioproducts, and Bioenergy & Mixed Feedstock:** Types of Waste and Their Distributions, Strategies for Waste Management, Waste Preparation and Pretreatment for Conversion, Technologies for Conversion of Waste to Energy and Products, Economic and Environmental Issues Related to Waste Conversion, Future of the Waste Industry, Advantages and Disadvantages of Mixed Feedstock, Transportation, Storage, and Pretreatment, Gasification Technologies, Liquefaction Technologies, Future of Mixed Feedstock. | 7 |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**

1. Biofuels and Bioenergy: Processes and Technologies by Sunggyu Lee and Y. T. Shah, CRC Press
2. Bioenergy and Biofuel from Biowastes and Biomass by Samir K. Khanal, Rao Y. Surampalli, Tian C. Zhang, Buddhi P. Lamsal, R. D. Tyagi and C.M. Kao, ASCE Publishers .

**Suggested Reference Book(s):**

1. Review and research articles from Science Direct, Springer, Wiley and PubMed Publishers

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment, Quizzes&Attendance |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 2.17 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | - | 3 | 2.27 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2.42 |
| CO5 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2.58 |
| Average | 3.00 | 3.00 | 3.00 | 3.00 | 1.40 | 2.20 | 1.60 | 2.40 | 1.60 | 2.00 | 1.00 | 3.00 | |

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## Interpersonal Dynamics, Values and Ethics

### Course Goal

This course is designed to help students understand the importance of values in their development as professionals and responsible citizens. This starts with developing an understanding of their own needs and wants what they 'really want to be' in their life and profession. This understanding of oneself then leads to understanding others better so that effective personal and professional relationships can be built. The moment a student enters the workplace they are confronted with organizational values and ethical dilemma. This course helps facilitate the students to understand harmony at all the levels of human living, and live an ethical and happy life.

### Course Objectives

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Appreciate the relationship between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the value of harmonious relationship based on trust and respect in their life and profession
4. Understand the role of a human being in ensuring harmony in society and nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

### Detailed Syllabi
### Lecture-wise Breakup

| | | | |
|---|---|---|---|
| **Subject Code** | 18B11H5311 | **Semester** | III |
| **Subject Name** | Interpersonal Dynamics, Values and Ethics | | |
| **Credits** | 3 | **Contact Hours** | 3 |

| Module No. | Subtitle of the Module | Topics | No. of Lectures |
|---|---|---|---|
| 1. | Human Values | Definition and classification of values: Extrinsic values, Universal and Situational values, Physical, Environmental, Sensuous, Economic, Social, Aesthetic, Moral and Religious values.<br>The Problem of Sustenance of value in the process of Social, Political and technological change.<br>*Case Study 3 The Three Mile Island Disaster* | 5 |
| 2. | Understanding Individual | Understanding and Managing Yourself: Human Relations and You: Self-Esteem and | 5 |

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| | | | |
|---|---|---|---|
| | Differences, perceptions and attributions | Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes and Happiness; Problem Solving and Creativity. | |
| **3.** | Leadership and Motivation | Dealing Effectively with People: Communication in the Workplace, Becoming an Effective Leader; Motivating Others and Developing Teamwork | 5 |
| **4.** | Developing and leading teams | Tactics for Getting Along with Others in the Workplace; Managing Conflict; Specialized Diversity and Cross-Cultural Competence. | 4 |
| **5.** | Interpersonal Dynamics in practice | Self confidence and attitude building, Social and Professional etiquettes (To be conducted on workshop mode with the help of role plays, GDs, self and peer appraisal and class demonstrations. Performance to be evaluated for internal assessment) | 6 |
| **6.** | Engineering Ethics | History, Recent developments and General principles. *Case Study 1 Space Shuttle Challenger* | 4 |
| **7.** | Engineering as Social Experimentation | Engineer as experimenter, Responsibility in experimentation. | 3 |
| **8.** | Engineers' Responsibility for Safety and Risk | Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination *Case Study 2 Bhopal Gas Tragedy* | 4 |
| **9.** | Global Issues | Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility *Case Study 4 The Chernobyl Disaster* | 4 |
| **10.** | Ethical Audit | Need for and ethics audit, Procedure, Best practices | 2 |



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| | |
|---|---|
| **Total number of Lectures** | 42 |

| **Recommended Reading** | |
|---|---|
| **1.** | Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2016. |
| **2.** | Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 |
| **3.** | Stephen P. Robbins, Timothy A. Judge, Organizational Behavior, Pearson Education, 15th, 2015 |
| **4.** | Ken Blanchard, Spencer Johnson, The New One-Minute Manager, HarperCollins Publishers Limited, 2015 |
| | • Institution of Engineers (India): Sample Codes of Ethics<br>• Acm Code of Ethics and Professional Conduct |
| **websites** | • www.onlineethics.org<br>• www.nspe.org<br>• www.globalethics.org<br>• www.ethics.org |

**Methodology & Evaluation Scheme**

| Methodology to be used | | Lectures, Case discussions, Group discussions on contemporary issues and group presentations | |
|---|---|---|---|
| Evaluation | | | |
| Theory | | Internal assessment | 25% |
| Test 1 | 15% | Attendance | 5% |
| Test 2 | 25% | Class participation in case discussion and group discussions | 10 % |
| Test 3 | 35% | Group Presentation | 10% |

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# Finance and Accounting

COURSE CODE: 18B11HS411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. Understand the issues and framework of accounting and corporate finance.
2. Prepare financial statements.
3. Analyze financial statements using different techniques.
4. Analyze projects, its financial needs, financial performance and design a suitable strategy in case of conflicting recommendations.
5. Make optimal financial decisions on sustainable basis, not only for the firm but also for the society at large.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understand the basic concepts of accounting and finance and their interrelationships | Familiarity |
| CO-2 | Prepare different types of financial statements from Journal to Balance Sheet. | Assessment |
| CO-3 | Analyze financial statements using different tools and techniques and hence be able to calculate the value of the firm. | Assessment |
| CO-4 | Calculate financing needs of the firm, effects of time on value of money, availability of finances and their costs, requirement of mix of finances, evaluation of projects | Usage |
| CO-5 | Apply the concepts and make optimal decisions | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction to Accounting:** Basic concepts of accounting, Accounting standards and Policies, Accounting Concepts and Conventions. Accounting Equation, Preparation of Journal, Ledger and Trial Balance | 6 |
| 2 | **Preparations of Final Accounts:** Understanding adjustments, Preparation of Final Accounts – Trading, Profit and Loss, Balance Sheet, Use of MS-Excel for financial statement analysis | 6 |
| 3 | **An Overview of Financial Management:** Nature and scope of financial management, Role of finance function, Finance decisions of the firm, Objective function in finance, Agency costs and corporate governance, Financial management and accounting, Financial objectives and organizational strategy | 2 |
| 4 | **Comparative and Historical Analysis:** Analyzing financial statement – Ratio Analysis – liquidity ratios, capital structure ratios, working capital ratios, profitability ratios, valuation ratios, Interlinking the ratios- Dupont analysis, Uses and limitations of ratio analysis | 5 |
| 5 | **Sources of Finance:** Role of financial markets, Financial Markets- segments, products and services, Long-term sources of finance - Equity, Debt, Debentures/Bonds | 2 |
| 6 | **Time Value of Money:** Basics of time value, Finding future value, Discounting and present value, Future value of annuity,, Present value of annuity, Periodicity of compounding and discounting, Equated monthly installments | 3 |
| 7 | **Cost of Capital:** Opportunity cost of capital, Weighted average cost of capital | 3 |

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|---|---|---|
| | (WACC), Cost of Debt, Cost of preference capital, Cost of equity, Assigning weights, WACC, Factors affecting cost of capital | |
| 8 | **Capital Structure – Theory:** Common assumptions for analysis, Net income approach, Net operating income approach, Traditional approach, MM theory without and with corporate taxes, Leverage and financial distress, Trade-off theory, Pecking order theory. | 2 |
| 9 | **Designing Capital Structure:** Operating leverage, Financial leverage, EBIT-EPS analysis, ROI-ROE analysis, Defining target/ optimal capital structure | 3 |
| 10 | **Capital Budgeting:** Features of capital budgeting decisions, Types of projects, Techniques of evaluation of capital budgeting decisions, Accounting rate of return, Payback period method, Net present value method, Internal rate of return, NPV and IRR – A comparison, Conflict between IRR and NPV, Advantages of NPV and IRR, Modified IRR, Projecting cash flows, Principles of cash flow projections, Cautions in capital budgeting and cash flow projection. | 6 |
| 11 | **Working Capital Management:** Meaning of working capital, Scope of working capital management, Working capital needs of different types of businesses, Operating cycle and its relevance for WCM, Working capital financing policies, Working capital policy, Estimation of working capital requirements. | 4 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. P. C. Tulsian: Financial Accounting, Pearson Education
2. Rajiv Srivastava and Anil Misra: Financial Management, 2nd Edition, Oxford University Press
3. I. M. Pandey: Financial Management, 9th Edition, Vikas Publishing House

**Suggested Reference Book(s):**

1. V. Rajasekaran and R. Lalitha, Financial Accounting, Pearson Accounting
2. E. F. Brigham: Fundamentals of Financial Management, Thomson Learning
3. Sheeba Kapil: Financial Management, Pearson Education

**Other useful resource(s):**

1. Link to NPTEL course contents:
   https://nptel.ac.in/courses/110101003/
   https://nptel.ac.in/courses/110107073/
   https://nptel.ac.in/courses/110104066/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Class Performance - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Finance and Accounting ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0.75 |
| CO-2 | 0 | 2 | 2 | 2 | 2 | 1 | 0 | 1 | 2 | 0 | 3 | 2 | 1.42 |
| CO-3 | 0 | 3 | 2 | 3 | 2 | 0 | 1 | 0 | 2 | 0 | 3 | 1 | 1.42 |
| CO-4 | 0 | 3 | 3 | 3 | 3 | 1 | 1 | 0 | 2 | 1 | 3 | 1 | 1.75 |
| CO-5 | 0 | 3 | 3 | 3 | 3 | 1 | 1 | 0 | 2 | 0 | 3 | 2 | 1.75 |
| Average | 0 | 2.4 | 2.2 | 2.4 | 2.2 | 0.8 | 0.8 | 0.2 | 1.8 | 0.2 | 2.6 | 1.4 | 1.4 |

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# PROJECT MANAGEMENT AND ENTREPRENEURSHIP

COURSE CODE: 18B11HS511

COURSE CREDITS: 3

CORE/ELECTIVE: CORE L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. Learn to lay the foundation for a firm understanding of project management concepts and principles.
2. Acquaintance with the complexity and challenge of managing public or private projects with stringent schedules and limited resources.
3. Introduction to basic entrepreneurship concepts and framework.
4. To develop and systematically apply an entrepreneurial way of thinking that will allow the students to identify and create business opportunities of commercial value.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Distinct between management of projects and operational activities. | Familiarity |
| CO-2 | Screen and select projects. | Usage |
| CO-3 | Assess the costs, people, time and quality associated with the projects. | Assessment |
| CO-4 | Apply quantitative tools and techniques for risk management, budgeting and scheduling. | Usage |
| CO-5 | Knowledgeable about Government programs and policies w.r.t. entepreneurship. | Familiarity |
| CO-6 | Know the parameters to assess opportunities and constraints for new business ideas. | Assessment |
| CO-7 | Discern the factors that can deem the idea successful and viable and write a business plan | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** The Definition of a "Project"; The Relationships Among Portfolios, Programs, and Projects; Why Project Management?; The Project Life Cycle; Role of the Project Manager; Responsibilities and Competencies of the Project Manager. | 4 |
| 2 | **Selection of project:** Project Selection and Criteria of Choice; The Nature of Project Selection Models; Types of Project Selection Models; Risk analysis of the project. | 4 |
| 3 | **Planning the project:** Project Activity Planning; Initial Project Coordination and the Project Plan; Systems Integration; The Action Plan; The Work Breakdown Structure and Linear Responsibility Chart; Plan Scope Management: Define, Inputs, Tools and Techniques, Output. | 5 |
| 4 | **Budgeting and financing the project:** Estimating Project Budgets; Improving the Process of Cost Estimation; Plan Cost Management: Inputs, Tools and techniques, outputs, control process. | 3 |
| 5 | **Scheduling (Gantt chart, PERT, CPM):** Plan Schedule Management: Inputs, Tools and Techniques, Outputs; Define Activities, Sequence Activities; Network Techniques: PERT and CPM; Hand-on experience on Microsoft Project Management software. | 6 |
| 6 | **Resource allocation and monitoring:** Resource Allocation; Crashing a Project; The Resource Allocation Problem; Resource Loading and Levelling; Goldratt's Critical Chain; Project procurement management. | 3 |

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|---|---|---|
| 7 | **Project control and Project Termination**: The Planning-Monitoring-Controlling Cycle; Information Needs and Reporting; Fundamental Purposes of Control; Three Types of Control Processes; The Design of Control Systems Control: A Primary Function of Management; Control of Change and Scope Creep; The Varieties of Project Termination; When to Terminate a Project; The Termination Process; The Final Report—A Project History; Detailed Project Report. | 5 |
| 8 | **Introduction to Entrepreneurship:** Role of the entrepreneur in India and around the globe; Forces that are driving the growth of entrepreneurship;Benefits and drawbacks of entrepreneurship; | 2 |
| | Mistakes of entrepreneurship and how to avoid them; Entrepreneurial failure; Forms of Business Ownership. | |
| 9 | **Overview of Government Programs & Policies; Business and its functioning**: Business and industry; Components of macro and micro business environment; Government Programs and Policies. | 2 |
| 10 | **Business Idea and Feasibility:** Creativity, innovation and entrepreneurship; Mental locks" that limit individual creativity; Steps in the creative process; Techniques for improving the creative process; Protection of intellectual property involving patents, trademarks, and copyrights. | 2 |
| 11 | **Building the business plan: Marketing considerations:** Marketing concept and evolution; Marketing process; Guerilla marketing. | 2 |
| 12 | **Foundations of New Venture Finance:** Understanding capital requirements; Identifying the sources of finance; Angel investing and venture finance; Managing cash flow. | 2 |
| 13 | **Technical entrepreneur and The E-entrepreneur:** Process of creating and growing high potential ventures; Basic approaches to launch an e-commerce effort; Basics of ERP. | 2 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**


1. Project Management – A Managerial Approach – Jack R. Meredith and Samuel J. Mantel, Jr. Seventh edition, Wiley Publications
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition published by Project Management Institute, Inc (USA).
3. Entrepreneurship and New Venture Formation: Thomas W. Zimmerer, and Norman M. Scarborough. PHI
4. Entrepreneurship: Strategies and Resources, 3/E -: Marc Dollinger; Prentice Hall.


**Suggested Reference Book(s):**


1. Bringing New Technology to Market- Kathleen R. Allen, Prentice Hall
2. Entrepreneurship in Action, 2/E - Mary Coulter; Prentice Hall
3. Project Management – System Approach to Planning, Scheduling and Controlling – Harold Kerzner.
4. Project Management – Harvey Maylor.
5. Projects – Planning, Analysis, Financing, Implementation and Review – Prasanna Chandra.
6. Practical Project Management – R.G. Ghattas and Sandra L. McKee
7. Project Management – Garry R. Heerkens.


**Other useful resource(s):**

1. http://www.projectminds.com/
2. http://www.projectmanagement.com/
3. http://www.projectsatwork.com/
4. http://www.pmi.org/
5. http://managementhelp.org/projectmanagement/office.microsoft.com/en-in/project/
6. www.emeraldinsight.com/journal/ijmpb

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**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3 | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4 | Teaching Assessment | 25 | Entire Semester | Case Studies(2) – 10<br>Quizzes (2) - 10<br>Class participation- 5<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Project Management and Entrepreneurship) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 2 | 1.75 |
| CO-2 | 0 | 3 | | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 2.4 |
| CO-3 | 0 | 3 | 2 | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 3 | 2 | 2.25 |
| CO-4 | 0 | 2 | 2 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 2.33 |
| CO-5 | 1 | 1 | | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 3 | 2 | 2 |
| CO-6 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 2 | 2 |
| CO-7 | 0 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 2.4 |
| Average | 1 | 2.5 | 1.75 | 2 | 2.33 | 2 | 1.5 | 2 | 1.5 | 0 | 3 | 2 | |

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# CONTEMPORARY INDIA IN GLOBALIZED ERA: CHALLENGES OF DEMOCRACY AND DEVELOPMENT

COURSE CODE: 18B1WHS831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. The course introduces students to contemporary India with special focus on challenges of democracy and development and main vectors that are moulding India's course in today's globalised era.
2. The course begins with an overview of India's emergence from colonial trappings and its progression in past decades to acclaim a global stature in world affairs.
3. The course deliberates on major issues of Indian foreign policy, especially the problematic of peace and security in the globalised world.
4. The overall aim of the course is to develop a broad and yet nuanced understanding of prospects and challenges of contemporary India in the twenty-first century.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | The course introduces students to contemporary India with special focus on challenges of democracy and development and main vectors that are moulding India's course in today's globalised era. | Familiarity |
| CO-2 | The course begins with an overview of India's emergence from colonial trappings and its progression in past decades to acclaim a global stature in world affairs. | Familiarity |
| CO-3 | The course deliberates on major issues of Indian foreign policy, especially the problematic of peace and security in the globalised world. | Familiarity |
| CO-4 | The overall aim of the course is to develop a broad and yet nuanced understanding of prospects and challenges of contemporary India in the twenty-first century. | Familiarity |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Contextualising Modern India:** Overarching visions of India's national movement: domestic and international, Challenges of nation-building within its domestic contours, Continuities and shifts in Indian polity and society, Rising aspirations and constraints in post Globalized era, Digitising India: Prospects and Challenges | 10 |
| 2 | **India in World Affairs:**Gandhi-Nehru Legacy and policy of nonalignment: Formative Years, Post-Cold war challenges and changing global configurations, India's growing role in world affairs: soft power capacity, diaspora, major bilateral, | 15 |

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| | regional and global concerns and aspirations, India and Major Powers, India and its neighbours, India and Brics | |
| **3** | **India's security concerns:** External Threats: China and Pakistan,Internal Threats: Kashmir and Northeast, Spectre of Terrorism | **9** |
| **4** | **Non-traditional Security:** Human Security Concerns, Energy Security, Water and Food Security, Health and Safety | **6** |
| **5** | **Challenges ahead:** India has had a phenomenal rise in terms of economic growth, technical knowhow, and has performed well on various other parameters. Nonetheless there are severe constraints to its unfolding. This topic will cover some of the challenges that India is facing today and the measures it is taking to overcome them. | **2** |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Tharoor, Shashi. 'India: From Midnight to the Millennium'
2. Wajid Ali, H.M. 'India and the Non-aligned Movement'
3. Budhania, Rajpal. 'India's National Security Dilemma'
4. Asthana, Vandana. Shukla, A.C. 'Water Security in India'

**Suggested Reference Book(s):**

1. Candra Bipin, 'Freedom Struggle'
2. Ram Chandra Guha, 'India after Gandhi'
3. Tharoor, Shashi. 'India: From Midnight to the Millennium'
4. Chandra, Bipan. 'India since Independence'
5. Sen, Amartya. 'Development as Freedom'
6. Ninan Thomas,Pradeep. 'Digital India: Understanding Information, Communication and Social Change'
7. Menon, Shivshankar. 'Choices: Inside the Making of Indian Foreign Policy'
8. Wajid Ali, H.M. 'India and the Non-aligned Movement'
9. Mandrup, Thomas. 'The BRICS and Coexistance'
10. Sikri, Rajiv. 'Challenge and Strategies: Rethinking India's Foreign Policy'
11. P. Bajpai, Kanti. Pant, Harsh.V. 'India's National Security'.
12. Budhania, Rajpal. 'India's National Security Dilemma'
13. Sondhi. M.L. 'Nuclear Weapons and India's National Security'
14. Centre for Strategic Studies - 'Energy Security Challenges: Non Traditional Security Planning in India'
15. Asthana, Vandana. Shukla, A.C. 'Water Security in India'
16. Kolas, Ashild and Miklian, Jason. 'India's Human Security: Lost Debates, Forgotten
17. People, Intractable Challenges'.
18. Venkateshwar, Sita. 'Globalisation and the Challenges of Development in Contemporary India'

**Other useful resource(s):**

1. https://www.goodreads.com/book/show/356824.India_After_Gandhi
2. https://www.springer.com/in/book/9789811004537
3. https://www.academia.edu/35220477/NonAligned_Movement_A_Historic_Movement_reinventing_itself_for_Future_NonAligned_Movement_A_Historic_Movement_reinvening_itself_for_Future
4. https://www.routledge.com/Indias-Human-Security-Lost-Debates-Forgotten-People-Intractable-Challenges/Miklian Kolas/p/book/9780415830683

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |

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| | | | | |
|---|---|---|---|---|
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (5) - 10<br>Report writing (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Contemporary India in Globalized era: Challenges of Democracy and development) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 0 | 0 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 2.7 |
| CO-2 | 0 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 0 | 3 | 2.6 |
| CO-3 | 0 | 2 | 0 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 0 | 3 | 2.6 |
| CO-4 | 0 | 0 | 0 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 0 | 3 | 2.6 |
| Average | 0 | 2.5 | 3 | 2 | 2.2 | 3 | 3 | 3 | 2.2 | 3 | 0 | 3 | |

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# Business Analytics

COURSE CODE: 18B1WHS632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To understand facets of business analytics within an organization.
2. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
3. To become familiar with the processes needed to develop, report, and analyze business data.
4. To analyze real world business problems, not only with the context of the company but also with the context of the society, with the help of modern concepts and tools and techniques of the concerned area.
5. To provide an optimal solution which benefits both the company and the society as a whole.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Understanding the concepts and dimensions of business analytics | Familiarity |
| CO-2 | Formulations of business analytics problems | Assessment |
| CO-3 | Developing and reporting of the problems after proper assessment | Assessment |
| CO-4 | Analyzing problems using different tools and techniques of business analytics | Usage |
| CO-5 | Designing an optimal strategy to help the company | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Introduction:** Introduction and importance to Business Analytics, Categorization of Analytical Methods and Models, Business Analytics in Practice – Marketing, HR, Finance etc. | 3 |
| 2 | **Business Analytics Models:** Overview and Deployment of Business Analytics Models | 2 |
| 3 | **Exploring Data:** Describing the distribution of single variable – Types of data, categorical variables etc,; Relationships among variables – categorical variables, categorical and numerical variables and numerical variables | 6 |
| 4 | **Probability and Decision Making:** Probability and distributions – single random variables; Distributions – normal, binomial, poisson and exponential; Decision making under uncertainty – elements of decision analysis, precision tree, Bayes' rule, multistage decision problems; Applications in Business Management | 7 |
| 5 | **Statistical Inference:** Sampling and sampling distributions; Confidence Interval Estimations; Hypothesis testing; Applications in Business Management | 7 |
| 6 | **Regression Analysis:** Regression Analysis – Estimation; Regression Analysis – Inference; Applications in Business Management | 8 |
| 7 | **Simulation Modeling:** Introduction to Simulation Modeling; Simulation Models – Operations, Financials, Marketing Applications in Business Management | 9 |
| **Total lectures** | | 42 |

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**Suggested Text Book(s):**

1. S. Christian Albright and Wayne L. Winston: Business Analytics: Data Analysis and Decision Making, Cengage Learning, 5e

**Suggested Reference Book(s):**

1. Jeffrey D Camm et al.: Essentials of Business Analytics, Cengage Learning
2. Halady P: Business Analytics: An Application Focus, PHI
3. Seema Acharya and R. N. Prasad: Fundamentals of Business Analytics, Wiley

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Class Performance – 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Business Analytics) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 0 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 1 | 2 | 1.67 |
| CO-2 | 0 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1.67 |
| CO-3 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0.83 |
| CO-4 | 1 | 3 | 2 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1.75 |
| CO-5 | 0 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.42 |
| Average | 0.20 | 2.20 | 2.00 | 2.40 | 2.40 | 1.00 | 1.40 | 0.80 | 1.20 | 1.40 | 1.40 | 1.20 | 1.47 |

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# Software Engineering Practices

**Course Name:** Software Engineering Practices

**Course Code: 19B11CI411**

**Course Credit: L _3_ T _0_ P _0_**

**Course Pre-requisites (if any):** Computer Programming, Data Structures and Computer Architecture

**Course Objectives:**

1. Demonstrate the procedure of converting a valid software design into efficient code.
2. State the central themes involved in The Software Crisis.
3. Apply the concepts of Software Process and Model.
4. State the requirements for efficient Project Management.
5. Execute the needed steps in Software Design: Requirements, Specification, Architectural Design, and OOD.
6. State the steps involved in Program Verification and Validation.
7. Execute a thorough Software Test.
8. Apply the procedures for Software Quality Assurance and Cost Estimation

## Course outcomes:

| S.NO | Course outcomes ( Software Engineering: Principles and Practice) | Level of Attainment |
|---|---|---|
| CO-1 | Ability to apply software engineering principles and techniques. | Familiarity |
| CO-2 | Ability to develop, maintain and evaluate large-scale software systems. | Usage |
| CO-3 | To produce efficient, reliable, robust and cost-effective software solutions. | Usage |
| CO-4 | Ability to perform independent research and analysis. | Usage |
| CO-5 | To learn common lifecycle processes and requirement engineering concept. | Usage |
| CO-6 | Ability to work as an effective member or leader of software engineering teams. | Usage |
| CO-7 | To manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals Identify and | Familiarity |

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|---|---|---|
| | analyzes the common threats in each domain. . | |
| CO-8 | Ability to understand and meet ethical standards and legal responsibilities. | Familiarity |

**Detailed Course Contents:**

| Module | Contents | Lectures required |
|---|---|---|
| Module 1 | Introduction to Software Engineering<br>Phases in the Development of Software, Maintenance or Evolution, Software Engineering Ethics, Introduction to Software Engineering Management, planning a Software Development Project, Controlling a Software Development Project<br><br>The Software Life Cycle:<br>The Waterfall Model,Agile Methods, Prototyping, Incremental Development, Rapid Application Development and DSDM, Extreme Programming, The Rational Unified Process,Intermezzo: Maintenance or Evolution,Software Product Lines, Process Modelling<br><br>Configuration Management:<br>Tasks and Responsibilities, Configuration Management Plan | 6 |
| **Module 2** | People Management and Team Organization:<br>People Management, Coordination Mechanisms, Management Styles, Team Organization, Hierarchical Organization, Matrix Organization, Chief Programmer Team, SWAT Team, Agile Team, Open Source Software Development, General Principles for Organizing a Team<br><br>**Software Quality:**<br>A Taxonomy of Quality Attributes, Perspectives on Quality, The Quality System, Software Quality Assurance, The Capability Maturity Model (CMM), | **6** |
| **Module 3** | **Cost Estimation:**<br>Algorithmic Models, Walston—Felix, COCOMO, Putnam, Function Point Analysis, COCOMO 2: Variations on a Theme, Guidelines for Estimating Cost, Distribution of Manpower over Time<br><br>**Project Planning and Control:**<br>A Systems View of Project Control, A Taxonomy of Software Development Projects, Risk Management, Techniques for Project Planning and Control | **6** |

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| | | |
|---|---|---|
| **Module 4** | **Requirements Engineering:**<br>Requirements Elicitation, Requirements Engineering Paradigms, Requirements Elicitation Techniques, Goals and Viewpoints, Prioritizing Requirements, COTS selection, Requirements Documentation and Management, Requirements Specification Techniques, Verification and Validation<br><br>**Modeling:**<br>Entity--Relationship Modeling, Finite State Machines, Data Flow Diagrams (DFD), CRC Cards, The Unified Modeling Language, The Class Diagram, The State Machine Diagram, The Sequence Diagram, The Communication Diagram, The Component Diagram, The Use Case | 6 |
| **Module 5** | **Software Architecture:**<br>Software Architecture and the Software Life Cycle, Architecture design, Architectural views, Architectural Styles, Software Architecture Assessment<br><br>**Software Design:**<br>Design Considerations, Abstraction, Modularity, Information Hiding, Complexity, System Structure, System Structure, Classical Design Methods, Functional Decomposition, Data Flow Design (SA/SD), Design based on Data Structures, Object-Oriented Analysis and Design Methods, The Booch Method, Fusion, | 6 |
| Module 6 | Software Testing:<br>Software Testing, Test Adequacy Criteria, Fault Detection Versus Confidence Building, From Fault Detection to Fault Prevention, Testing and the Software Life Cycle, Requirements Engineering, Design, Implementation, Maintenance, Test-Driven Development (TDD), Verification and Validation Planning and Documentation, Manual Test Techniques, Walkthroughs and Inspections, Correctness Proofs, Stepwise Abstraction, Coverage-Based Test Techniques, Control-Flow Coverage, Dataflow Coverage, Coverage-Based Testing of Requirements Specifications,Fault-Based Test Techniques, Error Seeding, Mutation Testing, Error-Based Test Techniques, Comparison of Test Techniques, Comparison of Test Adequacy Criteria, Properties of Test Adequacy Criteria, Experimental Results, Different Test Stages, Estimating Software Reliability | 7 |
| Module 7 | Software Maintenance:<br>Software Maintenance, Software Maintenance, Major Causes of Maintenance Problems, Reverse Engineering and Refactoring, Reverse Engineering and Refactoring, Organizational and Managerial Issues, Organization of Maintenance Activities, Software Maintenance from a Service Perspective, Control of Maintenance Tasks, Quality Issues | 5 |
| | **TOTAL LECTURES** | **42** |

**Suggested Text Book(s):**

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1. Sommerville, "Introduction to Software Engineering", 8Edition, Addison-Wesley, 2007
2. R.S. Pressman, "Software Engineering: A Practitioner's Approach", 7Edition, McGraw Hill, 2010

**Suggested Reference Book(s):**

1. Ghezzi, Jazayeri and Mandrioli, "Fundamentals of Software Engineering", 2Edition, Prentice-Hall, 2003
2. Peters and Pedrycz, "Software Engineering: An Engineering Approach, John Wiley, 2004
3. Len Bass, "Software Architecture in Practice", 2Edn. Addison Wesley, 2003
4. Allamaraju, "Professional Java Server Programming", Apress, 2004
5. Eric Gamma, "Design Patterns: Elements of Reusable OO Software", 1994
6. A concise introduction to software Engineering, Pankaj Jalote, Springer

**Evaluation Scheme:**

| | |
|---|---|
| Test 1 | 15 |
| Test 2 | 25 |
| Test 3 | 35 |
| Internal | 25(quiz=12,Assignment=9,Regularity=4) |
| Total | 100 marks |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| CO-PO Mappings (18B11CI111: Programming for Problem Solving) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | |
| CO-1 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 83.3 |
| CO-2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 86.1 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 80.6 |
| CO-4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 83.3 |
| CO-5 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 80.6 |
| CO-6 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 86.1 |
| CO-7 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 80.6 |
| CO-8 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 83.3 |
| | 88.9 | 72.2 | 88.9 | 72.2 | 83.3 | 83.3 | 83.3 | 83.3 | 72.2 | 88.9 | 94.4 | 88.9 | |

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# Software Engineering Practices (Lab)

**Lab Course Name:** Software Engineering Practices Lab

**Lab Course Code: 19B17CI471**

**Course Credit: L _0_ T _0_ P _2_**

**Lab Course Objectives:**

1. Understand the Requirement Engineering. Identifying the Requirements from Problem Statements for a case study.
2. To understand the working of UML tools. Create and edit UML diagrams (Requirement Engineering, Design Tools,) and Reverse engineering tools
3. To understand the Object oriented analysis and Object Oriented Design (OOA/OOD). To draw UML diagrams for a case study.
4. To understand the Structured analysis/ structured design (SA/SD). To draw Data Flow Diagrams for a case study
5. To Understand the User Interface Design
6. Analyze and Apply project management techniques for a case study

**Course outcomes:**

| S.NO | **Course outcomes** (Software Engineering Principles and Practice Lab) | **Level of Attainment** |
|---|---|---|
| **CO-1** | Understand the Requirement Engineering. Identifying the Requirements from Problem Statements for a case study. | Familiarity |
| **CO-2** | To understand the working of UML tools. Create and edit UML diagrams (Requirement Engineering, Design Tools,) and Reverse engineering tools. | Assessment |
| **CO-3** | To understand the E-R Modeling. To draw UML diagrams for a case study. | Assessment |
| **CO-4** | To understand the Structured analysis/ structured design (SA/SD). To draw Data Flow Diagrams for a case study | Assessment |
| **CO-5** | To Understand the User Interface Design | Assessment |
| **CO-6** | Analyze and Apply project management techniques for a case study | Usage |

**List of Experiments:**

| **Experiment** | **Details** | **Lab Hours** |
|---|---|---|
| **Experiment 1** | Identifying the Requirements from Problem Statements (User requirements and System requirements) | **2** |

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| | | |
|---|---|---|
| **Experiment 2** | Identifying the Requirements from Problem Statements (Functional requirements and Non-functional requirements) | **2** |
| **Experiment 3** | Preparing Software Requirements Specifications (SRS) | 2 |
| **Experiment 4** | Estimation of Project Metrics (Project Estimation Techniques) | 2 |
| **Experiment 5** | Estimation of Project Metrics (Basic COCOMO Model, Intermediate COCOMO Model,Complete COCOMO Model) | 2 |
| **Experiment 6** | Halstead's Complexity Metrics | 2 |
| **Experiment 7** | Modeling UML Use Case Diagrams and Capturing Use Case Scenarios | 2 |
| **Experiment 8** | Modeling UML class diagram & sequence diagrams | 2 |
| **Experiment 9** | Case Study: a) Use case diagram b) Use Case Template c) activity diagrams d) sequence diagrams | 2 |
| **Experiment 10** | UML diagram of ATM APPLICATION | 2 |
| **Experiment 10** | UML diagram of LIBRARY MANAGEMENT SYSTEM | 2 |
| **Experiment 11** | UML diagram of ONLINE BOOK SHOP | 2 |
| **Experiment 12** | UML diagram of RAILWAY RESERVATION SYSTEM | 2 |
| **Experiment 13** | UML diagram of BANKING SYSTEM | 2 |
| **Experiment 14** | State Transition diagram | 2 |
| **Experiment 15** | E-R Modeling from the Problem Statements (Graphical Notations for ER Diagram, Entity Generalization and Specialization,Mapping Cardinalities) | 2 |
| **Experiment 16** | E-R Modeling of LIBRARY MANAGEMENT SYSTEM | 2 |
| **Experiment 17** | E-R Modeling of BANKING SYSTEM | 2 |
| **Experiment 18** | E-R Modeling of RAILWAY RESERVATION SYSTEM | 2 |
| **Experiment 19** | Statechart Diagrams (Building Blocks of a Statechart Diagrams) | 2 |
| **Experiment 20** | Activity Diagram Components of an Activity Diagram | 2 |
| **Experiment 21** | DFD model(level-0, level-1) | 2 |
| **Experiment 22** | Estimation of Test Coverage Metrics and Structural Complexity (Control Flow Graph, Computing Cyclomatic Complexity) | 2 |
| **Experiment 23** | Designing Test Suites | 2 |
| **Experiment 24** | Project management using GanttProject | 2 |
| **Mini Project** | Development of Mini Project using Software Engineering Principles and Practice | 8 |
| **TOTAL LAB Hours** | | **56 hrs** |

**Suggested Text Book(s):**


1. Sommerville, "Introduction to Software Engineering", 8Edition, Addison-Wesley, 2007
2. R.S. Pressman, "Software Engineering: A Practitioner's Approach", 7Edition, McGraw Hill, 2010



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**Suggested Reference Book(s):**


1. Ghezzi, Jazayeri and Mandrioli, "Fundamentals of Software Engineering", 2Edition, Prentice-Hall, 2003
2. Peters and Pedrycz, "Software Engineering: An Engineering Approach, John Wiley, 2004
3. Len Bass, "Software Architecture in Practice", 2Edn. Addison Wesley, 2003
4. Allamaraju, "Professional Java Server Programming", Apress, 2004
5. Eric Gamma, "Design Patterns: Elements of Reusable OO Software", 1994
6. A concise introduction to software Engineering, Pankaj Jalote, Springer


**Other useful resource(s) for Lab:**

**A. Web Resources:**

Software Engineering Virtual Lab
**http://vlabs.iitkgp.ernet.in/se/**

**B. Study Material:**

List of experiments with the detailed theory required for better understanding of the experiments is posted on Student Resource. In addition additional online/downloadable resources will be useful.

**Evaluation Scheme:**

| | | |
|---|---|---|
| 1 | Attendance & Discipline in Lab | 15 |
| 2 | Mid-Term Lab Exam and Viva | 20 |
| 3 | End-Term Lab Exam and Viva | 20 |
| 4. | Lab Records | 15 |
| 5. | Regular Assessment | 30 |

**Course Outcomes (COs) contribution to the ProgrammeOutcomes(POs)**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 |
| CO-2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO-3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO-4 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 |
| CO-5 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 2 |
| CO-6 | 3 | 1 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 1 |
| | 3 | 2.8 | 1.4 | 2.2 | 2 | 3 | 2 | 1.8 | 1.9 | 2.2 | 2 | 2 |

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# Sustainable Technologies for Waste Management

COURSE CODE: 19B1WBT731

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Environmental pollution: Cause and remediation strategies

**C ourse Objectives:**

1. Sustainable strategies and technologies for waste and resource management at national and international level for overall development in this sector

**Course Outcomes:**

**CO I.** Students will know about the types of waste, their prevalence and available treatment options.

**CO II:** Students will be able to grasps the concepts of waste to energy technologies and apply their knowledge to look for appropriate one.

**CO III.** Students will develop the skill of linking waste and management strategies to society and its needs.

**CO IV:** Students will develop an understanding risk assessment and life cycle of the waste.

**CO V:** Students will be able to recognize real-world examples of waste disposal and handling

**Course Content:**

| S.No. | Topics | No. of lectures |
|---|---|---|
| 1 | **Introduction**<br>Concept of Sustainable Technologies for waste management. | 2 |
| | **Technology Matrix for Solid Waste Management**<br>Type of Wastes and appropriate technologies, Municipal Solid Waste, Industrial waste, medical and other wastes. Status of various waste streams in India and available treatment options | 5 |

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|---|---|---|
| 2 | **Waste to Energy Technologies**<br>Technologies for recovering energy from waste, based in part on their potential for climate change mitigation and relevance to India, Case studies of adapted waste-to-energy technologies and evaluating their impact. The focus will be on methane, hydrogen and ethanol and next generation fuel technologies utilizing agricultural and municipality waste. | 6 |
| 3 | **Developing Sustainable Strategies**<br>Corporate / Organizational responsibility, Sustainability strategy development., Management tools, Sustainable/ethical investment accounts , Silos and open access, Product development and design | 5 |
| 4 | **Electronic waste and Battery Waste Management**<br><br>MOEFCC policy advice and carrying out activities relating to electronic/battery waste management, current status in India and global projections, hazardous substances in e- /battery waste and health perspectives, recycling technologies for e-/battery wastes, new strategies for waste collection and disposal, extended producer responsibility | 5 |
| 5 | **Green composites and Bioelectrochemical systems for sustainable world**<br>Green composites: towards a sustainable future; Cellulose fiber/nanofiber from natural sources including waste-based sources; Clean production strategies; Green composites for the built environment<br><br>Microbial electrosynthesis; BES for sustainable agriculture; BES for sustainable energy production and product recovery; Life cycle assessment of a BES | 8 |
| 6 | **Industrial Ecology & Economic, Social and legal instruments**<br>The onset of industrial ecology and conceptual framework and linkages with waste management.<br>Social issues and costs associated with waste management, traditional approaches to financing, the new advisory projects in India, economic incentive systems to avoid or recycle waste, Laws and obligations related to waste management, carbon foot print. | 6 |
| 7 | **Risk Assessment and Life cycle assessment of Waste, Case studies**<br>Hazardous wastes and their risk assessment, available models and management, life cycle inventory and impact assessment | 5 |
| | Total | 42 |

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**Evaluation scheme:**

| | | |
|---|---|---|
| T1 | 1 hour | 15 (course covered upto T1) |
| T2 | 1.5 hour | 25 (course covered upto T2, including that covered upto T1) |
| T3 | 2 hours | 35 (total syllabus) |

| | |
|---|---|
| Tutorials, quiz, and home assignments | 25 |
| Total | 100 |

**Text books:**

1. Concept of genetics by William S Klug and M.R. Cummings
2. Principles of Genetics. D P Snustad, M J Simmons

**Reference books:**

1. Sustainable Solid Waste Management. A system engineering approach. Chana Ni-Ben and Pires Ana. IEEE Press.
2. E-waste: Implications, regulations, and management in India and current global best practices. Rakesh Johri. Teri Press.
3. Green Composites: Natural and waste-based composites for a sustainable future by Caroline Baillie and Randika Jayasinghe
4. Scientific and research articles from Elsevier, Springer, Wiley and RSC Journals
5. Solid Waste Management - A Manual by All India Institute of LocalSelf-Government Publications
6. Toxic and Hazardous Waste by Sinha P.C.
7. Manual on Solid Waste Management by Palnitkar, Sneha
8. Basic Hazardous Waste Management by William C. Blackman
9. Management Of Municipal Solid Waste by Ramchandra T. V.
10. Solid Waste Management by H V. Bijalani
11. TED talks

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# Food Nutrition & Health Care

COURSE CODE: 19B1WBT732

COURSE CREDITS: 3

ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To provide basic understanding of the food, nutrition, life style diseases, drug abuse and rehabilitation

**Course Outcomes**

| S. No | Course Outcome | Level of Attainment |
|---|---|---|
| CO I | To understand the basics of nutrition, energy balance and essential nutrients. | Familiarity |
| CO II | To understand the nutritive and functional value of food products | Familiarity & Usage |
| CO III | To understand the basics of stress, life style diseases and its management | Familiarity & Usage |
| CO IV | To understand the basic concepts of addiction and rehabilitation | Familiarity & Usage |

**Course Contents:**

| Unit | Content | Contact Hrs. |
|---|---|---|
| 1 | Introduction to nutrition – energy requirements and energy balance, essential nutrients, my plate | 2 |
| 2 | Nutrition for a healthy person – micronutrients: vitamins, minerals and the indications for the use of nutritional supplements. macronutrients: basic concepts | 3 |
| 3 | Carbohydrates, glycemic index, metabolic implications of fructose, dietary fibre, protein. | 3 |
| 4 | Saturated fat, unsaturated fat, trans fat, omega 3/omega 6. | 2 |
| 5 | micronutrients: vitamins, minerals and nutritional supplements Vitamins: vitamin A, D, B, antioxidants – C, E, beta-carotene and others Minerals: iron and calcium | 5 |
| 6 | Consumption of fast food, snack foods, sugary beverages and fructose, and impairment in the regulation of food consumption. Distribution of fat - the difference between visceral and subcutaneous fat | 2 |
| 7 | Introduction to health supplements & protein diet, its pros and cons | 3 |
| 8 | Introduction to health psychology and life style diseases | 2 |
| 9 | The nature of stress, life events & social stressors, depression and suicidal intentions | 3 |
| 10 | Obesity, diabetes, diet/nutrition and its management | 3 |

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| | | |
|---|---|---|
| 11 | Short term and long term effects of excessive alcohol use | 2 |
| 12 | Medication and side effects of androstene dione, anabolic steroids, creatine monohydrate, etc. | 4 |
| 13 | Fundamental concepts, properties and effects of psychoactive substances. | 3 |
| 14 | Knowledge of the continue of drug use: such as initiation, intoxication, harmful use, abuse, dependence, withdrawal carving, relapse and recovery | 5 |
| | TOTAL | **42** |

**Suggested Text Books/References:**


1. Krause's Food & the Nutrition Care Process,14th Edition by L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CD
2. SrilakshmiB( 2017): Nutrition Science,6th Multicolour Ed. New Age International (P) Ltd
3. Mann J and TruswellS(2017) : Essentials of Human Nutrition, 5th Ed. Oxford University Press.
4. SwaminathanM(2007): Essentials of Food and Nutrition(Vol. I & II), 2nd Ed. Bappco
5. GopalanC , Rama Sastri BV and Balasubramanian SC(2016): Nutritive value of Indian Foods, Indian Council of Medical Research
6. Zimmermann M(2001):Burgerstein's Handbook of Nutrition: Micronutients in the Prevention and Therapy of Disease Thieme Stuttgart
7. MudambiSR(2018): Fundamentals of Foods, Nutrition and Diet Therapy, 6th Ed. New Age International (P) Ltd.
8. PruthiJS(2011):Spices and Condiments, National Book trust, New Delhi.
9. Mahajan BK, Roy RN , Saha I, Gupta, MC (2013):Text book of Preventive and Social Medicine, 4th Ed. Japee Brothers
10. Department of Health (Alcohol and Drug Abuse Division). (2013). Twelve core functions of the alcohol and other drug abuse counselor. Honolulu, Hawaii: DOH. Retrieved from: http://health.hawaii.gov/substance-abuse/files/2013/05/csac-corefunctions1.pdf
11. *Drugs, Society, and Human Behavior* Ksir, C., Hart, C., & Ray, O. McGraw-Hill, 14th Edition, 2010
12. https://www.drugabuse.gov/sites/default/files/soa_2014.pdf
13. https://ed.ted.com/on/Hm9X3Yrt
14. https://www.framingham.edu/Assets/uploads/academics/continuing-education/professional-development/documents/syllabi/prdv-71527.pdf

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**Course Assessment:**

| Assessment | Max. marks | Duration | Course Covered |
|---|---|---|---|
| T1 Test | 15 | 1 hr. | Unit 1-2 |
| T2 Test | 25 | 1.5 hrs. | Unit 1-5 |
| End Term Test | 35 | 2 hrs. | Whole Syllabus |
| Teacher Assessment (Based on Assignments, quizzes etc.) | 25 | Whole Sem | Inform class time to time |
| **Total** | **100** | | |

# Nanotechnology

COURSE CODE: 18B1WPH731
COURSE CREDITS: 3
CORE/ELECTIVE: Elective
L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To provide basic knowledge of nanoscience & technology.
2. To make students familiar with synthesis techniques of nanomaterials
3. To make students familiar with characterization techniques and tools.
4. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, etc.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Students will be able to learn basics of nanotechnology. | Familiarity |
| CO-2 | Synthesis of nanomaterials based on requirement. | Familiarity and Assessment |
| CO-3 | Characterization techniques and tools. | Assessment |
| CO-4 | Students will learn the effect of nano-transformation on properties of materials. | Familiarity, Assessment and Usage |
| CO-5 | Applications of nanotechnology in their respective fields as well as in interdisciplinary science and engineering. | Assessment and Usage |

**Course Contents:**

| Unit | Content | Lectures required |
|---|---|---|
| 1 | Introduction to Nanotechnology: Surface energy. Nanoparticles etc. | 5 |
| 2 | Synthesis of nanomaterials: Different approaches of synthesis (chemical, mechanical, etc.) | 9 |
| 3 | Characterization techniques: SEM, STM, AFM, X-ray diffraction, etc. | 10 |
| 4 | Properties of nanomaterials: Electronic, magnetic, optical, chemical and mechanical properties. | 12 |
| 5 | Applications of nanomaterials: Nanostructured materials in memory and electronic devices and for magnetic recording, sensors and interfaces, Biological applications. | 6 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**

1. Michael Köhler, Wolfgang Fritzsche, Nanotechnology An Introduction to Nanostructuring Techniques,

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Wiley, 2nd edition, (2008).

2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition (2011).
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley, (2003).

**Suggested Reference Book(s):**

1. Zheng Cui,Micro-Nanofabrication: Technologies and Applications , Springer; (2005).
2. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg (2017).
3. Guozhong Cao and Ying Wang, World Scientific Series in Nanoscience and Nanotechnology: Volume 2 , Nanostructures and Nanomaterials, Synthesis, Properties, and Applications, 2nd Edition (2011).

**Other useful resource(s):**

1. NPTEL course contents links
2. https://nanohub.org/groups/education
3. All relevant research articles

**Evalution Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Couse Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Nanoscience and Technology) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1.91 |
| CO-2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1.83 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.91 |
| CO-4 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.58 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 |
| Average | 3.00 | 2.60 | 2.80 | 2.60 | 2.80 | 1.80 | 1.40 | 1.60 | 1.20 | 1.20 | 1.20 | 1.20 | |

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# Optical Fiber Network Design

COURSE CODE: 18B1WPH732

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. Learn to analyze algorithms for Time and Space Complexity
2. Learn asymptotic notations for performance analysis of algorithms.
3. Learn various computing algorithms and data structure used in solving complexproblems.
4. Apply important algorithmic design paradigms and method of analysis.
5. Synthesize efficient algorithm design in common engineering design situations.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To revise and understand about the basic working of optical fibers | Familiarity |
| CO-2 | To design the basic structure of optical fibers | Assessment |
| CO-3 | To understand the layout of optical fiber networks. | Assessment |
| CO-4 | Apply CO-02 and 03 to design and understand working of optical fiber networks. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Basics of fiber optics:** Propagation, Dispersion, Attenuation and loss limits, Wave propagation in step index fibers, fiber gratings, Nonlinear effects in Fibre | 10 |
| 2 | **Optical fiber components** Optical fiber splices, connectors, couplers, Transmitters and Receivers | 5 |
| 3 | **Optical Link design:** Data Coding, Source selection, Power Budget, Optical amplifiers, dispersion compensation, Solitons, Soliton link Design | 10 |
| 4 | **Single wavelength fiber optic networks:** Network topologies, Standard fiber networks, FDDI networks, SONET/SDH | 10 |
| 5 | **Wavelength division multiplexing:** Selective WDM, Broad band WDM, Multiplexers, sources, nonlinearity in WDM links, WDM and optical amplifiers, Multipoint, Multi wavelength networks | 7 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**


1. Gerd Keiser: Optical Fiber Communication, 4th Edition, Tata McGraw-Hill Ltd., 2008.
2. A. Ghatak, K. Thyagarajan: Introduction To Fiber Optics, Foundation Books, 2002.
3. J. M. Senior: Optical Fiber Communications Principles and Practice, 2nd Edition, Prentice Hall India Pvt. Ltd., 2004.


**Suggested Reference Book(s):**


1. Govind P Agrawal: Fiber-Optic Communication Systems, John Wiley & Sons Asia, 2005


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**Other useful resource(s):**

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106104019/
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/106104019/1
   ii. https://nptel.ac.in/courses/106104019/4
   iii. https://nptel.ac.in/courses/106104019/26
   iv. https://nptel.ac.in/courses/106104019/2Ev

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Parallel and Distributed Algorithms ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | **1.72** |
| CO-2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **2.00** |
| CO-3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | **1.75** |
| CO-4 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | **2.08** |
| Average | **2.0** | **2.5** | **2.5** | **2.5** | **2.5** | **1.0** | **1.0** | **1.0** | **2.0** | **2.25** | **1.5** | **2.0** | |

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# Optoelectronic Devices

COURSE CODE: 18B1WPH831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Engineering Physics-II

**Course Objectives:**

1. To enable the students to get better understanding about Photonic materials and their applications.
2. To familiarize students for making proper selection of Microwave devices for different applications.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To define and explain the physics governing laser behaviour and light matter interaction. | Familiarity |
| CO-2 | To calculate properties of and design modern optical waveguides, microwave waveguides, photonic crystals fibers and microwave hybrid circuits. | Problem Solving/ Assesment |
| CO-3 | To approach and solve new problems in a range of advanced topics in Non linear optics | Usage |
| CO-4 | To understand important and unique engineering issues at microwave and millimeter wave frequencies. | Familiarity |
| CO-5 | To learn the applications of the microwave devices in the design of useful systems such as radars, receivers, etc. | Usage |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Photonics:** Optical sources, modulators and detectors: Introduction, laser sources, semiconductor sources, electro-optic modulator, magneto- optic modulator, and acousto-optic modulator. Photoconductive detectors, photodiodes. | 10 |
| 2 | **Waveguides:** Optical waveguides: Introduction, planar waveguides, integrated optics, cylindrical waveguides, optical fibers for communication, photonic crystal fibers. | 4 |
| 3 | **Non-linear optics:** Introduction, formalism of non-linear optics, second harmonic generation and phase matching, optical mixing, intensity dependent refractive index, non-linear effects in photonic crystal fibers. Antireflective coating, optical fiber current measurement, integrated optical spectrum analyzer, holography, optical fiber amplifier, optical fiber laser. | 10 |
| 4 | **Microwave waveguides:** Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits. | 2 |
| 5 | **Microwave transistors and diodes:** Introduction, microwave bipolar transistor & microwave tunnel diodes, IMPATT diodes, Transferred electron devices (TED), Quantum electron devices, and hot electron devices. | 9 |
| 6 | **Microwave field effect transistor:** Introduction, junction field effect transistor, MESFET, MOSFET, HEMTS, CCDs, Transistors as memory devices. | 4 |

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|---|---|---|
| 7 | **Microwave linear beam tubes (O-type):** Introduction, triode, tetrode, pentode, Klystron. Microwave crossed field tubes (M-type): Introduction, Magnetron oscillator, cylindrical magnetron, linear magnetron, voltage tunable magnetron, and frequency-agile coaxial magnetron | 3 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

1. Chi H. Lee, Microwave Photonics, CRC Press, 2nd edition (2013).
2. Samuel Y. Liao, Microwave Devices & circuits , Prinston Hall 3rd edition (2015)..
3. Ralf Menzel, Photonics: Linear and Nonlinear Interactions of Laser Light and Matter, Springer Berlin Heidelberg 1st edition (2007).
4. S. M. Sze, Semiconductor Devices, John Wiley & Sons, 3rd edition (2006).

**Suggested Reference Book(s):**

1. Chuang, Shun Lien,Physics of Photonic Devices, John Wiley & Sons, 2nd edition (2009).
2. Sisodia M L, Microwave Circuits and Passive Devices, New Age International Publishers (2002).

**Other useful resource(s):**

1. Link to topics related to course:
   i. https://nptel.ac.in/courses/115102026/
   ii. https://nptel.ac.in/courses/115101008/
   iii. https://nptel.ac.in/courses/108101112/

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes (2) - 10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

| Course outcomes (Photonics and Microwave Devices ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 1 | - | 2 | | | | 2 | | 2 | 1.5 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | | | | 2 | | 2 | 2.5 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 2 | | | | 2 | | 2 | 2.5 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-4 | 3 | 2 | 1 | 1 | 1 | 2 | | | | 1 | | 2 | 1.6 |
| CO-5 | 3 | 3 | 3 | 3 | 2 | 3 | | | | 2 | | 3 | 2.7 |
| Average | 2.8 | 2.6 | 2.2 | 2.2 | 1.4 | 2.2 | | | | 1.8 | | 2.2 | |

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# Applied Materials Science

COURSE CODE: 18B1WPH532

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (CSE, IT)

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

1. To enable the students to get better understanding about materials, properties and their applications in engineering
2. To familiarize students for making proper selection of materials for different applications..
3. To enable the students to use the knowledge about materials for their projects and ultimately apply the materials knowledge in their respective professional career.
4. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Computer-aided design, Computational Materials Science *etc*.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the fundamentals and Science of Materials. | Familiarity |
| CO-2 | To implement the concepts and theories for analyzing the behaviour of the materials. | Familiarity |
| CO-3 | To execute the concepts and theories in solving the problems related to material properties and their applications. | Analytical & Computational skills |
| CO-4 | To introduce innovations in areas like Display Technology and Engineering Materials Science, etc. | Innovative Skills |
| CO-5 | To analyze various materials for scientific and technical applications | Technical skills |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Dielectrics: Polarization mechanism & Dielectric Constant, Behavior of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, Piezoelectric effect; Applications of Dielectric Materials. | 12 |
| 2 | Polymers: Various types of Polymers and their applications; Mechanical behaviour of Polymers, synthesis of polymers. Conducting polymers | 4 |
| 3 | Ceramics: Structure, Types, Properties and Applications of Ceramics; Mechanical 2behaviour and Processing of Ceramics | 3 |
| 4 | Magnetism: Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Their properties and Applications; Hysteresis; Applications. | 9 |
| 5 | Superconductivity: Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; High temperature Superconductors and their Applications. | 6 |
| 6 | Optical fibres: Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode. | 4 |
| 7 | New Engineering Materials: Metallic Glasses, Shape Memory Alloys, Memory Effect, Nano-materials- significance of 2anoscale, 0-Dimensional, 1-Dimensional, 2- Dimensional, 3- Dimensional nanostructures, Applications. | 4 |
| **Total lectures** | | **42** |

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**Suggested Text Book(s):**

1. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)
2. William D. Callister and David G. Rethwisch, Materials science and engineering: an introduction, John Wiley & Sons, 8th edition (2010).
3. M.A. Wahab, Solid State Physics:Structure and Properties of Materials, Narosa, 3rd edition, (2015).

**Suggested Reference Book(s):**

1. Charles Kittel, Introduction to Solid State Physics. John Wiley & Sons, 8th edition 2005.
2. S. Sharma and J. Sharma, Engineering Physics, Pearson India (2018).

**Other useful resource(s):**

1. http://www.advancedsciencenews.com/best-of-advanced-optical-materials/
2. https://onlinecourses.nptel.ac.in/noc19_ph04/preview

**Evaluation Scheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Materials Science) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | | | | | | | | | | 3 | 3 |
| CO-2 | 3 | | | | | | | | | | | 3 | 3 |
| CO-3 | 1 | 1 | 1 | | | | | | | | | 1 | 1 |
| CO-4 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 |
| CO-5 | 3 | 3 | 3 | 3 | | | | | 3 | | | 3 | 3 |
| Average Score | 2.4 | 2.25 | 2 | 2.5 | | | | | 3 | | | 2.4 | 2.425 |

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# Science and Technology of Materials

COURSE CODE: 18B1WPH531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (ECE)

L-T-P: 3-1-0

**Pre-requisite:** None

**Course Objectives:**

1. To enable the students to get better understanding about materials, properties and their applications in engineering
2. To familiarize students for making proper selection of materials for different applications..
3. To enable the students to use the knowledge about materials for their projects and ultimately apply the materials knowledge in their respective professional career.
4. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Computer-aided design, Computational Materials Science *etc*.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | To learn the fundamentals and Science of Materials. | Familiarity |
| CO-2 | To implement the concepts and theories for analyzing the behaviour of the materials. | Familiarity |
| CO-3 | To execute the concepts and theories in solving the problems related to material properties and their applications. | Analytical & Computational skills |
| CO-4 | To introduce innovations in areas like Display Technology and Engineering Materials Science, etc. | Innovative Skills |
| CO-5 | To analyze various materials for scientific and technical applications | Technical skills |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | Introduction to Dielectric materials, Capacitance, Polarization, Types of Polarization, Polarization mechanism & Dielectric Constant, Frequency Dependence of the Dielectric Constant, Ferroelectricity, Piezoelectricity Applications of Dielectric Materials. | 10 |
| 2 | Introduction to Optoelectronic materials, Applications of Optical Phenomena Luminescence, Materials of Importance—Light-Emitting Diode Materials, photoconductivity, Lasers, Optical Fibers in Communications | 6 |
| 3 | Introduction to Thermoelectric materials, Figure of merit, Heat Capacity, Conductivity (electronic and thermal), Applications in sensors, energy harvesting etc. | 6 |
| 4 | Introduction to Magnetic materials, Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Influence of Temperature on Magnetic Behavior; Domains and Hysteresis; Magnetic Anisotropy Applications in storage devices. | 8 |

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|---|---|---|
| 5 | Introduction to Superconducting materials, Superconductivity Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; High temperature Superconductors and their Applications. | 4 |
| 6 | Introduction to Composite materials-Polymers & Ceramics, Various types of Polymers and their applications, Structure, Types, Properties and Applications of Ceramics, Electrical Conduction in Ceramics and Polymers. Applications. | 8 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

1. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)
2. William D. Callister and David G. Rethwisch, Materials science and engineering: an introduction, John Wiley & Sons, 8th edition (2010).
3. M.A. Wahab, Solid State Physics:Structure and Properties of Materials, Narosa, 3rd edition, (2015).

**Suggested Reference Book(s):**

1. Charles Kittel, Introduction to Solid State Physics. John Wiley & Sons, 8th edition 2005.
2. S. Sharma and J. Sharma, Engineering Physics, Pearson India (2018).

**Other useful resource(s):**

1. http://www.advancedsciencenews.com/best-of-advanced-optical-materials/
2. https://onlinecourses.nptel.ac.in/noc19_ph04/preview

**EvaluationScheme:**

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Materials Science) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | | | | | | | | | | 3 | 3 |
| CO-2 | 3 | | | | | | | | | | | 3 | 3 |
| CO-3 | 1 | 1 | 1 | | | | | | | | | 1 | 1 |
| CO-4 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 |
| CO-5 | 3 | 3 | 3 | 3 | | | | | 3 | | | 3 | 3 |
| Average Score | 2.4 | 2.25 | 2 | 2.5 | | | | | 3 | | | 2.4 | 2.425 |

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# Bioinstrumentation Techniques

COURSE CODE: 18B1WPH212

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

: 3-1-0

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**Pre-requisite:** None

**Course Objectives:**

1. To learn concepts for strong foundation of biophysical methods and their application in the field of biotechnology.
2. Exposure to various instruments used in Biophysics.
3. To be able to use important biophysical methods to decipher problems relevant to biology.
4. Understanding of the underlying theory of these methods and their practical applications in the laboratories.
5. Better understanding of the structure-function activity of biomolecules.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Knowledge about different degrees of freedom of biological molecules with varying energy of the electromagnetic spectrum. | Familiarity |
| CO-2 | Basic underlying techniques of the analytical instruments, their principle and working. | Familiarity |
| CO-3 | Information about different spectroscopic Techniques (microwave, Raman, FTIR, Electronic, Electronic, ESR, NMR etc). | Familiarity and assessment |
| CO-4 | Strong foundation of biophysical methods and their practical application in the field of bioinformatics and biotechnology. | Assessment and Usage |
| CO-5 | Complete understanding of the structure-function activity of biomolecules | Usage |

**Course Contents:**

| Unit | Contents | Lectures Required |
|---|---|---|
| 1 | Basic concepts: Quantization of energy, Regions of the electromagnetic spectrum, Representation of spectra, Basic elements of practical spectroscopy, The width and intensity of spectral lines. Crystal structure. | 3 |
| 2 | Electron Microscopy: Transmission electron microscope. Scanning electron Microscope, Tunneling Electron microscope and Atomic Force microscope. | 5 |
| 3 | Electronic Spectroscopy: Electronic Spectra of Diatomic molecules, Frank-Condon Principle, Dissociation energy, shape of molecular orbitals, Classification of states of diatomic molecules, Electronic spectra of polyatomic molecules. Analysis by Electronic spectroscopy, Fluorescence Spectroscopy | 8 |

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| | | |
|---|---|---|
| 4 | Infrared Spectroscopy: Vibration of diatomic molecules, Simple Harmonic Oscillator, Anharmonic oscillator, Vibration rotation spectra of diatomic molecules, Vibration of polyatomic molecules, Fourier Transform Infrared Spectroscopy, Analysis of Infrared techniques. | 6 |
| 5 | Raman Spectroscopy: Raman effect, Molecular polarisability, Rotational and vibrational Raman Spectra, Structure determination from Raman and Infrared spectroscopy. | 4 |
| 6 | Mass Spectroscopy: Basics of the technique, Producing the ion, Detection of ions and Identifying of compounds. Analysis and application. | 3 |
| 7 | Spin Resonance Spectroscopy: Interaction between spin and magnetic field, Nuclear Magnetic Resonance, Chemical Shift, Analysis by NMR Technique, NMR Applications in Biochemistry, Biophysics and Medicines. Electron Spin Resonance Spectroscopy and applications. | 5 |
| 8 | Microwave spectroscopy: Rotation of molecules, Rotational spectra of rigid diatomic molecule, Rigid and Non rigid, Polyatomic –Molecules, Analysis by microwave spectroscopy Technique. | 4 |
| 9 | Chromatography: Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, affinity, GC, HPLC, FPLC; Electro-chromatography | 4 |
| **Total Lectures** | | 42 |

**Suggested Text Book(s):**


1. C. N. Banwell, Fundamentals of Molecular Spectroscopy. McGraw-Hill, (1994).
2. Sune Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical applications, Springer Science & Business Media (2012).
3. G. Aruldhas, Molecular structure and spectroscopy, PHI Learning Pvt. Ltd. (2007).
4. Charles H. Townes, A. L. Schawlow, Microwave Spectroscopy, Dover Publications Inc.(1975).
5. Barbara H. Stuart , Infrared Spectroscopy: Fundamentals and Applications, Wiley (2004).
6. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016).


**Suggested Reference Book(s):**


1. Brian C. Smith, Fundamentals of Fourier Transform Infrared Spectroscopy, Second Edition, CRC Press (2011).
2. Walter Gordy, Microwave Spectroscopy, Springer Berlin Heidelberg (1957).


**Other useful resource(s):**

1. NPTEL course contents
2. Relevant research articles

**Evaluation Scheme:**

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**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

| Course outcomes (Biophysical Techniques) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1.75 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 2.00 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 2.16 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2.42 |
| CO-5 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.83 |
| Average | 3.00 | 3.00 | 2.80 | 3.00 | 2.20 | 1.40 | 1.20 | 1.40 | 1.60 | 1.00 | 1.20 | 2.60 | |

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