BTECH MATHEMATICS & COMPUTING

COURSE STRUCTURE

EFFECTIVE: 2025-26 ADMISSION BATCH

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B.TECH. MATHEMATICS & COMPUTING

PROGRAM OBJECTIVES

Program Educational Outcomes (PEOs):

Upon completion of the *B.Tech. degree in Mathematics and Computing*, the expected accomplishments of the program's graduates in their professional and personal lives are outlined in the following.

PEO No.	Description
PEO-1	Graduates will develop a strong foundational knowledge in mathematics and computing, enabling them to apply mathematical reasoning, computational techniques, and algorithmic processes to design and solve problems across a broad range of applications.
PEO-2	Graduates will demonstrate the ability to think critically and creatively to innovate and solve complex problems in mathematics and computing, including the capability to conduct research and integrate emerging technologies into their solutions.
PEO-3	Graduates will become effective professionals with a commitment to ethical practices, societal contributions, and lifelong learning. They will possess the skills necessary to lead projects and teams in multidisciplinary environments, both domestically and internationally.
PEO-4	Graduates will maintain an understanding of evolving technologies, adapting their skills accordingly to remain effective and relevant in the rapidly changing fields of mathematics and computing.
PEO-5	Graduates will excel in communicating complex mathematical and technical content clearly and effectively to a variety of audiences. They will also demonstrate the ability to work collaboratively in diverse teams, contributing effectively to the achievement of common goals.

Program Specific Outcomes (PSOs):

The program specifies the following outcomes that define the core competencies students will develop during their studies, preparing them for successful careers and meaningful contributions in their respective fields.

PSO No.	Description
PSO-1	Graduates will be able to apply advanced mathematical techniques and tools, including statistical and numerical methods, to model and solve complex real-world problems across various domains such as finance, technology, and engineering.
PSO-2	Graduates will possess strong programming skills and the ability to develop, test, and maintain software applications that utilize mathematical models and algorithms to address industry needs.
PSO-3	Graduates will be proficient in employing modern data analytics tools and machine learning algorithms to interpret and extract meaningful information from large datasets, enabling them to make data-driven decisions.

PSO-4	Graduates will demonstrate the ability to work effectively in interdisciplinary teams, integrating their mathematical and computing expertise to contribute to innovative solutions in scientific research and industry projects.
PSO-5	Graduates will continuously adapt to emerging technologies and methodologies in mathematics, computing, and their intersections, maintaining relevancy and proficiency in their professional practice.

Program Objectives (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

B. Tech. [Mathematics & Computing] - Curriculum 2025-2026 Batch								
B.Tech. (Maths & Computing) I SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	BSC	25B11MA113	MATHEMATICS-I	3	1	0	4	4
2	BSC	25B11PH111	PHYSICS-I	3	1	0	4	4
3	BSCL	25B17PH171	PHYSICS LAB-I	0	0	2	1	2
4	ESC	25B11CI112	SOFTWARE DEVELOPMENT FUNDAMENTALS-I	3	1	0	4	4
5	ESCL	25B17CI172	SOFTWARE DEVELOPMENT FUNDAMENTALS LAB-I	0	0	2	1	2
6	ESC	25B11EC111	BASIC ELECTRONICS	3	1	0	4	4
7	ESCL	25B17EC171	BASIC ELECTRONICS LAB	0	0	2	1	2
8	HSMC	25B11HS111	ENGLISH	1	0	2	2	3
9	ESCL	25B17GE171	WORKSHOP	0	0	3	1.5	3
				Total			**22.5**	**28**
B.Tech. (Maths & Computing) II SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	BSC	25B11MA211	MATHEMATICS-II	3	1	0	4	4
2	BSC	25B11PH211	PHYSICS-II	3	1	0	4	4
3	BSCL	25B17PH271	PHYSICS LAB-II	0	0	2	1	2
4	ESC	25B11CI211	SOFTWARE DEVELOPMENT FUNDAMENTALS-II	3	1	0	4	4
5	ESCL	25B17CI271	SOFTWARE DEVELOPMENT FUNDAMENTALS LAB-II	0	0	2	1	2
6	HSMCL	25B17HS271	LIFE SKILLS & PROFESSIONAL COMMUNICATION LAB	0	0	2	Audit	2
7	ESCL	25B17GE172	ENGINEERING DRAWING & DESIGN	0	0	3	1.5	3
8	HSMC	25B11HS211	UNIVERSAL HUMAN VALUES (UHV)	2	1	0	3	3
				Total			**18.5**	**24**
SUMMER TRAINING - I (4 Weeks)								
B.Tech. (Maths & Computing) III SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	BSC	25B11MA311	PROBABILITY AND RANDOM PROCESSES	3	1	0	4	4
2	PCC	25B11CIXXX	THEORY OF COMPUTATION	3	0	0	3	3
3	PCC	25B11CIXXX	DATA STRUCTURES	3	1	0	4	4
4	PCCL	25B11CIXXX	DATA STRUCTURES LAB	0	0	2	1	2
5	PCC	25B11CI313	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	3
6	PCCL	25B17CI373	DATABASE MANAGEMENT SYSTEMS LAB	0	0	2	1	2
7	PCC	25B11CIXXX	OBJECT ORIENTED PROGRAMMING USING JAVA	0	0	2	1	2
8	SEC	XXXCIXXXX	COMPETITIVE PROGRAMMING - I	0	0	2	1	2
9	HSMC	25B11HS311	ECONOMICS	2	1	0	3	3
10	MNC	25B11GE311	ENVIRONMENTAL STUDIES	3	0	0	Audit	3
11	PRC	25B19MA391	SUMMER TRAINING-I (4 WEEKS)*	4 Weeks			2	0
				Total			**23**	**28**

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B.Tech. (Maths & Computing) IV SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	PCC	25BS1MA411	NUMERICAL ANALYSIS FOR MATHEMATICAL COMPUTING	3	0	0	3	3
2	PCCL	25BS7MA471	NUMERICAL ANALYSIS FOR MATHEMATICAL COMPUTING LAB	0	0	2	1	2
3	PCC	25B11MA213	DISCRETE COMPUTATIONAL MATHEMATICS	3	1	0	4	4
4	PCC	25B11CI412	DESIGN AND ANALYSIS OF ALGORITHMS	3	1	0	4	4
5	PCCL	25B17CI472	DESIGN AND ANALYSIS OF ALGORITHMS LAB	0	0	2	1	2
6	PCC	25B11CI413	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	0	3	3
7	PCCL	25B17CI473	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	0	0	2	1	2
8	PCCL	25B17MA471	R - SOFTWARE LAB	0	0	2	1	2
9	HSMC	XXXHSXXX	HSS ELECTIVE	2	1	0	3	3
10	PEC	25B11CIXXX	DISCIPLINE ELECTIVE – 1	2	0	0	2	2
	PECL	25B11CIXXX	DISCIPLINE ELECTIVE – 1 LAB	0	0	2	1	2
11	SEC	25B17CI476	COMPETITIVE PROGRAMMING – II	0	0	2	1	2
				Total			**25**	**31**
SUMMER TRAINING – II (6 Weeks)								
B.Tech. (Maths & Computing) V SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	PCC	XXXMAXXX	REAL ANALYSIS AND DIFFERENTIAL EQUATIONS	3	1	0	4	4
2	PCC	XXXMAXXX	THEORY & APPLICATIONS OF LINEAR ALGEBRA	3	0	0	3	3
3	PCC	XXXCIXXXX	OPERATING SYSTEMS	3	0	0	3	3
4	PCCL	XXXCIXXXX	OPERATING SYSTEMS LAB	0	0	2	1	2
5	PCCL	XXXCIXXXX	FULL STACK DEVELOPMENT LAB	0	0	2	1	2
6	BSC	XXXXXXX	SCIENCE ELECTIVE	3	0	0	3	3
7	PEC	XXXXXXX	DISCIPLINE ELECTIVE – 2	2	0	0	2	2
8	PECL	XXXXXXX	DISCIPLINE ELECTIVE – 2 LAB	0	0	2	1	2
9	PEC	XXXXXXX	DISCIPLINE ELECTIVE – 3	3/2	0	0/2	3	3/4
11	HSC	XXXHSXXX	LOGICAL AND QUANTITATIVE TECHNIQUES-I	2	0	0	2	2
12	OMC	XXXHSXXX	INDIAN CONSTITUTION & TRADITIONAL KNOWLEDGE	2	0	0	Audit	2
13	SEC	XXXCIXXXX	COMPETITIVE PROGRAMMING – III	0	0	2	1	2
114	PR	25B19MA591	SUMMER TRAINING-II	6 Weeks			2	0
				Total			**26**	**30/31**

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B.Tech. (Maths & Computing) VI SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	PCC	XXXECXXXX	COMPUTER NETWORKS& IoT	3	0	0	3	3
2	PCC	XXXECXXXX	COMPUTER NETWORKS&IoT LAB	0	0	2	1	2
3	PCC	XXXMAXXXX	STATISTICAL METHODS AND APPLICATIONS	3	0	0	3	3
4	PCC	XXXMAXXXX	STATISTICAL METHODS AND APPLICATIONS LAB	0	0	2	1	2
5	PEC	XXXXXX	DISCIPLINE ELECTIVE – 4	3	0	0	3	3
6	PEC	XXXXXX	DISCIPLINE ELECTIVE – 5	3	0	0	3	3
7	OEC	XXXXXX	OPEN ELECTIVE –1	3	0	0	3	3
8	HSC	XXXHSXXX	LOGICAL AND QUANTITATIVE TECHNIQUES-II	2	0	0	2	2
9	VAC	XXXCIXXXX	SELECTED VALUE-ADDED COURSE	2	0	0	Audit	2
10	HSC	XXXHSXXX	SOFT SKILLS FOR EMPLOYABILITY	0	0	2	1	2
11	PR	25B19MAXXX	MINOR PROJECT	0	0	4	2	4
				Total			**22**	**29**
SUMMER TRAINING - III (6 Weeks)								
B.Tech. (Maths & Computing) VII SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	PEC	XXXXXX	DISCIPLINE ELECTIVE – 6	3	0	0	3	3
2	OEC	XXXXXX	OPEN ELECTIVE –2	3	0	0	3	3
3	PR	XXXXXX	SUMMER TRAINING-III	6 Weeks			4	0
4	PR	XXXXXX	MAJOR PROJECT – I	0	0	8	4	8
				Total			**14**	**14**
B.Tech. (Maths & Computing) VIII SEMESTER								
S. No.	**Category Code**	**Subject Code**	**Name of the Subjects**	**Course Hours**			**Credits**	**Total Hours**
				L	**T**	**P**		
1	PEC	XXXXXX	DISCIPLINE ELECTIVE – 7	3	0	0	3	3
2	OEC	XXXXXX	OPEN ELECTIVE –3	3	0	0	3	3
3	PR	XXXXXX	MAJOR PROJECT –II	0	0	16	8	16
				Total			**14**	**22**

Total Credits 165

1	Basic Science	BSC	22
2	Basic Science Lab	BSCL	2
3	Engineering Science	ESC	10
4	Engineering Science Lab	ESCL	7
5	Humanities & Social Sciences	HSMC	16
6	Humanities & Social Sciences Lab	HSMCL	1
7	Professional Core	PCC	41
8	Professional Core Lab	PCCL	11
9	Professional Elective	PEC	19
10	Professional Elective Lab	PECL	2
11	Open Elective	OEC	9
12	Mandatory Course	MNC	Audit
13	Project/Seminar	PR	22
14	Skill Enhancement Course	SEC	3
15	Value Added Courses	VAC	Audit

Total 165

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Baskets - B.Tech. (M&C) 2025-2026 Admitted Batch

Department of CSE & Mathematics
Bucket Wise Tentative List of Elective Courses
(2025-2026 Admitted Batch) (To be updated)

HSS ELECTIVE (4th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	25B1WHS431	Introduction to Finance and Accounting	2	1	0	3	3
2	XXXXXXX	India in a Globalized World: Democracy, Development and Contemporary Challenges	2	1	0	3	3
3	XXXXXXX	Career Readiness Blueprint: From Campus to Corporate	2	1	0	3	3
4	XXXXXXX	AI and Society	2	1	0	3	3

Discipline Elective – 1 and Discipline Elective – 1 Lab (offered in 4th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Data Analytics using R and Python	2	0	0	2	2
2	XXXXXX	Mobile Application Development	2	0	0	2	2
3	XXXXXX	Fundamentals of Smart Systems and IoT	2	0	0	2	2
4	XXXXXX	Introduction to Compiler Design	2	0	0	2	2
5	XXXXXX	Data Analytics using R and Python Lab	0	0	2	2	1
6	XXXXXX	Mobile Application Development Lab	0	0	2	2	1
7	XXXXXX	Fundamentals of Smart Systems and IoT Lab	0	0	2	2	1
8	XXXXXX	Introduction to Compiler Design Lab	0	0	2	2	1
9	XXXXXXX	Data Engineering	2	0	0	2	2
10	XXXXXXX	Data Engineering Lab	0	0	2	2	1
11	XXXXXXX	Foundation of Data Science and Visualization	2	0	0	2	2
12	XXXXXXX	Foundation of Data Science and Visualization Lab	0	0	2	2	1
13	XXXXXXX	Computational Fundamentals for Optimization	2	0	0	2	2
14	XXXXXXX	Computational Fundamentals for Optimization Lab	0	0	2	2	1
15	XXXXXXX	Artificial and Computational Intelligence	2	0	0	2	2
16	XXXXXXX	Artificial and Computational Intelligence Lab	0	0	2	2	1

Discipline Elective – 2 and Discipline Elective – 2 Lab (offered in 5th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Fundamentals of Soft Computing	2	0	0	2	2
2	XXXXXX	Fundamentals of Computer and Cyber Security	2	0	0	2	2
3	XXXXXX	Data Mining and Data Warehousing	2	0	0	2	2
4	XXXXXX	Agile Software Development Process	2	0	0	2	2
5	XXXXXX	IoT Analytics	2	0	0	2	2
6	XXXXXX	Fundamentals of Soft Computing Lab	0	0	2	2	1
7	XXXXXX	Fundamentals of Computer and Cyber Security Lab	0	0	2	2	1

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8	XXXXXX	Data Mining and Data Warehousing Lab	0	0	2	2	1
9	XXXXXX	Agile Software Development Process Lab	0	0	2	2	1
10	XXXXXX	IoT Analytics Lab	0	0	2	2	1
11	XXXXXXX	Big Data Analytics	2	0	0	2	2
12	XXXXXXX	Big Data Analytics Lab	0	0	2	2	1
13	XXXXXXX	Search in AI	2	0	0	2	2
14	XXXXXXX	Search in AI Lab	0	0	2	2	1

Discipline Elective – 3 and Discipline Elective – 3 Lab (offered in 5th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Image Processing and Computer Vision	2	0	0	2	2
2	XXXXXX	Introduction to Blockchain Technology	2	0	0	2	2
3	XXXXXX	Computing for Data Science	2	0	0	2	2
4	XXXXXX	Sensor Technology & Android Programming	2	0	0	2	2
5	XXXXXX	Concept of Graph Theory	2	0	0	2	2
6	XXXXXX	Image Processing and Computer Vision Lab	0	0	2	2	1
7	XXXXXX	Introduction to Blockchain Technology Lab	0	0	2	2	1
8	XXXXXX	Computing for Data Science Lab	0	0	2	2	1
9	XXXXXX	Sensor Technology & Android Programming Lab	0	0	2	2	1
10	XXXXXX	Concept of Graph Theory Lab	0	0	2	2	1
11	XXXXXXX	Computational Data Analysis	2	0	0	2	2
12	XXXXXXX	Computational Data Analysis Lab	0	0	2	2	1

Discipline Elective – 4 (offered in 6th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Introduction to Deep Learning	3	0	0	3	3
2	XXXXXX	Cryptocurrency Technologies	3	0	0	3	3
3	XXXXXX	Information Retrieval and Semantic Web	3	0	0	3	3
4	XXXXXX	Cloud Computing Essentials: Azure and AWS	3	0	0	3	3
5	XXXXXX	Operations Research	3	0	0	3	3
6	XXXXXX	Number Theory	3	0	0	3	3
7	XXXXXXX	Reinforcement Learning	3	0	0	3	3
8	XXXXXXX	Responsible AI and AI Ethics	3	0	0	3	3

Discipline Elective – 5 (offered in 6th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Optimization Techniques	3	0	0	3	3
2	XXXXXX	Mathematical Modelling and Simulation	3	0	0	3	3
3	XXXXXXX	Statistical Analysis and Computing	3	0	0	3	3
4	XXXXXXX	Time Series Analysis and Forecasting	3	0	0	3	3
5	XXXX	Soft Computing and Optimization Algorithms	3	0	0	3	3

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Discipline Elective – 6 (offered in 7th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXX	Machine Learning and Natural Language Processing	3	0	0	3	3
2	XXXX	Ethical Hacking & Prevention	3	0	0	3	3
3	XXXX	Introduction to Large Scale Database Systems	3	0	0	3	3
4	XXXX	Introduction to DevOps	3	0	0	3	3
5	XXXX	Industrial Automation and IOT	3	0	0	3	3
6	XXXX	Fuzzy Sets, Logic and Applications	3	0	0	3	3
7	XXXXXXX	Probabilistic Graphical Models	3	0	0	3	3
8	XXXXXXX	AI for IoT	3	0	0	3	3
9	XXXXXXX	Explainable AI	3	0	0	3	3
10	XXXXXXX	Sentiment Analysis and Opinion Mining	3	0	0	3	3

Discipline Elective – 7 (offered in 8th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	AI for Healthcare & Smart Systems	3	0	0	3	3
2	XXXXXX	Digital Forensics and Cyber Laws	3	0	0	3	3
3	XXXXXX	Social Network Analysis	3	0	0	3	3
4	XXXXXX	Software Construction using Kubernetes and Micro-services	3	0	0	3	3
5	XXXXXX	Algebraic Coding and Cryptography	3	0	0	3	3
6	XXXXXX	Linear Algebra for Data Science and Machine Learning	3	0	0	3	3
7	XXXXXXX	AI for Finance	3	0	0	3	3
8	XXXXXXX	Agentic AI	3	0	0	3	3

Science Elective (offered in 5th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Physics of Renewable Energy Systems	3	0	0	3	3
2	XXXXXX	Optoelectronic Materials and Devices	3	0	0	3	3
3	XXXXXX	Physics of Functional Materials & Devices	3	0	0	3	3
4	XXXXXX	Physics of Medical Imaging Techniques	3	0	0	3	3
5	XXXXXX	Science and Technology of Materials	3	0	0	3	3
6	XXXXXX	Applied Materials Science	3	0	0	3	3
7			3	0	0	3	3
8			3	0	0	3	3

Open Elective – 1 (offered in 6th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Waste to Energy Conversion	3	0	0	3	3
2	XXXXXX	Solid State Electronic Devices	3	0	0	3	3
3	XXXXXX	Photovoltaic Techniques	3	0	0	3	3
4	XXXXXX	Applied Statistical Mechanics	3	0	0	3	3
5	XXXXXX	Medical and Industrial Applications of Nuclear Radiations	3	0	0	3	3
6	XXXXXX	Cyber Security	3	0	0	3	3
7	XXXXXX	Introduction to Information Theory	3	0	0	3	3
8	XXXXXX	Sociology of Youth	3	0	0	3	3

Open Elective – 2 (offered in 7th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Healthcare Marketplace	3	0	0	3	3
2	XXXXXX	Stress: Biology, Behaviour and Management	3	0	0	3	3
3	XXXXXX	HUMAN RESOURCE ANALYTICS	3	0	0	3	3
4	XXXXXX	Superconducting Materials, Magnets and Devices	3	0	0	3	3
5	XXXXXX	Introduction to Quantum Information Processing	3	0	0	3	3
6	XXXXXX	Nanoscience and Technology	3	0	0	3	3
7	XXXXXX	Algorithm and Analysis and AI	3	0	0	3	3

Open Elective – 3 (offered in 8th Semester)

S. No.	Course Code	Course Title	L	T	P	Total	Credits
1	XXXXXX	Photonics and Applications	3	0	0	3	3
2	XXXXXX	Astrophysics	3	0	0	3	3
3	XXXXXX	Biophysics	3	0	0	3	3
4	XXXXXX	Plasma Physics	3	0	0	3	3

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Mathematics-I

COURSE CODE: 25B11MA113
COURSE CREDITS: 4
CORE/ELECTIVE: CORE
L-T-P: 3-1-0

Pre-requisites: Basic concepts of calculus and algebra.

Course Objectives:

- Understand and apply partial differentiation, Taylor series, and Jacobians for multivariable analysis.
- Evaluate double integrals, use variable transformations, and apply special functions to geometric problems.
- Analyze vector fields and apply vector integral theorems in physical contexts.
- Solve linear differential equations and use Laplace transforms and matrix methods.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Students will be able to analyze and optimize multivariable functions using chain rule, change of variables, Taylor series, maxima-minima techniques, and Jacobians.	Familiarity
CO-2	Students will be able to evaluate integrals using change of order and variables, apply special functions, and interpret curves and surfaces.	Assessment & Usage
CO-3	Students will be able to analyze vector fields using gradient, divergence, and curl, and apply fundamental theorems of vector calculus to evaluate line, surface, and volume integrals.	Assessment & Usage
CO-4	Students will be able to solve linear differential equations and initial value problems using analytical methods and Laplace transforms, including special functions like Dirac delta and unit step functions.	Assessment
CO-5	Students will be able to analyze systems of linear equations, compute eigenvalues and eigenvectors, and apply matrix methods to obtain diagonal forms.	Assessment

Course Contents:

Unit	Contents	Lectures required
1	**Partial differentiation:** Chain rule, change of variables, Taylor's series for function of two or more variables, maxima and minima of function of two variables, Jacobians.	7
2	**Double integrals:** Change of order and change of variables, Gamma and Beta functions, Applications to areas and volumes, Equations to curves and surfaces, Plots of some well-known curves and surfaces.	7
3	**Vector Differentiation and Integration:** Gradient, divergence and curl, Normal and tangent to a plane surface. Line integrals, Green's Theorem in a plane, surface integrals, Gauss and Stokes theorems.	10

4	**Differential Equations, and Laplace Transform:** Differential Equations with constant coefficients, Cauchy-Euler equations, Equations of the form $y'' = f(y)$, simple applications. Laplace Transform, inverse Laplace transform, Dirac delta and unit step function, Solution of IVPs.	12
5	**Matrices:** Linear dependence and independence of rows, row echelon form, Rank, Gauss elimination method, Eigen values and vectors, symmetric matrices, Reduction to diagonal form, Quadratic forms.	6
	Total Lectures	**42**

Text Books:

- Jain and Iyengar, Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House, 2023.
- Thomas, G. B and Finney, R. L., Calculus and Analytical Geometry, Pearson Education Asia (Addison Wesley), New Delhi.

Reference Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2023.
- Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki; Thomas Calculus, 15th Edition, Pearson Education, 2024.
- Lipschutz, S., Lipson, M., Linear Algebra, Schaum Outline Series.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage/ Scope of Examination
1	T-1	15	1 Hour	Syllabus covered uptoT-1
2	T-2	25	1.5 Hours	Syllabus covered uptoT-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2)-08 Quizzes (3)-12 Attendance - 05

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	2	2	2	2	2	1	1	1	2	2	2	2	**1.8**
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	**1.8**
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	**2.1**
CO-5	2	2	2	2	2	1	1	1	2	2	1	2	**1.7**
Average	**2**	**2.4**	**2.4**	**2.4**	**2.4**	**1**	**1**	**1**	**2**	**2.2**	**1.4**	**2**	

Physics - I

COURSE CODE: 25B11PH111

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: None

Course Objectives:

1. To enable the students to get a better understanding of electromagnetic fields and their applications in engineering.
2. To enable the students to get a better understanding of physical optics and its applications in engineering.
3. After the course, students should have enhanced their ability to think logically about science and technology problems and obtain their solutions.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall the basic principles of physics related to optics, relativity, quantum mechanics, and atomic physics.	Familiarity
CO-2	Illustrate the various physical phenomena with an interpretation based on the mathematical expressions involved.	Assessment
CO-3	Apply the concepts/principles to solve the problems related to the wave nature of light, relativity, quantum mechanics and atomic physics.	Assessment and Implementation
CO-4	Analyse and examine the solutions to the problems using the physical and mathematical concepts involved.	Assessment and Implementation

Course Contents:

Unit	Title of the Module	Contents	Lectures required
1	Physical Optics	Analytical treatment of interference, Intensity distribution of fringe system, Fresnel's Biprism, Newton's rings, Michelson interferometer, Diffraction (limited to Fraunhoffer class) from Single slit, double slit and Diffraction grating, Polarization, Phenomenological understanding of Birefringence, Principles of use of uni-axial crystals in practical polarizers, compensators andwave plates, Production and analysis of completely polarized light. Optical activity, Polarimeter	**17**
2	Relativity	Michelson-Morley experiment, Lorentz transformations, Addition of velocities, Mass variation with velocity, Mass-energy relation.	**4**
3	Radiation	Blackbody radiation, Wien's law, Rayleigh-Jeans law, Planck's law of radiation.	**3**
4	Quantum Mechanics	Wave-particle duality, Compton scattering, Matter waves, Heisenberg's uncertainty principle, Schrödinger wave	

		equation and its applications to the free particle in a box, potential barrier and Harmonic oscillator.	**8**
5	Atomic Structure	Origin of spectral lines, spin and orbital angular momentum, Quantum numbers, Atoms in magnetic field, Zeeman effect.	**4**
6	Thermodynamics	Review of the basic laws of thermodynamics, Entropy and Clausius-Cleyperon equation.	**6**
		Total Lectures	**42**

Suggested Text Book(s):

1. A. Beiser, Concepts of Modern Physics, McGraw-Hill International, 2019.
2. S. Sharma & J. Sharma, Engineering Physics, Pearson Pub, 2018.
3. B.K. Pandey and S. Chaturvedi, A Textbook of Optics, 2nd Ed. Cengage, 2024.

Suggested Reference Book(s):

1. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill, 2001.
2. D. J. Griffiths, Introduction to Quantum Mechanics, Reed College: Prentice Hall, 2018.
3. A. Ghatak, Optics, 7th ed. Tata McGraw-Hill, 2020.
4. Mark W.Zemansky, Thermodynamics, 7th ed. Tata McGraw-Hill, 2007.
5. A. N. Michael and I. L. Chuang, Quantum Computation and Quantum Information, 10th ed. Cambridge University Press, 2010.

Other useful resource(s):

1. NPTEL sources
2. MIT OpenCourseWare resources

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 Quizzes (2) - 10 Attendance - 5

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

Course outcomes (Physics -1)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	1	1	1		1						1	**1**
CO-2	1	1	1	1	1						1	**1**
CO-3	1	1	1	1	1	1					1	**1**
CO-4	1	1	1	1	1	1					1	**1**
Average	**1**	**1**	**1**	**1**	**1**	**1**					**1**	

Physics Lab-I

COURSE CODE: 25B17PH171

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall optics and modern physics principles behind the experiments.	Familiarity
CO-2	Explain the experimental setup and the principles involved behind the experiments performed.	Assessment
CO-3	Plan the experiment and set the apparatus and take measurements.	Assessment and Implementation
CO-4	Analyze the data obtained and calculate the error.	Analysis
CO-5	Interpret and justify the results.	Evaluation

List of Experiments:

S.No	Title of the module	Description	Hours
1	Optics	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.	**4**
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.	**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 Books:

1. S. P. Singh, Advanced Practical Physics,Pragati Prakashan, Vol. 1, 2016.
2. C. L. Arora, Practical Physics, S. Chand Company Limited, 21st edition, 2015.
3. N. Subrahmanayam, Brij Lal and M.N. Avadhanulu, A Text Book of Optics, S. Chand (2015)
4. Ajoy Ghatak, Optics, Tata McGraw Hill, 7th addition, (2020)
5. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill (2001).

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	P-1	20	1 Hour	Experiments covered upto P-1
2	P-2	20	1.5 Hours	Experiments covered upto P-2
3	P-3	60 (30- Lab Record, Attendance; 30- Project)	Throughout semester	All experiments

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

Course outcomes (Physics Lab-1)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	1	1	1	1	1	1					1	**1**
CO-2	1	1	1	1	1	1					1	**1**
CO-3	1	1	1	1	1	1					1	**1**
CO-4	1	1	1	1	1	1					1	**1**
CO-5	1	1	1	1	1	1		1	1		1	**1**
Average	**1**	**1**	**1**	**1**	**1**	**1**		**1**	**1**		**1**	

Software Development Fundamentals – I

COURSE CODE: 25B11CI112

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: NONE

Course Objectives:

1. To introduce the software development life cycle and develop problem-solving skills using flowcharts and pseudocode.
2. To provide a strong foundation in C programming concepts including data types, operators, and control flow statements.
3. To enable students to implement and manipulate arrays and pointers for solving computational problems.
4. To develop the ability to write modular programs using functions with various parameter passing techniques.
5. To familiarize students with structures and unions for handling complex data in C.
6. To equip students with skills in file handling to manage text and binary data through C programs.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Explain the logic for solving problems considering various phases of software development life cycle and depicting them using algorithms and flowcharts	Understand
CO-2	Explain basics of C programming concepts to make decision for solving problems	Understand
CO-3	Demonstrate and contrast different methods for writing modular programs in C	Understand
CO-4	Use various C programming constructs to implement iteration, and recursion	Apply
CO-5	Apply and implement arrays, pointers, structures and file handling for solving real-world problems	Apply

Course Contents:

Unit	Contents	Lectures required
1	Introduction: Introduction to Software Development Life Cycle, Step by step solution to simple problems, developing logic/flow- chart/pseudo code to solve problems like 2D screen saver, simple/logical games, puzzles	**6**
2	Data types, operators, and Control Flow: Data, variables and constants, data types, operators – binary, unary, ternary, operator precedence, operations using different operators, if, if-else, while, do-while, for, switch-case in C Programming	**8**
3	Array: Fundamentals of Array, Implementation of 1D/2D Array and related operations like insertion, traversal, updation, etc. in C programming using different problems	**7**
4	Pointers: Pointers in C, Dynamic memory allocation for 1D/2D array, Arithmetical operations on pointers	**5**
5	Functions: Introduction to Functions and its implementation in C programming language, Functions using Pass by value, functions using pass by reference, recursive functions	**5**
6	Structures and Union: Introduction and implementation of Structures and Union in C programming, Array of Structures, Pointer to Structures and related operations like insertion, traversal, updation, etc. in C programming using different problems, Structures using function	**5**
7	File Handling: Introduction to File, creation of files in C programming language, Modes of File Handling like read, write, update; different types of files like binary file and text file and respective operations like, opening, closing, reading, writing, end of file, traversing the file, for structured and unstructured data	**6**
Total lectures		**42**

Suggested Text Book(s):

1. Paul Deitel and Harvey Deitel, “C How to Program”, 9th Edition, Pearson Education, 2022, ISBN: 978-0-13-739839-3
2. E Balagurusamy, “Computing Fundamentals & C Programming”, 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-9352604166
3. Greg Perry and Dean Miller, “C Programming Absolute Beginner's Guide”, 3rd Edition, Que Publishing, 2013, ISBN: 978-0789751980
4. DavidGriffiths and Dawn Griffiths, “Head First C: A Brain-Friendly Guide”, O’Reilly Media, Inc., 2012, ISBN: 978-1449399917

Suggested Reference Book(s):

1. Herbert Schildt, "The Complete Reference C", 4th Edition, McGraw Hill Education, 2017, ISBN: 978-0070411838
2. Brian W. Kernighan and DennisRitchie, "The C Programming Language", 2nd Edition, Pearson Education India, 2015, ISBN: 978-9332549449
3. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 3rd Edition, Cengage Learning, 2007, ISBN: 978-8131503638

Other useful resource(s):

1. Link to NPTEL course contents: https://archive.nptel.ac.in/courses/106/105/106105171/
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

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 Quizzes (2) -10 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	3	3	2	2	2	1	1	2	2	2	2	**2.0**
CO-2	3	3	2	2	2	1	1	1	2	1	2	**1.8**
CO-3	3	3	3	2	3	1	1	1	2	2	1	**2.0**
CO-4	3	3	3	3	3	1	1	1	2	2	2	**2.3**
CO-5	3	3	3	3	3	1	1	1	1	1	2	**2.2**
Average	**3**	**3**	**2.6**	**2.4**	**2.6**	**1.0**	**1.0**	**1.2**	**1.8**	**1.6**	**1.8**	

Software Development Fundamentals Lab-I

COURSE CODE: 25B17CI172

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: NONE

Course Objectives:

1. To develop logic using data types, expressions, and control structures.
2. To implement programs using arrays, strings, and pointers.
3. To apply functions and recursion for modular programming.
4. To use structures and unions for handling complex data.
5. To build menu-driven programs for basic file operations.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Develop programs/logic for data types, expressions and conditional structure	Apply
CO2	Perform programs for arrays, strings and pointers	Apply
CO3	Perform programs of functions and recursive functions.	Apply
CO4	Implement programs for structure and union.	Apply
CO5	Implement menu driven programs to perform basic file operations.	Apply

List of Experiments

S. No.	Description	Hours
1	Flow chart and Logic Building: Developing logic/flow-chart/pseudo code to solve problems, simple/logical games, puzzles	**4**
2	Data Type, Statements, Expressions, Operators: Data, variables and constants, data types, operators – binary, unary, ternary, operator precedence, associativity	**2**

3	Control Flow: Develop C programs using conditional structure (if, ifelse, nested if), and iterative control structure (do-while, while, for). Implement switch case statement.	**4**
4	Array and String: Array initialization, reading and writing operations with array, one dimensional, two-dimensional array, strings, and related operations like addition, multiplication, traversal, transpose etc.	**4**
5	Pointers: Pointers in C, Dynamic memory allocation for 1D/2Darray, Arithmetical operations on pointers, recursive functions like palindrome, factorial, fibonacci series, number system etc	**4**
6	Functions: User defined functions and inbuilt functions, Functions definition, declaration, calling, Pass by value, functions using pass by reference, functions with array	**2**
7	Structures and Union: Struct keyword, Structure and Union, Structure variable, dot operator, pointer to structures, arrow operator, Array of Structures, structure using functions.	**4**
8	File Handling: File creation, Modes of File Handling like read, write, update; different types of files like binary file and textfile and respective operations like, opening, closing, reading, writing, end of file, traversing the file for structured and unstructured data	**4**
Total Lab hours		**28**

Suggested/Resources:

1. Paul Deitel and Harvey Deitel, "C HOW TO PROGRAM", 9th Edition, Pearson Education, 2023, ISBN 978-0-13-739839-3.
2. H. Cooper and H. Mullish, Jaico Publishing House. "Spirit of C", 4th Edition, Jaico Publishing House,2006.
3. Herbert Schildt. "The Complete Reference C ", 4th Edition, TMH, 2000.
4. Brian W. Kernighan and Dennis M. Ritchie,"The C Programming Language", 2nd Edition, PrenticeHall India, New Delhi, 2002.
5. Peter Norton, "Introduction to Computers", 5th edition, Tata McGraw-Hill, Delhi., 2005.
6. Balaguruswamy, Programming in ANCI C", 2nd Edition, TMH, 2001.
7. Ashok N. Kamthane , "Programming with ANSI and Turbo C", Pearson Education, Delhi, 2003.
8. Rajaraman V., "Fundamentals of Computer", 3rd Edition, Prentice-Hall India, New Delhi, 2005.
9. B. A. Forouzan, R. F. Gilberg "Computer Science: A Structured Programming Approach Using C",2nd Edition, Thomson Press, New Delhi, 2006.
10. AviSilberschatz, Henry F. Korth, and S. Sudarshan, "Database System Concepts", 6th edition,McGraw-Hill, 2010.

Evaluation Scheme:

S. No	Exam	Marks
1	Mid Sem. Evaluation (P-1)	20
2	End Sem. Evaluation (P-2)	20

3.	Internal Assessment (P-3) (May include attendance, class participation, lab file records, experiment execution, viva voce, quizzes, mini-projects 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	Average
CO-1	3	3	2	2	3	1	1	2	2	2	2	**2.1**
CO-2	3	3	2	2	3	1	1	2	2	2	2	**2.1**
CO-3	3	3	3	2	3	1	1	2	2	2	2	**2.2**
CO-4	3	3	3	2	3	1	1	2	2	2	2	**2.2**
CO-5	3	3	3	3	3	2	2	3	3	3	3	**2.8**
Average	**3.0**	**3.0**	**2.6**	**2.2**	**3**	**1.2**	**1.2**	**2.2**	**2.2**	**2.2**	**2.2**	

Basic Electronics

COURSE CODE: 25B11EC111
COURSE CREDITS: 4
CORE/ELECTIVE: CORE
L-T-P: 3-1-0

Pre-requisite: None

Course Objectives:

1. To provide a foundational understanding of electronic components, circuits, and fundamental concepts.

2. To analyze different circuits using various fundamental concepts.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall the concepts of various circuit elements and Kirchhoff's laws.	Remembering Level C1
CO-2	Understand the basics of semiconductor PN junction diodes and Op-Amp, and their applications.	Understanding Level C2
CO-3	Apply network theorems to effectively solve complex DC circuits.	Applying Level C3
CO-4	Explain the operation of transistors (BJT and MOSFET) and analyze their biasing techniques.	Analyzing Level C4

Course Contents:

Unit	Contents	Lectures required
1	Basic Circuit Analysis: Kirchhoff's Laws, Voltage Divider rule, Current Divider Rule, DC circuit analysis (Nodal, Mesh), Superposition and Thevenin/Norton Theorem	15
2	PN Junction diode and Applications : PN Junction, Biasing the PN Junction, Current–Voltage Characteristics of a PN Junction, PN Junction Diodes, Half Wave Rectifier & Full Wave Rectifier Clipper & Clamping Circuits	8
3	Zener Diode and Applications: Zener Diode and applications, Line and Load Regulations of reference circuits.	2
4	Introduction to BJT : Introduction to BJT, operation, characteristics, Biasing and Stability	7
5	Introduction to MOSFET: Introduction to MOSFET, operation, characteristics and biasing	2
6	Op-amps and applications: Block Diagram Representation of Typical Op-Amp, Schematic Symbol, Op-Amp parameters, Ideal Op-Amp, Equivalent Circuit of Op-Amp, Op-Amp Applications: Inverting Configuration, Non-Inverting Configuration, Voltage Follower, summer, comparator, difference Amplifier, Integrator, Differentiator	8
Total lectures		42

Suggested Text Book(s):

1. William H. Hayt, Jack Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Education; Eighth edition, 2013
2. R. L. Boylestad, and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th edition, Prentice Hall of India, 2014.

Suggested Reference Book(s):

1. R.C. Dorf and James A.Svoboda, "Introduction to ElectricCircuits", 9thedition, John Wiley & Sons,2013.
2. Charles K. Alexander (Author),Matthew N.OSadiku,"Fundamentals of Electric Circuits", 6th edition,Tata McGraw Hill, 2019.

Other useful resource(s):

1. https://onlinecourses.nptel.ac.in/noc21_ee55/preview
2. https://nptel.ac.in/courses/122106025

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1 (16 Lectures)
2	T-2	25	1.5 Hours	Syllabus covered upto T-2 (12 Lectures)
3.	T-3	35	2 Hours	Entire Syllabus (14 Lectures after T2)
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2)- 10 Attendance - 5

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

Course outcomes (Basic Electronics)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	3	3	3	3	2	2	1	1	1	1	1	1.91
CO-2	3	2	2	2	3	2	1	1	1	1	2	1.82
CO-3	3	3	3	3	2	2	1	1	1	1	1	1.91
CO-4	3	3	3	3	2	2	1	1	1	1	1	1.91
Average	3	2.75	2.75	2.75	2.25	2	1	1	1	1	1.25	

Basic Electronics Lab

COURSE CODE: 25B17EC171
COURSE CREDITS: 1
CORE/ELECTIVE: CORE
L-T-P: 0--2

Pre-requisite: None
Course Objectives:

1. To provide a foundational understanding of electronic components, circuits, and fundamental concepts.
2. To analyze different circuits using various fundamental concepts.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall various electronic components and working of basic measuring instruments	Remembering Level C1
CO-2	Understand the input-output characteristics of BJT	Understanding Level C2
CO-3	Verify Kirchhoff's laws and apply network theorems to solve DC circuit	Applying Level C3
CO-4	Analyze operational amplifier in various configurations and characteristics of basic diodes including their applications	Analyzing Level C4

List of Experiments:

S. No.	Description	Hours
1	Introduction to various components (Resistor, Capacitor, Inductor, and IC) and instruments: Multimeter, Bread board, Regulated D.C. power supply.	2
2	Introduction to Function generator, Digital Storage Oscilloscope (DSO). Study the properties of sinusoidal, triangular and rectangular pulse signals on DSO.	2
3	Verification of Ohm's law, KCL and KVL.	2
4	Verification of Superposition Theorem.	2
5	Verification of Thevenin's and Maximum Power Transfer Theorem.	2
6	To study the forward bias I-V (current-voltage) characteristics of a simple p-n junction diode. Also determine the forward resistance of the diode.	2
7	To observe the output waveform of half/full wave rectifier and calculate its ripple factor and efficiency	2
8	To study the reverse bias I-V (current-voltage) characteristics of a Zener diode. Also determine the breakdown voltage, static and dynamic resistances.	2
9	Realization of desired wave shapes using clipper and clamper circuits.	2
10	To plot input and output characteristics of a common emitter NPN BJT.	2
11	To realize inverting and non inverting amplifier configuration using Op-Amp IC- 741.	2
12	To realize adder and subtractor circuits using Op-Amp IC-741.	2
13	VIRTUAL LAB 1: BJT Common Base Characteristics. https://be-iitkgp.vlabs.ac.in/exp/common-base-characteristics/	

14	VIRTUAL LAB 2: Study of basic properties of operational amplifier: inverting andnon-inverting amplifiers. https://be-iitkgp.vlabs.ac.in/exp/non-inverting-amplifiers/	
Total lectures		24

Suggested Text Book(s):

1. William H. Hayt, Jack Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Education; Eighth edition, 2013
2. R. L. Boylestad, and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th edition, Prentice Hall of India, 2014.

Suggested Reference Book(s):

1. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 9thedition, John Wiley & Sons, 2013.
2. Charles K. Alexander (Author), Matthew N. O Sadiku, "Fundamentals of Electric Circuits", 6th edition, Tata McGraw Hill, 2019.

Other useful resource(s):

1. https://onlinecourses.nptel.ac.in/noc21_ee55/preview
2. https://nptel.ac.in/courses/122106025

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	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	

ENGLISH

COURSECODE: 25B11HS111
COURSE CREDITS: 2
CORE/ELECTIVE: CORE
L-T-P: 1-0-2

Pre-requisite: None

The course provides undergraduate students with a comprehensive understanding of English language and its usages across different aspects of professional life making them future ready for professional environments. The course provides a comprehensive knowledge of reading, writing, listening and speaking in English language.

Course Objectives:

1. The students will develop command over their language and synchronize their thoughts into written and verbal form
2. The student will learn to deliver effective presentations in contexts that may require PowerPoint, extemporaneous or impromptu oral presentations.
3. The student will learn to write effective emails, letters and reports
4. The student will learn to develop rhetorical skills via an understanding of literature.
5. The students will be able to understand and analyze the most effective and efficient ways to communicate in different communication scenarios.

Course Outcomes:

S. No	CourseOutcomes	Level of Attainment
CO-1	Show proficiency in basic concepts of grammar and phonetics usage.	Assessment andUsage
CO-2	Demonstrate an understanding of the basic aspects of English as a communication tool.	Understanding
CO-3	Apply grammar concepts, vocabulary skills and phonetics for effective communication and also develop effective professional writing skills.	Assessment and Usage
CO-4	Analyze rhetorical devices and literature for enhancing communication skills.	Assessment
CO-5	Communicate in diverse workplace scenarios	Usage

CourseContents:

Unit	Contents	Lectures required
1	**English as a Communication Tool** • Basic aspects of English: LSRW: Listening, Speaking, Reading, Writing • Non-Verbal Communication: Body Language, Voice Modulation, Posture • Presentation Skills • Phonetics: Transcription, Pronunciation	6
2	**Grammar & Vocabulary** • Tense, Aspect, Mood and Voice • Vocabulary Enrichment strategies	1

3	**Language through Literature** • Forms of Literature & Rhetorical Devices • One act Play • Refund by Fritz Karinthy • Famous Speeches • Swami Vivekanand's Chicago Speech	**3**
4	**Professional Application/Writing** • Textual Organization • Notice, Agenda and Minutes • Format of Report Writing	**4**
Total lectures		**14**

Syllabus for Practical:	
Syllabus for Reading Module	**No. of Hours in Lab: 7**
Practical for Learning Comprehension Strategies of Reading: Summarizing Inferencing Newspaper reading and comprehension Relating background knowledge Distinguishing between fact and opinion Finding the main idea, important facts, and supporting details	5 Hrs
Practice Quick reading through Speed-Reading software.	2 Hrs.

Syllabus for Listening Modules	**No. of Hours in Lab: 7**
Practical for Mastering the Skill of Listening: Listening for the Main Idea; Listening in sequence: for order following Through Ted Talks Listening for understanding personal & social connotations through News Brief, such as BBC, and Interviews. Listening for non-verbal connotations through Audio-Videos and Movie Clips Listening for Functional Language: understanding choice of words for same situation.	5 Hrs.
Practice Listening through software of IIT Guwahati Listening Exercises or Podcasts	2 Hrs

Syllabus for Speaking Module	No. of Hours in Lab: 7
Activities for Vocabulary Enrichment and learning Public Speaking: Practice through JAM Session- Situational Dialogues – Greetings – Taking; Leave – Introducing Oneself and Others. Making Requests and Seeking Permissions. Exposure to Structured Talks - Non-verbal Communication: Practice. Practice of Phonetics, Stress and Intonation while Making a Short Speech, Extempore and Making a Presentation	5 Hrs.
Practice speaking through specialised software	2 Hrs.

Syllabus for Writing Modules	No. of Hours in Lab: 7
Grammar Practice & Exercises: Jumbled Paragraphs for grammar learning Picking the Out of Context sentence in a Jumbled Paragraph for proper communication. Application of right grammar concepts	2 Hrs.
Cohesion in Writing Practical on Different forms of writing, like persuasive writing, expository, narrative, descriptive	2 Hrs.
Practice of Professional Writing Notice, Agenda. Minutes Memorandum and Letter Format Report Writing	3 Hrs

Suggested Text Books

1. **C.L. Bovee, J.V. Thill, M. Chaturvedi, *Business Communication Today*, 9thEd, Pearson Education, Pvt. Ltd, 2021.**
2. **A. Tiwari, *Communication Skills in English*. Khanna Publishers, 2022.**
3. **S. Kumar and P. Lata, *Communication Skills*, 1sted.Oxford University Press, 2011.**
4. **F.Karinthy,"TheRefund,"Online.Available:https://egyankosh.ac.in/bitstream/123456789/27478/1/Unit-4.pdf.**
5. **Swami Vivekananda and S. Srinivasan, "Sisters & Brothers of America: Speech at World Parliament of Religions, Chicago, 1893,"CreativeSpaceIndependentPublishingPlatform, 2015.**

Suggested Reference Books

1. **R.K. Bansal and J.B. Harrison, *Spoken English for India*, Orient Longman, 2018.**
2. **M. A. Yadugiri, *The Pronunciation of English: Principles and Practice*, India: Viva Books Pvt. Ltd, 2015.**
3. **A.R. Rizvi, *Effective Technical Communication*, 2nd ed. Chennai, India: McGraw Hill Education Private Limited, 2018.**
4. **R. Murphy, *English Grammar in Use*, 5th ed. Cambridge, UK: Cambridge University Press, 2019.**
5. **K. Mohan and N.P. Singh, *Speaking English Effectively*, 2nd ed. Delhi: Macmillan Publishers India Ltd., 2011.**
6. **E. Suresh Kumar and P.A. Sreehari, *A Handbook for English Language Laboratories*, New Delhi: Foundation, 2009.**
7. **K. M. Quintanilla and S.T. Wahl, *Business and Professional Communication*, Sage Publications Pvt India Ltd, 2011.**

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.	Practical Assessment	25	Entire Semester	Listening- 5 Reading – 5 Speaking -5 Writing – 5 Attendance- 5

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	Average	Course outcomes
CO-1	1	3	3	3	1	2	3	3	3	3	1	2.2	CO-1
CO-2	1	2	3	2	1	1	2	3	3	3	1	2	CO-2
CO-3	1	1	3	2	2	2	1	2	3	3	1	1.9	CO-3
CO-4	1	2	2	3	2	1	1	3	2	3	1	1.9	CO-4
CO-5	1	2	3	2	2	2	1	3	2	3	1	2	CO-5
Average	1	2	2.6	2.4	1.6	1.6	1.5	2.8	2.5	3	1	2	Average

Workshop

COURSE CODE: 25B17GE171

COURSE CREDITS: 1.5
CORE/ELECTIVE: CORE
L-T-P: 0-0-3

Pre-requisite: Nil

Course Objectives:

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 manufacturing of different wood working joints	Familiarity and Assessment
CO2	Study and Manufacturing of various welding joints using electric arc welding and gas welding	Familiarity and Assessment
CO3	To impart the knowledge of Sheet metal work	Familiarity and Assessment
CO4	To impart the knowledge on Lathe machine and tapering operation	Familiarity and Assessment
CO5	To have understanding of drilling and milling operation	Familiarity and Assessment

List of Experiments

S No	Description	Hours
1	To make a T-Lap/ T-Bridle joint as shown in figures, from the given reaper of size 200 x 60 x 30 mm..	3
2	To make a dovetail lap joint as shown in figures from the given reaper of size 200 x 60 x 30mm..	3
3	To make a mortise and tenon joint as shown in figure from the given reaper of size 200 x 60x 30 mm..	3
4	To make a double lap joint, using the given mild steel pieces and by arc welding.	3
5	Preparation of butt joint as shown in figure using shielded metal arc welding process.	3
6	To perform the facing, plain turning and the tapering operations in a lathe on the given cylindrical work piece for the given	3

	dimensions	
7	To perform the drilling operations and side and face milling operation on a given workpiece of given dimension in a drilling machine and milling machine.	3
8	To make a V- fitting from the given two M.S pieces.	3
9	To make a T-fitting from the given two M.S pieces.	3
10	To make a rectangular Tray as per required dimensions using Galvanized Iron sheet (150*110*26 gauge)	3
11	To make a cylindrical pipe as per required dimensions Galvanized Iron sheet (100*38*26 gauge)	3
	Total Lab hours	**33**

Suggested/Resources:

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

Evaluation Scheme:

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	Average
CO1	3	3	3	3	3	2	2	1	3	3	1	2.45
CO2	3	3	3	3	3	2	2	1	3	3	1	2.45
CO3	3	3	2	3	2	2	2	1	3	3	2	2.36
CO4	3	3	3	2	3	2	2	1	3	3	1	2.36
CO5	2	2	3	3	3	2	2	1	3	3	1	2.27
Average	**2.80**	**2.80**	**2.80**	**2.80**	**3.00**	**2.00**	**2.00**	**1.00**	**3.00**	**3.00**	**1.20**	

MATHEMATICS – II

COURSE CODE: 25B11MA211

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Prerequisite: Students should be familiar with concepts of limits, continuity, differentiation, integration, and basic matrix operations.

Course Objectives: This course equips students with: (a) comprehensive understanding of analytical, series, and transform methods for solving differential equations; (b) the ability to model physical and engineering systems mathematically using differential and complex-variable techniques; and (c) a foundation for advanced topics such as vector calculus, complex analysis, and mathematical methods in data science and engineering applications.

Course Outcomes (COs): On successful completion of this course, a student will be able to

S. No.	Course Outcomes	Level of Attainment
CO-1	Apply analytical methods to solve linear ordinary differential equations of second order with constant and variable coefficients.	Familiarity & Usage
CO-2	Explain and apply various tests for convergence of infinite series and determine power series representations of functions.	Familiarity & Usage
CO-3	Obtain series solutions of differential equations and construct special functions such as Bessel and Legendre functions with their properties.	Familiarity & Usage
CO-4	Classify and form partial differential equations, and apply Fourier series methods to solve one-dimensional wave and heat equations.	Familiarity & Application
CO-5	Apply concepts of complex analysis including analytic functions, Taylor and Laurent series, singularities, residues, and conformal mappings to evaluate complex integrals.	Familiarity & Application

Course Contents:

Unit	Contents	Lectures required
1	**Second Order Linear Differential Equations:** Linear differential equations of second order with variable coefficients; Cauchy-Euler equations; change of variable; method of variation of parameters.	**6**
2	**Infinite Series and Power Series:** Convergence of infinite series; tests for convergence; alternating and absolute convergence; Introduction to power series; radius and interval of convergence.	**8**
3	**Series Solutions and Special Functions:** Series solutions of differential equations; Bessel functions - definition, recurrence relations, and orthogonality; Legendre functions - definition, recurrence relations, and orthogonality.	**10**

4	**Fourier Series and Partial Differential Equations:** Fourier series and their applications; classification and formation of partial differential equations; equation of a vibrating string; one-dimensional wave and heat equations and their solutions.	**10**
5	**Complex Analysis:** Limit, continuity, and differentiability of complex functions; analytic functions and Cauchy-Riemann equations; bilinear (Möbius) transformations; Taylor and Laurent expansions; singularities and poles; Cauchy's integral theorem and residue theorem with applications.	**8**
Total Lectures		**42**

Textbooks:

1. R. K. Jain, and S. R. K. Iyengar, *Advanced Engineering Mathematics*, 5th Edition, Narosa Publishing House, New Delhi, 2016.
2. *E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, Inc., 2015.*
3. *J. W. Brown and R. V. Churchill, Complex Variables and Applications, 6th Edition, McGraw-Hill, 1996.*
4. *G. F. Simmons, Differential Equations with Applications and Historical Notes, 2nd Ed, McGraw-Hill, 1991.*

Reference Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, 44th Edition, Khanna Publishers, New Delhi, 2018.
2. M. R. Spiegel, *Complex Variables*, Schaum's Outline Series, McGraw-Hill, 2009.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1.0 Hour	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2.0 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignments (2) - 08 Quizzes (3) - 12 Attendance - 5

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

Course Outcomes (Mathematics-II)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	3	2	1	2	0	0	0	0	0	0	0	**0.73**
CO-2	3	2	1	2	0	0	0	0	0	0	0	**0.73**
CO-3	3	2	1	2	0	0	0	0	0	0	0	**0.73**
CO-4	3	2	1	3	1	0	0	0	0	0	0	**0.91**
CO-5	3	3	2	3	1	0	0	0	0	0	0	**1.09**
Average	**3.0**	**2.2**	**1.2**	**2.4**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.84** / **0.84**

Physics-II

Course code: 25B11PHXXX
Course credits: 4
Core/Elective: Core
L-T-P: 3-1-0
Pre-requisite: None

Course Objectives:

1. To develop a strong foundation in electromagnetic theory.
2. To introduce the fundamentals of fiber optics.
3. To understand statistical distribution functions.
4. To provide insight into the structure and electronic properties of solids.
5. To promote project-based learning by enabling students to apply theoretical physics concepts to real-world technologies and industrial domains such as optical communication, medical instrumentation, laser systems, and semiconductor devices.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall the basic concepts relating to electromagnetic theory, lasers, fibre optics, and solid-state physics.	Familiarity
CO-2	Illustrate the various physical phenomena with an interpretation based on the mathematical expressions involved.	Assessment
CO-3	Apply the basic principles in solving a variety of problems related to lasers, electromagnetism theory, fibre optics, and solid-state physics.	Assessment and Implementation
CO-4	Analyse and examine the solutions to problems using physical and Mathematical concepts involved in the course.	Assessment and Implementation

Course Contents:

Unit	Title of Module	Contents	Lecture required
1	Electromagnetism and Optical Fiber	Coulomb's law, Gauss law and its applications, Treatment of electrostatic problems by solution of Laplace and Poisson's equations, Biot-Savart law, Ampere's law, Maxwell's equations in free space and dielectric media. Electromagnetic waves, Derivations of expressions for energy density and energy flux (Poynting vector) in an electromagnetic field, Radiation pressure. Propagation of EM waves through boundary-Reflection, Refraction, Absorption and Total Internal Reflection. Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode.	**17**
2	Statistical Distributions and Lasers	Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications. Principle and working of laser, Einstein A and B coefficients, Ruby Laser.	**10**

3	Solid State Physics	Basic ideas of bonding in solids, Crystal structure, Bragg's law X-ray diffraction, Band theory of solids, Distinction between metals, semiconductors and insulators. Electronic conduction in metals, Intrinsic and extrinsic (n and p-type)semiconductors and their electrical conductivity. p-njunction and Hall effect in semiconductors.	**15**
		Total lectures	**42**

Suggested Text Book(s):

1. D.J. Griffiths, Introduction to electrodynamics,5th ed. Pearson India, 2023.
2. G.Keiser, Optical Fiber Communications, 5th ed. Tata McGraw Hill Education, 2017.
3. A. Beiser, Concepts of Modern Physics, 7th ed. McGraw Hill International, 2018.
4. S.O. Pillai, Solid State physics, 10th ed. New Age International(P)Limited, 2023.
5. A. Lal, N. Subrahmanyam and P.S. Hemne, Heat Thermodynamics and Statistical Physics, 3rd ed. S. Chand, 2018.

Suggested Reference Book(s):

1. R. Fitzpatrick. (2011). Electromagnetism and Optics (An Introductory Course) [Electronic]. https://farside.ph.utexas.edu/teaching/302l/302l.html.
2. V. V. Mitin, D. I. Sementsov, An Introduction to Applied Electromagnetics and Optics, CRC Press: Taylor and Francis Group, 2017.
3. R. A. Silvio, Salinass, Introduction to Statistical Physics, Springer Verlag, 2012.

Other useful resource(s):

1. NPTEL sources
2. MIT Open Course ware resources

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) -15 Quizzes(2) -5 Attendance - 5

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

Course outcomes (Physics -2)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	1	1	1		1						1	**1**
CO-2	1	1	1	1	1						1	**1**
CO-3	1	1	1	1	1	1					1	**1**
CO-4	1	1	1	1	1	1					1	**1**
Average	**1**	**1**	**1**	**1**	**1**	**1**					**1**	

Physics Lab-II

COURSE CODE: 25B17PHXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Course outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recall laser, fibre optics, semiconductor and solid state physics Principles behind the experiments.	Familiarity
CO-2	Explain the experimental setup and the principles involved behind the experiments performed.	Assessment
CO-3	Plan the experiment and set the apparatus and take measurements.	Assessment and Implementation
CO-4	Analyze the data obtained and calculate the error.	Analysis
CO-5	Interpret and justify the results.	Evaluation

List of Experiments:

S.No	Title of Module	Description	Hours
1	Optical Fiber	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	Semiconductor Physics	To measure resistivity of semiconductor using four probe methods.	**4**
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.	**4**
6		To determine the carrier concentration and type of doping using hall coefficient.	**2**
7	Modern Physics	To calculate the e/m ratio for an electron using Thomson method/Bar magnet method	**4**

		Experimental Determination of Planck's constant using Light Emitting Diodes (LEDs) and Photoelectric Effect.	**2**
8	Solid state Physics	To study magnetostriction in magnetic materials using He-Ne laser.	**2**
9		To study the coercivity, saturation magnetization, retentivity of given materials.	**4**
10		To determine the magnetic susceptibility of a given paramagnetic liquid using Quinck's method.	**2**
		Total Lab hours	**28**

Suggested Books:

1. S. P. Singh, Advanced Practical Physics,Pragati Prakashan, Vol. 1, 2016.
2. C. L. Arora, Practical Physics, S. Chand Company Limited, 21st edition, 2015.
3. N. Subrahmanayam, Brij Lal and M.N. Avadhanulu, A Text Book of Optics, S. Chand (2015)
4. Ajoy Ghatak, Optics, Tata McGraw Hill, 7th addition, (2020)
5. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill (2001).

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	P-1	20	1 Hour	Experiments covered upto P-1
2	P-2	20	1.5 Hours	Experiments covered upto P-2
3	P-3	60 (30- Lab Record, Attendance; 30- Project)	Throughout semester	All experiments

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

Course outcomes (Physics Lab -2)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	1	1	1	1	1	1					1	**1**
CO-2	1	1	1	1	1	1					1	**1**
CO-3	1	1	1	1	1	1					1	**1**
CO-4	1	1	1	1	1	1					1	**1**
CO-5	1	1	1	1	1	1		1	1		1	**1**
Average	**1**	**1**	**1**	**1**	**1**	**1**		**1**	**1**		**1**	

Software Development Fundamentals – II

COURSE CODE: XXXXXXXX

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: C Programming

Course Objectives:

1. To understand core OOPs concepts like classes, objects, constructors, abstraction, and access specifiers.
2. To apply inheritance, polymorphism, and templates to real-world problems.
3. To implement arrays, stacks, queues, and linked lists for problem-solving.
4. To analyze and debug code with attention to outcomes and exceptions.
5. To design and implement class diagrams for practical applications.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Explain various object-oriented concepts like class and objects, constructors, abstraction, data hiding (access specifiers) etc.	Understand
CO-2	Apply object-oriented concepts like inheritance, polymorphism and templates to various real-world problems.	Apply
CO-3	Apply concepts of data structures such as arrays, stacks, queues, and linked lists to solve real-world problems.	Apply
CO-4	Analyze the source code for possible outcomes, and exceptions, and debugging the errors.	Analyze
CO-5	Design and implement class diagram for varied real life problems using OOPs	Create

Course Contents:

Unit	Contents	Lectures required
1	Introduction to Object Oriented Programming: Comparison of Procedural and Object-Oriented Approach, Characteristics of Object-Oriented Languages, Separation of behaviour and implementation	**1**

2	OO Concepts using C++: Objects, Classes, Internal representations of Objects, Constructors, Destructors Function and Operator Overloading, Static and Friend Functions	**8**
3	Inheritance using C++: Base Class, Derived class, Method Overriding, Private and Public Inheritance, Multiple Inheritance.	**3**
4	Polymorphism using C++: Virtual Functions, Pure Virtual Functions, Abstract Classes, Dynamic Dispatch, Internal representations of method tables, RTTI	**3**
5	UML/Relationship Implementation in C++: Models, Views and Model Elements, Class Diagram, Relationships of Association, Aggregation, Composition, and Inheritance, etc. and their implementing	**6**
6	Exceptions, Templates, and STL in C++: Exceptions, Try, Catch and Throw, Re-throwing exceptions, Exception and Inheritance, Function Templates, Overloading Functions Template, Class Templates, Collection classes and iteration protocols (STL)	**9**
7	Introduction of Data Structures: Fundamentals of data structures, dynamic memory allocation, overview of linear and non-linear DS; Limitations of array and need of linked list, different types of linked list; Stack and Queue, stack and queue operations using STL; Recursion, recursion removal using stack, recursive approaches to solve problems like Tower of Hanoi, N-queen, rat in a maze, etc.	**12**
Total lectures		**42**

Suggested Text Book(s):

1. Herbert Schildt, C++: The Complete Reference, McGraw-Hill Osborne Media, 4th Edition, 2017
2. Ellis Horowitz,SartajSahni and Dinesh P. Mehta, Fundamentals of Data Structures in C++, Galgotia
   Press, 2009
3. Stroustrup B., The C++ Programming Language, Addison Wesley, 4th Edition, 2013
4. John R. Hubbard, Data Structures with C++, Schaum's Outline Series, McGraw Hill, First Edition,
   2017.

Suggested Reference Book(s):

1. Robert Lafore, Object Oriented Programming in C++, SAMS, 4th Edition, 2002
2. John Hubbard, Schaum's Outline of Programming with C++, McGraw-Hill, 2nd Edition, 2000

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106105234
2. Link to NPTEL course contents: https://nptel.ac.in/courses/106102064
3. Link to topics related to course:
   a. https://www.tutorialspoint.com/cplusplus

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 Quizzes (2) -10 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	3	2	2	1	2	1	1	1	2	1	2	**1.6**
CO-2	3	3	3	2	3	1	1	1	2	2	2	**2.1**
CO-3	3	2	2	2	3	1	1	1	2	2	2	**1.9**
CO-4	2	3	2	3	2	1	1	1	2	2	3	**2.0**
CO-5	3	2	3	2	3	1	1	2	3	2	2	**2.2**
Average	**2.8**	**2.4**	**2.4**	**2.0**	**2.6**	**1.0**	**1.0**	**1.2**	**2.2**	**1.8**	**2.2**	

Software Development Fundamentals Lab-II

COURSE CODE: XXXXXXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: C Programming

Course Objectives:

1. To understand and implement object-oriented concepts such as classes, constructors, destructors, and friend functions.
2. To apply encapsulation, inheritance, polymorphism, and abstraction in solving real-world programming problems.
3. To utilize the Standard Template Library (STL) for writing efficient and reusable code.
4. To develop robust programs using exception handling techniques.
5. To implement linear data structures and recursive algorithms using dynamic memory and STL.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Make use of the concepts related to objects, classes, constructor, destructor, and friend function for solving real-world problems.	Apply
CO2	Apply the principles of encapsulation, inheritance, polymorphism and abstraction in different programming problems.	Apply
CO3	Utilize the Standard Template Library to optimize the object-oriented programming solutions	Apply
CO4	Develop solutions using exception handling for programming problems.	Apply
CO5	Develop linear data structures and recursive algorithms using dynamic memory and Standard Template Library (STL).	Apply

List of Experiments

S. No	Description	Hours
1	Output based C++ programs to implement the concepts of Objects, Classes, Internal representations of Objects, encapsulation, Constructors, Destructors, Function and Operator Overloading, Static and Friend Functions	**6**
2	Write programs in C++ to implement Inheritance, Method Overriding, Private and Public Inheritance, Multiple Inheritance	**4**

3	Write programs in C++ involving Virtual Functions, Abstract Classes, Dynamic Dispatch, operator overriding, etc.	**2**
4	Write programs in C++ to implement the relationships of Association, Aggregation, Composition, and Inheritance	**4**
5	Write programs in C++ to handle Exceptions, Re-throwing exceptions, Function Templates, Overloading Functions Template, Class Templates, Collection classes and iteration protocols (STL)	**4**
6	Programs for Dynamic Memory Allocation, Abstract Data Types; Templates and STL to implementation linear data structures like Array, Linked List, Stack and Queue; implementation of recursive algorithm to solve different problems	**8**
Total Lab hours		**28**

Suggested/Resources:

1. Herbert Schildt, C++: The Complete Reference, McGraw-Hill Osborne Media, 4th Edition, 2017.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson, 7th Edition, 2016
3. Walter Savitch, Kenrick Mock," Absolute C++", Pearson, 6th Edition, 2016.
4. E BALAGURUSAMY, Object Oriented Programming with C++, McGraw-Hill Education (India), 8th Edition, 2020.
5. Avi Silberschatz, Henry F. Korth, and S. Sudarshan, "Database System Concepts", McGraw-Hill, 7thedition, 2019.
6. Cay S. Horstmann, Big C++: Late Objects, Wiley, 3rd edition, 2017.
7. Stroustrup B., The C++ Programming Language, Addison Wesley, 4th Edition, 2015.
8. Robert Lafore, Object Oriented Programming in C++, SAMS, 4th Edition, 2002.
9. John Hubbard, Schaum's Outline of Programming with C++, McGraw-Hill, 2nd Edition, 2000.

Evaluation Scheme:

S. No	Exam	Marks
1	Mid Sem. Evaluation (P-1)	20
2	End Sem. Evaluation (P-2)	20
3.	Internal Assessment (P-3) (May include attendance, class participation, lab file records, experiment execution, viva voce, quizzes, mini-projects 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	Average
CO-1	3	2	3	1	3	1	1	2	2	1	2	**1.9**
CO-2	3	3	3	1	3	1	1	2	2	1	2	**2.0**
CO-3	3	2	2	1	3	1	1	1	1	1	2	**1.6**
CO-4	3	2	2	2	2	1	1	1	1	1	2	**1.6**
CO-5	3	2	3	2	3	1	1	1	2	2	2	**2.0**
Average	**3.0**	**2.2**	**2.6**	**1.4**	**2.8**	**1.0**	**1.0**	**1.4**	**1.6**	**1.2**	**2.0**	

LIFE SKILLS & PROFESSIONAL COMMUNICATION LAB

COURSE CODE:

COURSE CREDITS: 0 (AUDIT)

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: None

Course Objectives:

1. Improve spoken and written communication in English.
2. Develop students' interpersonal communication ability in the professional settings.
3. Learn to design effective resume and cover letter
4. Understand how to make effective and impressive presentations using digital media.
5. Develop the confidence to perform well in interviews.

Course Outcomes:

SNo	Course Outcomes	Level of Attainment
CO-1	Improved spoken and written communication in English.	Familiarity
CO-2	Develop the ability to interact effectively in the professional setting.	Familiarity
CO-3	Design a good resume and be able to update it from time to time.	Assessment and Usage
CO-4	Make effective and impressive presentations using digital media	Usage
CO-5	Develop the confidence to perform well in interviews.	Usage

Course Contents:

Unit	Contents	Lab Hours required
1	**Professional Communication and CV/Resume Writing (W) (Language Lab):** Introduction to CV writing, difference between a CV and a Resume, samples of good CVs/Resumes and cover letters, Drafting Resumes in Language Lab	3
2	**Discover your personality (GD class)** SWOC analysis and understanding your goals	2

3	**Developing Writing Skills (GD Class)** Discussing the nature of professional and technical writing, giving students a hands-on experience with report writing, suggesting topics for report writing, helping students improve their final reports before submission	**4**
5	**Study Skills Success (Language Lab): Independent Learning, Critical Thinking, Working with Visuals** Students will practice exercises which will enhance their self-learning, critical-thinking and visual presentation skills.	**3**
6	**Creative and Critical Thinking Development (GD class)** Topical and Case Study Group Discussion, Assertion vs Aggression	**3**
7	**Creating a LinkedIn Profile (Language Lab)** Students will create a Linked In profile and work on it to make it professional and up to the industry requirements throughout the semester.	**1**
8	**Developing Presentation Skills (GD class)** Dividing students in small groups, suggesting topics for presentation, conducting mock presentations, providing suggestions and feedback after mock presentations, conducting final presentations	**5**
9	**Road to IELTS (Language Lab): Listening, Speaking, Reading and Writing** Students will learn how to enhance their communication skills in various departments to make it at par with the global standards.	**7**
Note:	Report writing and Linked In profile will be a part of continuous evaluation and hence should be discussed throughout the semester.	
Total lectures		**28**

Evaluation Scheme:

S. No	Exam	Marks
1	PPT Presentation	20
2	Report	20
3	LinkedIn Profile	10
4	GD	10
5	Resume	10
6	Lab File	05
7	LSRW evaluation in Lab- (Continuous)	20

8	Attendance	05

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	Average
CO-1	1	2	1	2	1	3	1	2	3	x	3	1.9
CO-2	1	2	1	2	1	3	1	3	3	x	3	2
CO-3	x	x	x	1	x	3	x	2	3	x	2	2.2
CO-4	1	2	1	2	1	3	1	3	3	x	2	1.9
CO-5	x	x	1	2	1	3	x	1	3	x	3	2
Average	1	2	1	1.8	1	3	1	2.2	3	x	2.6	2

Engineering Drawing and Design

COURSE CODE: 25B17GE172

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

L-T-P: 0-0-3

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	3
3	Construction of Polygons	3
4	Projection of points	3
5	Projection of lines	3
6	Projection of planes	3
7	Drawing of Building Plan (CE)/ Designing a Computer Network	3

	Layout (CSE-IT)/ Designing a Laboratory Setup (BT-BI)/ Designing a PCB Layout (ECE)	
8	AutoCAD 3D Solid Modelling	3
9	Introduction to Basic Commands in Auto-CAD	3
10	Orthographic projections in Auto-CAD	3
11	Isometric Projection in Auto-CAD	3
12	Projections & Section of solids in Auto-CAD	3
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	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	Average
CO1	2	3	3	3	2	2	2	1	2	1	1	**2.00**
CO2	3	3	3	3	3	1	1	1	2	2	1	**2.09**
CO3	3	3	2	3	2	3	1	2	2	2	1	**2.18**
CO4	3	2	3	2	3	2	1	1	2	1	1	**1.91**
Average	**2.75**	**2.75**	**2.75**	**2.75**	**2.5**	**2**	**1.25**	**1.25**	**2.00**	**1.50**	**1.00**	

UNIVERSAL HUMAN VALUES II-Understanding Harmony

COURSE CODE: 23B11HS211

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 2-1-0

Pre-requisite: None

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), Family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/ existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Self Awareness, Social awareness (family, society, nature).Sustainability in relationships and Critical thinking	Familiarity
CO-2	. Introspection and self reflection	Assessment
CO-3	Sensitive to commitment towards human values, human relationship and human society	Usage
CO-4	Developing commitment and courage	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	6
2	**Understanding Harmony in the Human Being - Harmony in Myself!** 7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility 9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 10. Understanding the characteristics and activities of 'I' and harmony in 'I' 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 12. Programs to ensure Sanyam and Health.	6
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** 13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 14. Understanding the meaning of Trust; Difference between intention and competence 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals	5

	17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	
4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** 18. Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self regulation in nature 20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space 21. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	**5**
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** 22. Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 26. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations	**6**
Total lectures		**28**

Suggested Text Book(s):

1. Text Book 1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004

Suggested Reference Book(s):

1. The Story of Stuff (Book).
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
4. Small is Beautiful - E. F Schumacher.
5. Slow is Beautiful - Cecile Andrews
6. Economy of Permanence - J C Kumarappa

7. Bharat Mein Angreji Raj - PanditSunderlal
8. Rediscovering India - by Dharampal
9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
10. India Wins Freedom - Maulana Abdul Kalam Azad
11. Vivekananda - Romain Rolland (English)
12. Gandhi - Romain Rolland (English)

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 Quizzes (2) - 10 Attendance - 5

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	Average
CO-1	3	3	3	3	3	3	3	3	**3**
CO-2	3	3	3	3	3	3	3	3	**3**
CO-3	3	3	3	3	3	3	3	3	**3**
CO-4	3	3	3	3	3	3	3	3	**3**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	3

Probability and Random Processes

COURSE CODE: 25B11MA311

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: Knowledge of Differential/Integral Calculus from Engineering Mathematics - I & II.

Course Objectives: On successful completion of this course, students will be able to

1. Understand different types of random variables and study probability distributions of practical importance.
2. Equip students with foundational statistical tools for summarizing and interpreting data, and to develop their ability to construct and evaluate statistical models for solving real-world data analysis.
3. Learn and apply stochastic processes as mathematical models for random phenomena evolving in time.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understand the basic probability concepts; understand the axiomatic approach of probability theory and compute probabilities; and apply Bayes' theorem to update posterior probabilities by incorporating prior probabilities.	Familiarity & Usage
CO-2	Recognize random variables of random experiments, describe probability distributions using moments; compute probabilities for various events using appropriate probability distributions as models; demonstrate proficiency in generation of random numbers.	Familiarity & Assessment
CO-3	Formulate and interpret basic statistical measures such as central tendency, dispersion, skewness, kurtosis, covariance, and correlation, and apply them to evaluate statistical parameters for discrete distributions including binomial and Poisson models.	Assessment & Usage
CO-4	Construct and evaluate statistical models such as multiple linear regression and logistic regression to solve data classification and prediction problems in data mining contexts.	Assessment & Usage
CO-5	Understand and describe stochastic processes; determine correlation and covariance of stationary random processes; analyze and apply stochastic processes in the context of communication models, demonstrating proficiency in modeling random phenomena over time.	Familiarity & Usage

Course Contents:

Unit	Contents	Lectures
1	**Basic probability:** Random experiments; probability axioms; combinatorial probability; conditional probability; multiplication rule - independence of events and repeated independent trials, Bayes' theorem.	**8**

2	**Random variables and distributions:** Concept of random variables (RVs); probability mass functions, density functions and cumulative distribution functions; expectation, variance and MGF of RVs; joint, marginal, and conditional densities, distribution of sum of two independent RVs; modeling and probability calculations with discrete and continuous distributions: binomial, Poisson, exponential, uniform, and univariate/ multivariate Gaussian distributions; simulation of RVs – generating random numbers.	**12**
3	**Basic Statistics & Statistical Modeling:** Measures of central tendency & dispersion: evaluation of statistical parameters for binomial and Poisson distributions; interpretation of skewness and kurtosis; concept of covariance and correlation; statistical models for data mining: multiple linear regression, and logistic regression in data classification problems.	**12**
4	**Stochastic Processes:** Probabilistic structure of a random process X(t); statistical averages: mean, auto-correlation, auto-covariance functions of X(t); strict-sense stationary & wide-sense stationary processes; Markov chain and *n*-step transition probability matrix; Gaussian process - covariance matrix; random processes in signal processing - modeling noise in communication systems.	**10**
	Total Lectures	**42**

Suggested Text Book(s):

1. Jay L. Devore, "Probability and statistics for engineering and the sciences", Cengage, 9th Edition, 2015.
2. Henry Stark and John W. Woods, "Probability and random processes with applications to signal processing", Pearson Education, 4th Edition, 2011.

Suggested Reference Book(s):

1. Richard A. Johnson, Irwin Miller, and John E. Freund, `` Miller & Freund's Probability and statistics for engineers", Pearson Education, 8th Edition, 2015.
2. Oliver C. Ibe, "Fundamentals of applied probability and random processes", Elsevier, 2nd Edition, 2014.

Evaluation Scheme:

S. No.	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1.0 Hours	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3	T-3	35	2.0 Hours	Entire Syllabus
4	Teaching Assessment	25	Entire Semester	Assignment (2) - 08 Quizzes (3) - 12 Attendance - 05

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

Course Outcomes (PTRP)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	3	3	1	1	1	1	1	1	1	1	2	**1.5**
CO-2	3	3	1	2	2	1	1	1	1	1	2	**1.6**
CO-3	3	3	2	3	3	3	1	1	1	1	3	**2.2**
CO-4	3	3	3	3	3	3	1	1	1	2	3	**2.4**
CO-5	3	2	2	2	3	3	2	1	1	1	3	**2.1**
Average	**3.0**	**2.8**	**1.8**	**2.4**	**2.4**	**2.0**	**1.2**	**1.0**	**1.0**	**1.2**	**2.6**	

Theory of Computation

COURSE CODE: XXXXXXXX

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

Pre-requisite: Basics of probability and statistics

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 Outcomes:

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	Remember, Understand
CO-2	Understand the concept of Deterministic Finite Automata and Non-Deterministic Finite Automata, minimize the states, usage Moore and Mealy Machine	Evaluate
CO-3	Understand how to use the context free grammars and how to derive parse trees and solve ambiguity problems; Understand Normal forms for Context Free Grammar's Chomsky and Greibach Normal Forms, Push Down Automaton algorithm	Evaluate
CO-4	Understand the basic concepts of Turing Machine, configuration of Turing Machine, computing, multiple tapes, two-way infinite tape concepts, concept of non-deterministic Turing machines	Apply
CO-5	Understand the computational power of languages, numerical functions applied to Turing machines, numerical functions applied to Turing machines, concept of halting problem. Grammars, properties of recursive languages, concept of polynomial decidable	Evaluate

Course Contents:

Unit	Contents	Lectures required
1	General introduction, Complexity theory, Computability theory, Automata theory, Mathematical preliminaries Infinite Sets, Closures, Alphabets, Languages & Representation	3
2	Finite Automata and Regular Languages, Deterministic finite automata, Regular operations, Non-deterministic finite automata, Equivalence of DFA sand NFAs, Closure under the regular operations	9
3	Regular expressions, Equivalence of regular expressions and regular languages, The pumping lemma and non-regular languages	5
4	Context-Free Languages, Context-free grammars, Parse Trees & Ambiguity, Chomsky and Greibach Normal forms	5
5	Push Down Automata, Equivalence of PDA and CFG, Properties of context free languages, Determinism & Parsing DCFG, Top-down & Bottom-up Parsing	9
6	Turing Machine-Introduction, Recursive and Recursively Enumerable Language, Multi-tape Turing machines, Non-deterministic Turing machines, Universal Turing machines, Halting problem	5
7	Decidable and Undecidable Languages; Complexity Theory, The Complexity Class NP, NP Completeness and Reducibility NP complete problems	6
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
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	3	2	2	2	2	3	3	2	1	3	2	**2.27**
CO-2	3	3	3	2	2	3	3	3	1	3	3	**2.64**
CO-3	3	3	3	2	2	3	2	3	2	2	3	**2.55**
CO-4	3	3	3	2	2	2	3	2	2	3	2	**2.46**
CO-5	3	3	3	2	2	2	2	2	1	2	2	**2.18**
Average	**3**	**2.8**	**2.8**	**2**	**2**	**2.6**	**2.6**	**2.4**	**1.4**	**2.6**	**2.4**	

Data Structures

COURSE CODE: XXXXXXXX

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: Programming languages C and C++

Course Objectives:

1. To understand and implement linear data structures and basic representations of trees and graphs.
2. To apply various searching and sorting algorithms with analysis of their time and space complexity.
3. To implement efficient hashing techniques for optimized data access.
4. To design and apply advanced tree and heap data structures for effective data management
5. To use graphs, special trees, and string data structures in solving complex computational problems.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understand and implement linear data structures and basic tree/graph representations.	Remember, Understand
CO-2	Apply searching and sorting algorithms with time and space complexity analysis.	Evaluate
CO-3	Implement hashing techniques and evaluate their efficiency.	Evaluate
CO-4	Design and apply advanced tree and heap structures for optimized data organization and retrieval.	Apply
CO-5	Use graphs, special trees, and string data structures in solving computational problems.	Apply

Course Contents:

Unit	Contents	Lectures required
1	Overview of linear data structures: array, linked list, stack, and queue	**3**
2	Searching and sorting algorithms – Interpolation Search, Median Search; Hashing – Hash Table, Chaining, Probing; Sorting – Merge, Quick, Radix, Bucket, and Count; Time and Space complexity analysis	**7**

	of searching and sorting algorithms	
3	Implementation of Multi List, Binary Tree, K-ary Tree, Tree traversals, Threaded Binary Tree, Priority Queue using Binary Heap, Binomial Heap, and Fibonacci Heap, Heap Sort	**10**
4	Binary Search Tree (BST), Balanced BST: AVL Tree and RB Tree; Multiway Tree: B Tree and B+ Tree	**10**
5	Fundamentals of Graph, Adjacency Matrix and List; Graph Traversal using DFS and BFS, Basic Algorithms – Shortest Path and Minimum Spanning Tree	**6**
6	Interval Tree, Segment Tree, and String Data Structures: Suffix Tree, Tries, Suffix Array	**6**
Total Lectures		**42**

Suggested Text Book(s):

1. Aaron M. Tanenbaum, *Data Structures Using C*, Pearson Education, Year not specified.
2. Ellis Horowitz and Sartaj Sahni, *Fundamentals of Data Structures*, Illustrated Edition, Computer Science Press, Year not specified.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, *Introduction to Algorithms*, 3rd Edition, MIT Press, 2009.
4. Dinesh P. Mehta and Sartaj Sahni, *Handbook of Data Structures and Applications*, 2nd Edition, Chapman and Hall/CRC Computer and Information Science Series, CRC Press, Year not specified.

Suggested Reference Book(s):

1. Mark Allen Weiss, *Algorithms, Data Structures, and Problem Solving with C++*, Illustrated Edition, Addison-Wesley Publishing Company, Year not specified.
2. Ellis Horowitz, Sartaj Sahni, and Dinesh P. Mehta, *Fundamentals of Data Structures in C++*, Galgotia Press, 2009.
3. Seymour Lipschutz, *Data Structures with C*, Schaum's Outline Series, McGraw Hill, 2010.
4. Sara Baase and Allen Van Gelder, *Computer Algorithms: Introduction to Design and Analysis*, Pearson Education, Year not specified.
5. Thomas H. Cormen, *Algorithms Unlocked*, MIT Press, Year not specified.
6. Debasis Samanta, *Classic Data Structures*, Prentice Hall of India, Year not specified.

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/
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 Quizzes (2) -10 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	3	2	2	1	2	1	1	1	1	1	2	**1.5**
CO-2	3	3	2	2	3	1	1	1	1	1	2	**1.8**
CO-3	3	2	2	2	3	1	1	1	1	1	2	**1.7**
CO-4	3	3	3	2	3	1	1	1	1	1	2	**1.9**
CO-5	3	3	3	2	3	1	1	1	1	1	2	**1.9**
Average	**3**	**2.6**	**2.4**	**1.8**	**2.8**	**1**	**1**	**1**	**1**	**1**	**2**	

Data Structures Lab

COURSE CODE: XXXXXXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: C/C++

Course Objectives:

1. To understand and implement linear data structures such as arrays, linked lists, stacks, queues, and sparse matrix representations.
2. To learn and apply various searching, sorting, and hashing algorithms along with their complexity analysis.
3. To implement different types of trees including binary trees, K-ary trees, threaded trees, and various heap structures.
4. To design and apply balanced and multiway trees like AVL, Red-Black, B, and B+ Trees for efficient data handling.
5. To develop graph traversal algorithms and advanced structures such as Tries, Segment Trees, and Interval Trees for solving complex computational problems.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Implement linear data structures such as arrays, linked lists, stacks, queues, and multi-linked lists for sparse matrix representation.	Remember, Understand
CO2	Apply searching, sorting, and hashing techniques including interpolation search, merge sort, radix sort, and hash table operations.	Evaluate
CO3	Implement various tree structures including binary trees, K-ary trees, threaded trees, and heaps like binary and Fibonacci heaps.	Apply
CO4	Develop balanced and multiway trees such as AVL, Red-Black, B, and B+ Trees for efficient data organization and access.	Apply
CO5	Implement graph traversal algorithms (DFS & BFS), shortest path, minimum spanning tree, and advanced structures like Tries, Segment and Interval Trees.	Apply

List of Experiments

S. No	Description	Hours
1	Implementation of linear data structures like, array, linked lists, stack, queue and related operations, multi linked list for sparse matrix representation	**4**
2	Implementation of searching and sorting algorithms like, linear search, binary Search, interpolation search, median Search; Hashing – Hash Table, Chaining, Probing; Sorting – Merge, Quick, Radix, Bucket, and Count	**4**
3	Implementation of Binary Tree, K-ary Tree, Threaded Tree, Priority Queue using Binary Heap and Fibonacci Heap, Heap Sort	**6**
4	Implementation of Binary Search Tree (BST), Balanced BST: AVL Tree & RB Tree; Multiway Tree: B Tree & B+ Tree	**6**
5	Writing programs to traverse graph using DFS & BFS and implement the algorithms for Shortest Path and Minimum Spanning Tree	**4**
6	Implementation of Interval Tree, Segment Tree, and Tries	**4**
Total Lab hours		**28**

Suggested/Resources:

1. Ellis Horowitz, Sartaj Sahni and Dinesh P. Mehta, Fundamentals of Data Structures in C++, Galgotia Publications, 2009.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson Education, 2014.
4. Dinesh P. Mehta and Sartaj Sahni, Handbook of Data Structures and Applications, 2nd Edition, Chapman & Hall/CRC, 2018.
5. Robert Sedgewick and Kevin Wayne, Algorithms, 4th Edition, Addison-Wesley, 2011.
6. Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education, 2006.
7. Link to topics related to course:
   i. https://www.geeksforgeeks.org
   ii. https://www.coursera.org/specializations/data-structures-algorithms

Evaluation Scheme:

S. No	Exam	Marks
1	Mid Sem. Evaluation (P-1)	20
2	End Sem. Evaluation (P-2)	20
3.	Internal Assessment (P-3) (May include attendance, class participation, lab file records, experiment execution, viva voce, quizzes, mini-projects 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	Average
CO-1	3	2	2	1	3	1	1	1	1	1	2	**1.6**
CO-2	3	3	2	2	3	1	1	1	1	1	2	**1.8**
CO-3	3	2	2	2	3	1	1	1	1	1	2	**1.7**
CO-4	3	3	3	2	3	1	1	1	1	1	2	**1.9**
CO-5	3	3	3	2	3	1	1	1	1	1	2	**1.9**
Average	**3**	**2.6**	**2.4**	**1.8**	**3**	**1**	**1**	**1**	**1**	**1**	**2**	

Database Management Systems

COURSE CODE: 25B11CI313

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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.	Remember, Understand
CO-2	For a given specification of the requirement, design the databases using E-R method and normalization.	Apply
CO-3	For a given query write relational algebra expressions for that query and optimize the developed expressions.	Apply
CO-4	Determine the functional dependency between two or more attributes, compute the closure of a set of attributes, evaluate a proposed decomposition	Evaluate
CO-5	Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.	Apply
CO-6	Familiarize with the security in databases and gaining familiarity with other popular databases used in the industry	Remember, Understand

Course Contents:

Unit	Contents	Lectures required
1	Fundamentals of Database and Database Management System, Physical Level of Data Storage, Structure of Relational Database, Table, Attributes, Records	**3**
2	Introduction to SQL, Data Types in SQL, Operations on Single Table like Create, Insert, Delete, Update, Alter, etc., SQL Queries on Single Table using Select Statement with or without Where and Group By Clause, etc., Overview of No SQL Databases	**4**
3	Database Design and ER Model, Entity type, Attributes, Relation types, Notations, Constraints, Extended ER Features	**5**
4	Relational Model and Structured Query Language, Data Definition and Data Manipulation, Relational Algebra	**7**
5	Procedural Language, PL/SQL, Stored Procedures, Functions, Cursors, Triggers	**5**
6	Functional Dependency & Normalization, Data Dependencies, 2NF, 3NF, BCNF, Building Normalized Databases	**8**
7	Transaction Management, ACID properties of Transactions, Need of Concurrency, Concurrency Control Techniques, Deadlocks, Database Recovery System, Database Security and Authorization	**10**
Total lectures		**42**

Suggested Text Book(s):

1. R. Elmasri, S. B. Navathe , "Fundamentals of Database Systems", Pearson Education.
2. H. F. Korth, A. Silberschatz, S. Sudarshan, “Database system concepts”, McGraw-Hill Ellis.
3. C. J. Date, “An Introduction to Database Systems”, Pearson Education.
4. Bayross, “SQL, PL/SQL – The Programming Language of Oracle” BPB Publications.

Suggested Reference Book(s):

1. J. D. Ullman, J Windon, “A First Course in Database Systems”, Pearson, Education.
2. R. T. Watson, “Data Management: Databases and Organization”, Wiley.

Other useful resource(s):

1. Link to NPTEL Course Contents:
   https://archive.nptel.ac.in/courses/106/105/106105175/

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 Quizzes (2) -10 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	**1.73**
CO-2	2	3	3	3	3	1	1	1	2	2	1	**2**
CO-3	2	2	2	2	3	1	1	1	2	2	1	**1.73**
CO-4	2	3	3	3	2	1	1	1	2	3	2	**2.09**
CO-5	1	2	2	1	3	2	1	1	1	1	1	**1.45**
CO-6	1	2	2	1	3	2	1	1	1	1	1	**1.45**
Average	**1.6**	**2.3**	**2.3**	**2.2**	**2.0**	**1.3**	**1**	**1**	**1.6**	**1.8**	**1.3**	

Database Management Systems Lab

COURSE CODE: 25B17CI373

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Basics of Programming Language

Course Objectives:

1. To develop the ability to design, implement and manipulate databases.
2. To build database management systems.
3. To apply DBMS concepts in real life applications.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Design and implement a database schema using Structured Query Language	Apply
CO2	Design different views of tables for different users and to apply embedded and nested queries	Apply
CO3	Understand, analyze and apply common SQL statements including DDL, DML, DCL statements to perform different operations	Evaluate, Apply
CO4	Develop application programs using PL/SQL	Apply

List of Experiments

S. No	Description	Hours
1	To implement Data Definition language and Data Manipulation Language commands: Create database/table, alter, drop, truncate, Insert, Select, Update, Delete etc.	**2**
2	To implement Constraints as a part of Data Definition language: Primary key, Foreign Key, Check, Unique, Null, Not null, Default, Enable Constraints, Disable Constraints, Drop Constraints	**2**
3	To practice in Built Functions: Date functions, numerical functions, character functions, conversion functions, group functions, count functions etc.	**2**
4	To practice group by, having clause and special operators such as between, like, in etc.	**2**

5	To practice Set Operators Union, Intersect, Minus, Except	**2**
6	To implement Views from Single and Multiple Tables	**2**
7	To implement the ER Diagram modelled for different problems	**2**
8	To implement and practice PL/SQL control structure if, if then else, else if, nested if, for and while loop	**2**
9	To implement PL/SQL Procedures and Functions	**6**
10	To implement Cursors and Triggers	**2**
11	To implement Transaction Processing Commands: Commit, Rollback, Save Point and Time Stamps	**2**
12	To implement Data Control Language Commands: Grant and Revoke	**2**
Total Lab hours		**28**

Suggested/Resources:

1. I. Bayross, “SQL, PL/SQL – The Programming Language of Oracle” BPB Publications.
2. R. Elmasri, S. B. Navathe," Fundamentals of Database Systems", Pearson Education.
3. H. F. Korth, A. Silberschatz, S. Sudarshan, “Database system concepts”, McGraw-Hill Ellis.

Evaluation Scheme:

S. No	Exam	Marks
1	Mid Sem. Evaluation (P-1)	20
2	End Sem. Evaluation (P-2)	20
3.	Internal Assessment (P-3) (May include attendance, class participation, lab file records, experiment execution, viva voce, quizzes, mini-projects 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	Average
CO-1	3	2	2	2	3	1	1	1	1	1	2	**1.73**
CO-2	3	3	3	3	3	2	1	2	2	1	2	**2.27**
CO-3	3	3	2	3	3	2	1	2	2	1	2	**2.18**
CO-4	3	3	3	3	3	2	1	2	2	1	2	**2.27**
Average	**3**	**2.75**	**2.5**	**2.75**	**3**	**1.75**	**1**	**1.75**	**1.75**	**1**	**2**	

Object Oriented Programming using Java

COURSE CODE: XXXXXXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Basic knowledge of programming fundamentals using languages like C or Python.

Course Objectives:

1. To introduce students to the Java programming environment and develop the ability to construct reusable and modular classes using fundamental OOP concepts.
2. To provide practical experience in implementing object-oriented relationships such as inheritance, association, aggregation, and composition in Java.
3. To develop skills in abstraction and modularization using abstract classes, interfaces, packages, and memory management techniques like garbage collection.
4. To strengthen students' ability to write reliable Java programs using exception handling, string manipulation, and the Java Collections Framework.
5. To enable students to apply advanced programming concepts such as multithreading, generics, and reflection, along with developing GUI-based Java applets.

Course Outcomes:

S. No.	Course Outcomes (COs)	Level of Attainment
CO1	Apply object-oriented concepts to design and implement reusable and modular Java classes and programs.	Apply
CO2	Demonstrate implementation of relationships such as Inheritance, Association, Aggregation, and Composition in Java.	Remember, Understand
CO3	Develop Java applications using abstract classes, interfaces, packages, and effective memory management practices.	Apply
CO4	Build robust Java programs with proper exception handling and use of collection frameworks for data manipulation.	Evaluate
CO5	Develop Java programs that demonstrate concurrency using multithreading, utilize generics for type-safe programming.	Evaluate
CO6	Design interactive Java applets and demonstrate the ability to embed and parameterize them in HTML pages.	Apply
CO7	Analyze string handling in Java and implement programs using the String class and its methods effectively.	Evaluate

List of Experiments

S. No.	Description	Hours
1.	Introduction to Java and its features, Functioning of JVM and JDK, Structure of class and primitive data types in Java	**2**
2.	Implementation of class in Java involving tokens, variables, methods, operators, control statements, array, static variables and methods, reference data types, variables and methods, constructors.	**2**
3.	Implementation of Inheritance and other relationships like Association, Aggregation and Composition in Java.	**4**
4.	Implementation of abstract class and methods, interface, packages, and garbage collection in Java.	**4**
5.	Writing programs in Java to handle strings.	**2**
6.	Java programs involving exception handling, exception propagation, and user defined checked & unchecked exceptions.	**2**
7.	Writing Java programs involving Collections framework, Collection interfaces, Collection classes, Iterators, Comparators, User defined classes in Collections, etc.	**4**
8.	Implementing Multithreading in Java and Java programs involving Generic classes and methods, Wild cards, Metadata & Reflection	**4**
9.	Writing Java programs to implement Applet fundamentals, applet class, HTML Applet tag, passing parameters to applets.	**4**
Total Lab hours		**28**

Suggested/Resources:

1. Herbert Schildt, *Java: The Complete Reference*, 12th Edition, McGraw Hill, 2024.
2. Kathy Sierra and Bert Bates*, Head First Java,* 3rd Edition, O'Reilly Media, 2022.
3. Paul Deitel and Harvey Deitel*, Java: How to Program,* 11th Edition, Pearson, 2018.
4. Joshua Bloch*, Effective Java,* 3rd Edition, Addison-Wesley, 2018.
5. Course links

   i) NPTEL – Programming in Java (IIT Kharagpur) | https://nptel.ac.in/courses/106105084
   ii) Oracle Java Tutorials (Official Documentation) | https://docs.oracle.com/javase/tutorial/
   iii) GeeksforGeeks – Java Programming Language | https://www.geeksforgeeks.org/java/
   iv) JavaTpoint – Java Tutorial | https://www.javatpoint.com/java-tutorial
   v) TutorialsPoint – Java Programming | https://www.tutorialspoint.com/java/index.htm

vi) Coursera – Object Oriented Programming in Java (Duke University) | https://www.coursera.org/learn/object-oriented-java

Evaluation Scheme:

S. No	Exam	Marks
1	Mid Sem. Evaluation (P-1)	20
2	End Sem. Evaluation (P-2)	20
3.	Internal Assessment (P-3) (May include attendance, class participation, lab file records, experiment execution, viva voce, quizzes, mini-projects 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	Average
CO1	2	2	3	3	3	1	1	1	1	1	3	**1.90**
CO2	2	2	3	3	3	2	1	2	2	1	3	**2.36**
CO3	2	2	3	3	3	2	1	2	2	1	3	**2.18**
CO4	2	2	3	3	3	2	1	2	2	1	3	**2.18**
CO5	2	2	3	3	3	2	1	1	1	1	3	**2.0**
CO6	2	2	3	3	3	2	1	2	2	1	2	**2.18**
CO7	2	2	3	3	3	1	1	1	1	1	2	**1.82**
Average	**2.3**	**2.0**	**3.0**	**3.0**	**3.0**	**1.71**	**1**	**1.57**	**1.57**	**1**	**2.71**	

Competitive Programming -I

COURSE CODE: XXXXXXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Software Development Fundamentals – I & II

Course Objectives:

1. To develop analytical problem-solving skills.
2. To strengthen the programming skills in C/C++.
3. To prepare students for national and international programming contests
4. To enhance technical coding ability for placement and interviews.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Apply problem-solving strategies to develop efficient solutions for algorithmic problems.	Apply
CO2	Participate confidently in online programming contests.	Apply
CO3	Implement and use C/C++ programming concepts.	Apply
CO4	Prepare for technical interviews by solving coding-related problems with realistic constraints.	Create, Evaluate

List of Experiments

S. No	Description	Hours
1	**Introduction to Competitive Programming:** Online Platforms (HackerRank, GeeksforGeeks, CodeStudio, LeetCode), Test Cases, Demo of Passing Test Cases to the program. Submission of Codes.	**2**
2	**C++ OOP Concepts:**Class, Object, Constructor, Inheritance, Polymorphism, Function Overloading	**2**
3	**Control Structures & Number Problems -** Nested loops, Decision making	**2**
4	**Arrays (1D & 2D):** Rotation, rearrangement, subarrays, Searching techniques	**2**

5	**Strings: C**-strings & string in C++, Palindromes, pattern matching, anagrams, longest substring	**4**
6	**Functions & Recursion:** User-defined functions, Recursive functions	**4**
7	**Pointers & Dynamic Memory:** Pointers, Memory allocation (malloc, calloc), Pointer to array and functions	**4**
8	**Structures, Unions, and Files:** Structures, nested structures, File handling (text files)	**4**
9	**Pseudo Code & Logic -** Output Prediction, Error Finding, Loops, Strings, Arrays, Pointers, Functions, Recursion	**4**
Total Lab hours		**28**

Suggested/Resources:

1. "Cracking the Coding Interview", by Gayle Laakmann McDowell, CareerCup; 6th edition.
2. "Test Your C++ Skills", by Y. P. Kanetkar, BPB Publications, 2011.
3. "Stroustrup: The C++ Programming Language (4th Edition)," by Bjarne Stroustrup, Addison-Wesley; 4th edition.
4. "Programming interviews exposed: secrets to landing your next job", by John Mongan, Giguère E., and N. Kindler, John Wiley & Sons, 2013.

Online Practice Platforms:

1. GeeksforGeeks C/C++ Placement Practice – Topic-wise questions with solutions.
2. InterviewBit / LeetCode / HackerRank

Evaluation Scheme:

1	Mid Sem. Evaluation (50-question test)	20 Marks
2	End Sem. Evaluation (Online Assessment test)	20 Marks
3	Attendance	10 Marks
4	Assignments (Also includes weekly contests on Online Platforms)	20 Marks
5	Daily Lab Assessments (including Mock tests, Timely submission of codes, Passing of test cases, etc.)	30 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	Average
CO-1	3	2	-	-	-	-	-	3	-	-	-	**2.6**
CO-2	3	3	2	3	2	-	-	3	-	-	-	**2.7**
CO-3	3	3	2	2	-	-	-	3	-	-	-	**2.6**
CO-4	3	2	3	2	2	-	-	3	-	-	-	**2.5**
Average	**3**	**2.5**	**2.3**	**2**	**2**	-	-	**3**	-	-	-	

ECONOMICS

COURSE CODE: 25B11HS311

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 2-1-0

Pre-requisite: None

Course Objectives:

1. To provide understanding about economics and its applicability to engineering discipline.
2. To apply micro economics concepts and techniques in evaluating business decisions taken by firms.
3. To engage in learning the techniques of economic thinking and decision making.

Course Outcomes:

S. NO.	Course Outcomes	Level of Attainment
CO1	*Understand* the fundamental concepts of micro and macro economics	Familiarity
CO2	*Apply* the concepts of opportunity cost, national income accounting andvarious business forecasting methods.	Assessment
CO3	*Analyze* the concepts of demand, supply, market equilibrium, consumerchoices and production in micro-economic decision making.	Usage
CO4	*Evaluate* the different market structures and their implications on thebehavior of the firm.	Usage

Course Contents:

UNIT	Contents	Lectures Required
1.	**Introduction:** Economics Definition, Basic economic problems, Resource constraints and welfare maximization, Micro and Macroeconomics, Production Possibility Curve, Circular flow of economic activities.	**2**
2.	**Basics of Demand, Supply and Market Equilibrium:** Demand side and supply side of the market, Factors affecting demand & supply, Elasticity of demand & supply–price, income and cross-price elasticity, Market equilibrium price.	**4**

3.	**Theory of Consumer Choice:** Theory of Utility and consumer's equilibrium, Indifference Curve analysis, Budget Constraints, Consumer Equilibrium.	**4**
4.	**Demand Forecasting:** Regression Technique, Time-series, Smoothing Techniques: Exponential, Moving Averages Method	**3**
5.	**Production Theory and Analysis:** Production function. Isoquants, Isocost lines, Optimal combination of inputs. Stages of production, Law of returns, Return to scale.	**3**
6.	**Cost Theory and Analysis:** Nature and types of cost, Cost functions-short run and long run, Economies and diseconomies of scale	**2**
7.	**Market Structure:** Market structure and degree of competition, Perfect competition, Monopoly, Monopolistic competition, Oligopoly	**7**
8.	**National Income Accounting:** Overview of Macroeconomics, Basic concepts of National Income Accounting	**1**
9.	**Macro Economics Issues:** Introduction to Business Cycle, Inflation-causes, consequences and remedies: Monetary and Fiscal policy.	**2**
	Total Lectures	**28**

Suggested Textbooks:

1. H.C. Petersen, W.C. Lewis, *Managerial Economics*, 4th ed., Pearson Education 2001.
2. D. Salvatore, *Managerial Economics in a Global Economy*, 8th ed., Oxford University Press,2015.
3. William A. McEachern, *Micro ECON*, 6th ed., Cengage Learning, 2022.
4. Hal R. Varian. Intermediate Microeconomics, W. W. Norton and Company, 2019.
5. Henderson J., & Quandt, R.E. Microeconomic Theory: A Mathematical Approach. McGrawHill, New Delhi.
6. Mankiw: Principles of Macroeconomics with MindTap, 8thEdition, Cengage Learning, 2022.
7. Olivier Blanchard: Macroeconomics, 7th Edition, Pearson, 2020.
8. Ruder Dutt and Sundaram, Indian Economy, 65th Ed., S. Chand, 2018.
9. D. Salvatore, International Economics, 11th Ed., John Wiley & Sons, 2013.
10. Handa, J. Monetary Economics. Routledge.

Suggested Reference Books:

1. A. Koutsoyiannis. Modern Microeconomics. Macmillan.
2. Sodersten, BO, International Economics. Macmillan Press Ltd. London
3. R Dornbusch, S Fischer and R Startz: Macroeconomics, 12th Edition, TMH, 2018.

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
	Teaching Assessment	25	Entire Semester	Class Performance– 10 MCQ-10 Attendance – 5

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**Average**
CO1	2	2	3	3	2	3	2	3	2	1	3	**2.36**
CO2	3	3	3	3	3	3	2	2	1	1	3	**2.45**
CO3	3	3	3	3	3	3	2	2	2	1	3	**2.54**
CO4	3	3	3	3	3	2	2	2	2	1	2	**2.36**
Average	**2.75**	**2.75**	**3**	**3**	**2.75**	**2.75**	**2**	**2.25**	**1.75**	**1**	**2.75**	**2.43**

Environmental Studies Syllabus

COURSE CODE: 25B11GE411

COURSE CREDITS: 2

CORE/ELECTIVE: Core Course

L-T-P: 2-0-0

Unit	Contents	Lectures required
1	**Humans and the Environment:** Population growth and natural resource exploitation; Global environmental change. The emergence of environmentalism: Anthropocentric and eco-centric perspectives.	2
2	**Natural Resources and Sustainable Development:** Natural resources, their consumption & Protection: Water, Land Energy (Renewable, non-renewable, wind, solar, hydro, Biomass), Mineral, Forest, & Food resources. Concept of sustainable development, its challenges.	3
3	**Environmental Issues: Local, Regional and Global:** Pollution: Impact of sectoral processes on Environment, Types of Pollution-air, noise, water, soil, municipal solid waste, hazardous waste; Transboundary air pollution; Acid rain; Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. Global change: Ozone layer depletion; Climate change.	3
4	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas;	5
5	**Environmental Pollution and Health:** Understanding pollution:	6

	Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. Important air pollutants, Sources of water pollution and adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
6	**Climate change: Impacts, adaptations and mitigation:** Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan.	**4**
7	**Environmental Management:** Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001, Life cycle analysis; Cost-benefit analysis, Environmental audit and impact assessment; Environmental risk assessment. Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability.	**3**
8	**Environmental Treaties and Legislation:** Major International Environmental Agreements. Major Indian Environmental Legislations on wildlife, water, forest, air and biological diversity. The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights); Industry-specific environmental standards; Waste management rules; Major International organizations and initiatives.	**4**
	Total	**30**
9	**Case studies (will be suggestive as part of self study) and fieldwork (part of assignments)**[*]: The students are expected to be engaged in some of the following or similar identified activities and report these activities twice in a week. • Discussion on one national and one international case study related to the environment and sustainable development. • Field visits to identify local/regional environmental issues, make	**20**

	observations including data collection and prepare a brief report. • Documentation of campus biodiversity. • Campus environmental management activities such as solid waste disposal, water management, and sewage treatment.	

* 12 to 15 hrs to these activities in correlating with swatch Bharat Abhiyan and Unnat Bharat Abhiyaan

Suggested Text Book(s):

1. Environmental Studies By: M. P. Poonia and S.C. Sharma, Khanna Publishers
2. Textbook of Environmental Studies for UG Courses - Erach Bharucha, University Press
3. Joseph, B., 2005, Environmental Studies, Tata McGraw Hill, India.
4. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press

Suggested Reference Book(s):

1. Nebel, B.J. & Wright, R.T., 1993, Environmental Science, 8th Edition, Prentice Hall, USA.
2. Chiras D D.(Ed.). 2001. Environmental Science – Creating a sustainable future. 6th ed. Jones & Barlett Publishers.
3. David Laurance. 2003. Environment Impact assessment, Wiley publications.
4. Chhokar KB, Pandya M & Raghunathan M. 2004. Understanding Environment. Sage publications, NewDelhi .

Other useful resource(s):

1. Issues of the journal: Down to Earth, published by Centre for Science and Environment.
2. Audio visuals from: Discovery, National Geographic etc.
3. https://nptel.ac.in/courses/120108002/
4. https://nptel.ac.in/courses/120108005
5. https://www.india.gov.in/official-website-central-pollution-control-board
6. https://unnatbharatabhiyan.gov.in/

Numerical Analysis for Mathematical Computing

COURSE CODE: 25BS1MA411
COURSE CREDITS: 3
CORE/ELECTIVE: Core
L-T-P: 3-0-0

Prerequisite: Basic knowledge of calculus, linear algebra, and programming fundamentals.

Course Objectives

1. To introduce the concepts of approximation and computational errors involved in numerical analysis.
2. To familiarize students with various numerical methods for solving non-linear equations and interpolation.
3. To enable the application of numerical techniques in solving interpolation, integration, systems of linear equations, and differential equations.
4. To develop the ability to analyse and evaluate numerical methods for accuracy, efficiency, and error estimation in solving mathematical problems.

Course Outcomes

S. No.	Course Outcomes	Level of Attainment
CO-1	Students will be able to relate with the concepts of approximation, errors in computation and roots of non-linear equations.	Familiarity
CO-2	Students will be able to apply numerical methods for finding the roots of non-linear equations	Assessment and Usage
CO-3	Students will be able to apply numerical methods for solution of system of linear equations	Assessment
CO-4	Students will be able to perform interpolation of a polynomial using various techniques.	Assessment and Usage
CO-5	Students will be able to perform numerical Differentiation and numerical Integration	Assessment and Usage
CO-6	Students will be able to solve initial value problems and boundary value problems.	Assessment and Usage

Course Contents

Unit	Contents	Lectures required
1.	**Errors in Computation:** Errors, relative error, absolute error, error in series approximation, round-off and truncation errors.	4
2.	**Roots of Non-linear Equations:** Iterative methods for finding the roots of non-linear equations - Bisection method, Regula-Falsi method, Iterative method, Newton-Raphson method, and Secant method - along with their convergence criteria.	8
3.	**Numerical Linear Algebra:** Solution of systems of linear equations: Gauss Elimination, Gauss-Jacobi, and Gauss-Seidel methods. LU Decomposition and its applications. Power Method for computing the dominant eigenvalue. Singular Value Decomposition (SVD) and its significance in numerical computations.	8
4.	**Interpolation:** Finite differences, Newton's forward and backward interpolation, Central difference formulas, Newton's divided difference formula, Lagrange's interpolation formula.	8

5.	**Numerical Differentiation and Integration:** Approximation of derivatives, Newton-Cote's formulae, Trapezoidal, Simpson's, Boole's and Weddle's rules.	6
6.	**Numerical Solution of Differential Equations:** Euler's method, Modified Euler's method, Fourth order Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs.	8
	Total Lectures	**42**

Suggested Textbook(s)

1. R. S. Gupta, *Elements of Numerical Analysis*, 2nd ed., Cambridge University Press, 2015.
2. M. Pal, *Numerical Analysis for Scientists and Engineers: Theory of C Programming*, Narosa Publishing House, 2020.
3. R. L. Burden and J. D. Faires, *Numerical Analysis*, 10th ed., Cengage Learning, MA, 2016.

Suggested Reference Book(s)

1. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation 5th Ed., New Age International, New Delhi, 2007.
2. Gerald, C. F., Applied Numerical Analysis, 7th Ed., Pearson 2009.

Online Resources

1. https://www.youtube.com/watch?v=pOtnzAXlXvI&list=PLwdnzlV3ogoUY43XoMwVVCWDSImC9mVQB
2. https://www.youtube.com/watch?v=M8HrMF1kh3c&list=PLOzRYVm0a65d0WWST6wvOP6m7VRQyRgSa

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 Quizzes (2) -10 Attendance – 5

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

Course Outcomes Numerical Analysis for Mathematical Computing	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	Average
CO-1	3	2	1	1	2	0	0	0	0	1	0	1
CO-2	3	3	1	2	2	0	0	0	0	1	0	1.27
CO-3	3	3	2	2	3	0	0	0	1	1	1	1.55
CO-4	3	3	2	3	3	0	0	0	1	1	1	1.73
CO-5	3	3	2	3	3	0	0	0	1	1	1	1.73
CO-6	3	3	2	3	3	0	0	0	1	1	1	1.73
Average	3	2.75	1.5	2	2.5	0	0	0	0.5	1	0.5	

Numerical Analysis for Mathematical Computing Lab

COURSE CODE: 25BS7MA471
COURSE CREDIT: 1
CORE/ELECTIVE: CORE
L-T-P: 0-0-2
Pre-requisite: Basic knowledge of Python programming.

Course Objectives: This course introduces student's theoretical and practical aspects of a relatively wide spectrum of numerical techniques and familiarize the student with numerical coding using Python language. On completion of the course, students will be able

1. To exercise the fundamentals of numerical analysis in the Python environment.
2. To develop programs for various numerical methods in Python programming.

S. No.	Course Outcomes	Level of Attainment
CO-1	Getting familiar with Python, learn data input, vector functions and arrays, understand to write Python functions and implementation.	Familiarity
CO-2	Learn to write and execute programs for solving algebraic & transcendental equation, and system of linear equations & eigen value problems.	Assessment& Usage
CO-3	Learn to write and execute programs for polynomial interpolation.	Assessment& Usage
CO-4	Learn to write and execute programs to perform numerical integration.	Assessment& Usage
CO-5	Learn to write and execute programs for finding numerical solution of ordinary differential equations.	

List of Experiments:

S. No.	Description	Hours
1	Getting started with Python, perform basic calculations, variables and basic data structures.	2
2	Python functions, loop and recursion syntax, reading and writing data inputs, visualization and plotting.	2
3	Error types: absolute, relative and percentage error, avoiding errors.	2
4	To write a program and execute it to find roots of algebraic and transcendental equation using bisection method.	2
5	To write a program and execute it to find roots of algebraic and transcendental equation using Newton-Raphson method.	2
6	To write a program and execute it for solving systems of equations using Gauss Seidel method	2
7	To write a program and execute it for calculating the eigenvalues and	2

	eigenvectors.	
8	To write a program and execute it for LU decomposition and Singular Value Decomposition.	2
9	To write a program and execute it for interpolation using Newton-Gregory' s formula.	2
10	To write a program and execute it for polynomial interpolation using Lagrange's formula.	2
11	To write a program and execute it for numerical integration using Trapezoidal rule.	2
12	To write a program and execute it for numerical integration using Simpson's rule.	2
13	To write a program and execute it for finding numerical solutions of ordinary differential equations (IVP) using Euler's method.	2
14	To write a program and execute it for finding numerical solutions of ordinary differential equations using Runge-Kutta's (RK) method.	2
Total Lab Hours		**28**

Suggested Text Book(s):

1. Qingkai Kong, Timmy Siauw, and Alexandre Bayen, "Python Programming And Numerical Methods: Guide For Engineers And Scientists", Academic Press Inc., 1st Edition, 2020.

Suggested Reference Book(s):

1. Robert Johansson, Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib, APRESS, 2nd Edition, 2019.

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	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	1	1	2	**1.58**
CO-2	3	2	2	2	2	2	1	1	1	1	1	2	**1.67**
CO-3	2	3	3	3	3	2	2	2	3	2	3	3	**2.58**
CO-4	2	3	3	3	3	3	3	2	3	3	3	3	**2.83**
CO-5	2	3	3	3	3	3	3	2	3	3	3	3	**2.83**
Average	**2.2**	**2.6**	**2.6**	**2.6**	**2.5**	**2.4**	**2**	**1.6**	**2.2**	**2**	**2.2**	**2.6**	**2.29**

Discrete Computational Mathematics

COURSE CODE: 25B11MA213
COURSE CREDITS: 4
CORE/ELECTIVE: CORE
L-T-P: 3-1-0

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: The students will be able to

S. No.	Course Outcomes	Level of Attainment
CO-1	explain partial order relations, Hasse diagram, lattices and recursive functions.	Understanding (C2)
CO-2	solve the difference equations using generating function and Z transform.	Applying (C3)
CO-3	explain the propositional and predicate calculus to check the validity of arguments.	Understanding (C2)
CO-4	demonstrate graphs, digraphs, trees and use it to solve the different problems of graph theory.	Applying (C3)
CO-5	illustrate various algebraic structures and their properties.	Understanding (C2)
CO-6	explain the theory of formal languages and solve the related problems of automata.	Applying (C3)

Course Contents:

Unit	Contents	Lectures required
1	**Relations & Lattices:** Relations and their composition. Pictorial representation, matrix and graphical representations. Equivalence relations and partitions. Partial ordered relations and Hasse diagram. Lattices.	5
2	**Functions:** Functions and recursively defined functions, generating functions, solution of recurrence relations by generating function. Z transforms, solution of difference equations by Z transform	8
3	**Propositional Calculus:** Propositions- simple and compound. Basic logical operators. Implication. Truth tables. Tautologies and contradictions. Valid arguments and fallacy. Propositional functions and quantifiers.	4
4	**Graphs:** Graphs and related definitions, subgraphs, isomorphism, paths and connectivity. Eulerian graph and Konigsberg 7 problem. Hamiltonian graph. Labelled and weighted graphs. Tree Graphs-Minimum spanning Tree (Prim's algorithm). Graph colorings. Four color problem.	7
5	**Trees & Directed Graphs:** Trees, Digraphs and related definitions. Rooted trees. Algebraic expressions and Polish notation. Sequential representation. Adjacency matrix. Path matrix. Shortest path. Linked representation of directed graphs. Binary trees.	5
6	**Algebraic Structures:** Groups- definitions and examples, order of elements, subgroup, condition for subgroups. Quotient groups, Lagrange theorem and applications, Rings, integral domains and Fields- definition and examples.	7

7	**Languages & Grammars:** Strings (words) and languages, grammars, types of grammars, Finite state machines, finite state automata, regular languages and regular expressions.	6
Total Lectures		**42**

Suggested Text Book(s):

1. K. H. Rosen, "*Discrete Mathematics and Its Applications"*, 7th Edition, McGraw-Hill Education, 2012.
2. C. L. Liu and D. P. Mohapatra, "*Elements of Discrete Mathematics: A Computer-Oriented Approach"*, 4th Edition, McGraw-Hill Education, 2013.

Suggested Reference Book(s):

1. B. Kolman, R.C. Busby & S.C. Ross, "Discrete Mathematical Structures", 6th Edition (New International Edition), Pearson Education, 2014.
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=7cTWea9Y

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 Quizzes (2) - 10 Attendance - 5

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**
Average	**3**	**2.6**	**2.3**	**1.1**	**1.6**	**2.6**	**2.6**	**1.7**	**1.9**	**2.6**	**2**	**1.4**	

Design and Analysis of Algorithms

COURSE CODE: 25B11CI412

COURSE CREDITS: 3

CORE/ELECTIVE: Core

L-T-P: 3-1-0

Pre-requisite: Data structure and algorithm

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	Understand the concepts of algorithms and their analysis.	Familiarity
CO-2	Apply algorithmic design techniques to solve fundamental computational problems.	Apply
CO-3	Analyze a given problem to identify an appropriate data structure and algorithm design strategy.	Assessment
CO-4	Evaluate the efficiency and suitability of different algorithmic approaches for solving a given problem.	Evaluation

Course Contents:

Unit	Subtitle of the Module	Contents	No. of Lectures
1.	Introduction	Analyse the performance of algorithms; Asymptotic analysis and notations- big O, big omega, big theta, etc. Growth of Functions; Recurrence and Solving Recurrences using different approaches; Empirical analysis of sorting and searching algorithms	9
2.	Design Technique: Divide and Conquer	Fundamentals of Divide and Conquer (D&C) approach, designing the D&C based algorithms for binary search, quick sort, merge sort, matrix multiplication, closest pair, etc.	5
3.	Design Technique: Backtracking Algorithms	Fundamentals of backtracking algorithms and designing of backtracking based solutions for N-queen, Rat in a maze, etc. problems and designing backtracking based solutions for M-coloring problem, Hamiltonian Cycle detection, Travelling salesman problem, Network flow, etc	6

4.	Design Technique: Greedy Algorithms	Fundamentals of greedy algorithms and designing solutions for graph problems like Shortest Path, Minimum Spanning Trees (Prim's and Kruskal algorithms), Coloring, Covering, etc., fractional Knapsack, Coinage problem, Bin packing, Job scheduling, Text compression using Huffman coding & Shannon-Fanon coding, etc.	8
5.	Dynamic Programming	Fundamentals of Dynamic Programming (DP) and designing DP based solutions for 0/1 Knapsack, Shortest path, Coinage problem, Matrix Chain Multiplication, Longest common subsequence, Longest increasing sequence, String editing, etc.	7
6.	String Algorithms	String matching algorithms using Naïve String Matching, Finite Automata Matcher, Rabin Karp matching algorithm, Knuth Morris Pratt, etc; Review of string based data structures: Suffix Tree, Suffix Array and Tries.	6
7.	Tractable and Non-Tractable Problems	Efficiency and Tractability, P, NP, NP-Complete, NP- Hard problems	1
Total lectures			**42**

Suggested Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 4th Edition, 2022
2. Steven Skiena,The Algorithm Design Manual, Springer; 3rd Edition, 2020
3. Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3rd Edition,1997
4. Knuth, The art of Computer Programming Volume 3, Sorting and Searching, Addison-Wesley Professional; 2nd Edition,1998
5. Horowitz, Sahni and Rajasekaran, Fundamentals of Computer Algorithms, Computer Science Press, 2008
6. Sedgewick, Algorithms in C, 4th Edition. Addison Wesley, 2016
7. Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983

Suggested Reference Books:

1. Tim Roughgarden, Algorithms Illuminated: Part 1: The Basics, Sound like yourself Publishing, September 27, 2017
2. Tim Roughgarden, Algorithms Illuminated: Part 2: Graph Algorithms and Data Structures,Soundlike yourself Publishing, First Edition, 2018.
3. Tim Roughgarden, Algorithms Illuminated:Part3: Greedy Algorithms and Dynamic Programming, Sound likey ourself Publishing, First Edition, 2019.
4. Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2014

Other useful resource(s):

1. https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/
2. Link to NPTEL course contents:
   https://nptel.ac.in/courses/106106131
   http://www.digimat.in/nptel/courses/video/106101060/L01.html

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	Test-1	15	1 Hour.	Syllabus covered upto T-1
2	Test-2	25	1.5 Hours	Syllabus covered upto T-2
3.	Test-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment (TA)	25	Entire Semester	Assignment, Quizzes, Tutorial, Attendance.

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	2	2	2	2	2	1	1	1	2	2	2
CO-2	2	3	3	3	3	1	1	1	2	2	1
CO-3	2	2	2	2	3	1	1	1	2	2	1
CO-4	1	2	2	1	3	2	1	1	1	1	1
Average	1.75	2.25	2.25	2	2.75	1.25	1	1	1.75	1.75	1.25

Design and Analysis of Algorithms Lab

COURSE CODE: 25B17CI472

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Data Structures and Algorithms

Course Objectives:

1. Analyze asymptotic performance and correctness of algorithms
2. Apply divide and conquer to design efficient algorithms
3. Use backtracking to explore combinatorial search spaces
4. Design greedy algorithms and prove optimality
5. Formulate dynamic programming solutions for optimal substructure problems
6. Master string algorithms for pattern matching and text processing

Course Outcomes

S No	Course Outcomes	Level of Attainment
CO1	Understand and define appropriate data structure to a given problem	Apply
CO2	Understand complexity using asymptotic and experimental analysis for various algorithmic design techniques.	Apply
CO3	Apply and build various algorithms and design techniques to solve the given problem.	Apply
CO4	Formulate, elaborate, and design an efficient solution to a given problem using appropriate data structure and algorithm design technique.	Assessment

List of Experiments (To be Implemented using C/C++, or Java)

S No	Description	Hours
1	Implement and compare the runtime performance of the following sorting algorithms on identical input data and visualize how their execution times scale with array size. • Insertion Sort • Selection Sort • Merge Sort • Quick Sort (random pivot) • Heap Sort	**4**
2	Implement the base-case logic of Strassen's Algorithm to compute the product of two 2×2 matrices using a specific set of recursive formulas that prioritize reducing the number of multiplications.	**2**
3	You are given a graph with *N* vertices**.** The goal is to assign one of *M* colors to each vertex. Constraints: • No two adjacent vertices can have the same color. • If such a coloring exists, print it; otherwise, report that no solution exists.	**2**
4	You are given a set of *N* cities and the distances between each pair of cities. The salesman must start from a city, visit every other city exactly once**,** and return to the starting city. Find the shortest possible route that satisfies these conditions.	**2**

5	Place N queens on an $N \times N$ chessboard**.** Constraint: No two queens can attack each other. That means no two queens share the same row**,** column**,** or diagonal**.** Backtracking Approach Recursive placement: • Place a queen in a row. • Check if the position is safe (no conflicts with previously placed queens). • If safe, recurse to the next row. • If not safe, try the next column. • If no column works, backtrack to the previous row. Base case: • If all queens are placed successfully, print the board.	**4**
6	Write a program to compute optimal parenthesization and minimum multiplication cost for a chain of matrices. (Matrix Chain Multiplication)	**2**
7	Implement Prim's algorithm to compute the Minimum Spanning Tree (MST) of a weighted undirected graph and print the MST weight and edges.	**2**
8	Implement Huffman coding to compress and decompress a given text string. Build the Huffman tree from character frequencies, generate prefix codes, encode the input into a bitstring of 0s and 1s, then decode that bitstring back to the original text. ***Input*** • A single line containing the text to encode. The text may include spaces and printable ASCII characters. ***Output*** • First line: **k** the number of distinct symbols. • Next **k** lines: each symbol and its code as symbol code using readable labels for whitespace (for example SPACE for space). • Next line: Encoded followed by the encoded bitstring (sequence of 0 and 1). • Final line: Decoded followed by the decoded text. ***Constraints*** • Use a min-heap priority queue to build the tree. • Codes must be prefix free. • Handle empty input and single-symbol input correctly. • A plain string of 0/1 bits is acceptable for the encoded output; bit packing is optional.	**4**
9	Implement a C/C++/Java program that finds all occurrences of a pattern P in a text T using the Rabin–Karp algorithm. The program should compute a rolling hash for each length-m window in T, compare it to the pattern hash, and verify matches by direct comparison when hashes match.	**2**
10	Mini Project: Designing an efficient solution to a given problem using appropriate data structure and algorithm design technique.	**4**
Total Lab hours		**28**

Suggested/Resources:

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 4th Edition, 2022
2.	Steven Skiena,The Algorithm Design Manual, Springer; 3rd Edition, 2020
3.	Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3rd Edition,1997
4.	Knuth, The art of Computer Programming Volume 3, Sorting and Searching, Addison-Wesley Professional; 2nd Edition,1998
5.	Horowitz, Sahni and Rajasekaran, Fundamentals of Computer Algorithms, Computer Science Press, 2008

6.	Sedgewick, Algorithms in C, 4th Edition. Addison Wesley, 2016
7.	Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983
Recommended Reading material:	
1.	Tim Roughgarden, Algorithms Illuminated: Part 1: The Basics, Sound like yourself Publishing, September 27, 2017
2.	Tim Roughgarden, Algorithms Illuminated: Part 2: Graph Algorithms and Data Structures, Soundlike yourself Publishing, First Edition, 2018.
3.	Tim Roughgarden, Algorithms Illuminated:cPart3: Greedy Algorithms and Dynamic Programming, Sound like yourself Publishing, First Edition, 2019.
4.	Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition**,** Pearson, 2014

Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	10 Marks
4	Project	20 Marks
5	Lab Assessment	30 Marks
	Total	100 marks

Project based learning:

Students in a group of 4-5 will have to develop a mini project based on appropriate data structures and algorithm design techniques. The students can opt any real-world application where these algorithms can be applied. The students have to implement the mini project using C/C++/Java language. Project development and its presentation will enhance coding skills, knowledge and employability of the students in IT sector.

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	3	2	2	2	3	1	2	1	1	1	2	**1.82**
CO-2	3	2	3	3	3	2	1	2	2	1	2	**2.18**
CO-3	2	2	2	2	2	2	1	2	2	2	2	**1.91**
CO-4	3	3	3	3	3	2	1	2	2	3	2	**2.45**
Average	**2.75**	**2.25**	**2.5**	**2.5**	**2.75**	**1.75**	**1.25**	**1.75**	**1.75**	**1.75**	**2**	

Artificial Intelligence and Machine Learning

COURSE CODE: 25B11CI413

COURSE CREDITS: 3

CORE/ELECTIVE: Core

L-T-P: 3-0-0

Pre-requisite:

Basic knowledge of programming (preferably Python/R), data structures, and algorithms, along with fundamentals of linear algebra, probability, statistics, and data handling.

Course Objectives:

1. Understand the fundamental concepts of Artificial Intelligence, including problem-solving strategies and intelligent agents.
2. Apply intelligent search techniques to formulate and solve real-world computational problems.
3. Implement supervised, unsupervised, and semi-supervised learning algorithms for data-driven problem solving.
4. Apply machine learning algorithms to classification problems, analyzing their performance and limitations.
5. Analyze and compare deep learning architectures and evaluate their suitability for real-world applications.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understand the basics of artificial intelligence, problem solving strategies, and machine learning methods	Familiarity
CO-2	Apply intelligent searching techniques to solve a given problem	Familiarity
CO-3	Apply supervised, unsupervised or semi-supervised learning algorithms for a given problem	Assessment
CO-4	Apply the machine learning algorithms for classification problems	Assessment
CO-5	Analyze the different deep learning architectures for real-world applications.	Usage

Course Contents:

Unit	Contents	Lectures required
1	Introduction to AI, Problems of AI - Search, reasoning, planning, learning, perception, AI technique, Tic – Tac – Toe Problem as a state-space search problem. Intelligent Agents: Definition, properties, and rationality, Agents & Environment, Nature of Environment, Structure of Agents, Goal-based agents, Utility-based agents, learning agents, Identify PEAS (Performance, Environment, Actuators, Sensors) for: Vacuum cleaner agent, Self-driving car	**6**
2	Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search. Heuristic search strategies Greedy best -first search, A* search, AO* search.	**9**
3	Fundamentals of Machine learning, Types of Machine Learning: Supervised, unsupervised, reinforcement, Machine perception - feature extraction - classification, clustering, linear and logistic regression.	**9**
4	Concept of ANN (Artificial Neural Network): Perceptron and backpropagation neural network - k-nearest neighbor rule. Support vector machine: Decision trees: and random forest.	**9**
5	Introduction to Deep learning, Convolutional neural networks, CNN Architectures LeNet, AlexNet, GooleNet, VGG Net, ResNet: Comparative analysis	**9**
Total lectures		**42**

Suggested Text Book(s):

1. R. O. Duda, E. Hart, and D.G. Stork, “Pattern Classification”, Second Edition, John Wiley & Sons, Singapore, 2012.
2. Francois Chollet, “ Deep Learning with Python”, Manning Publications, Shelter Island, New York, 2018
3. Satish Kumar, “Neural Networks A Classroom Approach”, McGraw Hill Education (India) Pvt. Ltd, 2010
4. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2015.

Suggested Reference Book(s):

1. Ethem Alpaydin, “Introduction to Machine Learning”, 3rd Edition, MIT Press, 2014.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Elaine Rich, Kevin Knight, & Shivashankar B Nair, “Artificial Intelligence”, McGraw Hill, 3rd ed.,2017.
5. Patterson, “Introduction to Artificial Intelligence & Expert Systems”, Pearson, 1st ed. 2015.

Other useful resource(s):

1.Link to NPTEL course contents: https://nptel.ac.in/courses/106102220
2. https://nptel.ac.in/courses/106106139

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) - 5 Quizzes (2) - 15 Attendance - 5

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	**1.73**
CO-2	2	3	3	3	3	1	1	1	2	2	1	**2**
CO-3	2	2	2	2	3	1	1	1	2	2	1	**1.73**
CO-4	2	3	3	3	2	1	1	1	2	3	2	**2.09**
CO-5	1	2	2	1	3	2	1	1	1	1	1	**1.45**
Average	**1.8**	**2.4**	**2.4**	**2.2**	**2.6**	**1.2**	**1**	**1**	**1.8**	**2**	**1.4**	

Artificial Intelligence & Machine Learning Lab

COURSE CODE: 25B17CI473

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Python Programming Language

Course Objectives:

1. To familiarize students with the practical implementation of fundamental Artificial Intelligence and Machine Learning algorithms using standard programming tools and libraries.
2. To enable students to preprocess, clean, and prepare real-world datasets for effective machine learning model development.
3. To develop hands-on proficiency in implementing supervised and unsupervised learning techniques and evaluating their performance using appropriate metrics.
4. To train students in applying classification, regression, clustering, and dimensionality reduction techniques to solve standard engineering problems.
5. To inculcate good laboratory practices such as result analysis, model comparison, documentation, and interpretation of experimental outcomes.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Implement basic Artificial Intelligence and Machine Learning algorithms using standard programming tools and libraries.	Apply
CO2	Preprocess and prepare datasets by applying data cleaning, transformation, and feature selection techniques.	Apply
CO3	Analyze and evaluate the performance of supervised and unsupervised learning models using appropriate metrics.	Analyze
CO4	Design and implement machine learning solutions for classification, regression, and clustering problems.	Create
CO5	Interpret experimental results, compare models, and document outcomes following standard laboratory practices.	Evaluate

List of Experiments

S. No	Description	Hours
1	**Introduction to Python and Scientific Libraries** Study and use of NumPy, Pandas, Matplotlib, and Scikit-learn for ML experiments.	**4**
2	**Data Preprocessing and Exploratory Data Analysis** Handling missing values, normalization, encoding categorical data, and basic visualization.	**4**
3	**Implementation of Linear and Multiple Linear Regression** Predicting continuous outcomes and evaluating model performance.	**2**
4	**Implementation of Logistic Regression** Binary classification and performance evaluation.	**2**
5	**Implementation of k-Nearest Neighbour (k-NN) Algorithm** Distance metrics and model tuning.	**2**
6	**Implementation of Decision Tree Algorithm** Tree construction, pruning, and result interpretation.	**2**
7	**Implementation of Support Vector Machine (SVM)** Linear and non-linear classification using kernels.	**2**
8	**Implementation of k-Means Clustering** Unsupervised learning and cluster analysis.	**2**
9	**Mini Project / Case Study using Machine Learning** End-to-end problem: data preprocessing, model building, evaluation, and documentation.	**2**
10	**Breadth First Search (BFS), Depth First Search (DFS), and A* search algorithms** To implement and compare Breadth First Search (BFS), Depth First Search (DFS), and A* search algorithms, and to study the effect of heuristics on search efficiency and optimality.	**2**
11	**Implementation of Principal Component Analysis (PCA)** Dimensionality reduction and variance analysis.	**2**
12	**Implementation of Artificial Neural Network (ANN)** Feed-forward neural network using standard libraries.	**2**
	Total Lab hours	**28**

Suggested/Resources:

1. M. Lutz, Programming Python, 4th ed. Sebastopol, CA, USA: O'Reilly Media, Inc., 2010.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 1997, ISBN 0070428077.
3. Sebastian Raschka, "Python Machine Learning", Packt Publishing Ltd.
4. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc.
5. SunilaGollapudi, "Practical Machine Learning", Packt Publishing Ltd
6. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, Inc.
7. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019
8. K. P. Murphy, Machine Learning: A Probabilistic Perspective. Cambridge, MA, USA: MIT Press, 2012.
9. S. Weidman, Deep Learning from Scratch: Building with Python from First Principles. Sebastopol, CA, USA: O'Reilly Media, 2019.
10. Willi Richert, "Building Machine Learning Systems with Python", Packt Publishing Ltd.
11. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA: MIT Press, 2016.

Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	10 Marks
4	Project	20 Marks
4	Lab Assessment	30 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	Average
CO-1	3	2	2	-	3	-	-	-	-	-	-	**2.33**
CO-2	2	3	2	2	3	-	-	-	-	-	-	**2.40**
CO-3	2	3	2	3	2	-	-	-	-	-	-	**2.40**
CO-4	2	3	3	2	3	-	-	-	-	-	-	**2.60**
CO-5	1	2	2	2	2	-	-	2	-	3	-	**1.833**
Average	**2.00**	**2.60**	**2.20**	**2.25**	**2.60**	**-**	**-**	**2.00**		**3.00**	**-**	

R-SOFTWARE LAB

COURSE CODE: 25B17MA471

COURSE CREDIT: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Basic understanding of programming concepts such as variables, loops, and conditional statements. Fundamental knowledge of matrices, vectors, linear algebra operations, statistics and probability.

Course Objectives: On successful completion of this course, students will be able to:

1. Write and execute basic R programs for mathematical and statistical computations.
2. Perform data manipulation, cleaning, and visualization using R libraries.
3. Apply statistical and analytical techniques for data-driven problem solving.
4. Develop R-based solutions for mathematical modeling and computational analyses.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	**Understand the fundamentals of R programming**: Students will gain knowledge of R syntax, data types, operators, and basic control structures, enabling them to write and execute simple R programs confidently.	Familiarity & Usage
CO-2	**Perform data import, manipulation, and visualization**: Students will learn to handle various data formats, clean and transform datasets, and create informative visualizations using R libraries such as *ggplot2*, *dplyr, etc*.	Familiarity & Assessment
CO-3	**Apply statistical analysis and interpret results**: Students will be able to conduct descriptive and inferential statistical analyses, apply hypothesis testing, regression, and correlation techniques, and interpret outcomes effectively using R.	Assessment & Usage
CO-4	**Develop computational solutions using R**: Students will acquire the skills to implement mathematical models and computational algorithms in R to solve real-world data analysis and optimization problems.	Assessment & Usage

Course Contents:

S. No.	Description	Hours
1	**Introduction to R and RStudio:** Installation of R and RStudio, Advantages of R over Other Programming Languages, R Interface, Workspace, Script Editor, and Basic Commands, Different Packages in R	2
2	**Basic Syntax and Data Types in R:** Variable and Assignments, Finding Variable, Deleting Variables, Operators, Data Types (Numeric, Character, Logical), and Data Type Conversions.	2
3	**Vectors and Matrices:** Creation and Manipulation of Vectors and Matrices; Matrix Operations.	2
4	**Lists and Data Frames:** Lists and Data Frames, Indexing, Sub setting, and Basic Data Handling.	2
5	**Control Structures and Functions:** Logic, Conditional Statements, Loops, and Writing User-defined Functions in R.	2

6	**Importing and Exporting Data:** Working Directory, Importing Data from CSV, Excel, and Text Files; Export Results to External Files.	**2**
7	**Data Cleaning:** Data Cleaning and Manipulation, Filtering, Grouping, and Summarization Techniques using *dplyr* Package.	**2**
8	**Data Visualization:** Basic and Advanced Plots (Bar, Histogram, Scatter, Boxplot, etc.) using *ggplot2*, etc., Labeling of Plots, 3D Visualization, Exporting Plots.	**2**
9	**Descriptive Statistics and Data Summarization:** Measures of Central Tendency and Dispersion (Mean, Median, Mode, Variance, etc.), and Visualize Data Distributions.	**2**
10	**Probability Distributions in R:** Discrete and Continuous Probability Distributions (Binomial, Poisson, and Normal .), Random Number Generalization..	**2**
11	**Hypothesis Testing:** Perform t-Test, Chi-square Test, and ANOVA using built-in R Functions.	**2**
12	**Correlation and Regression Analysis:** Correlation, Simple, and Multiple Linear and Non-linear Regression Analysis in R.	**2**
13	**Advanced Statistical Modeling:** Logistic Regression, Poisson Regression, Generalized Linear Models (GLM), Residual Analysis.	**2**
14	**Resampling Techniques:** Bootstrapping, Cross-Validation (CV), Model Accuracy Estimation.	**2**
Total Lab Hours		**28**

Suggested Text Book(s):

1. Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Advanced R Statistical Programming and Data Analysis, CRC Press, 1st Edition, 2019.
2. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, 1st Edition, 2011.
3. Crawley M. J., The R Book, Wiley, 2nd Edition, Reprint, 2017.
4. Baclawski, K., Introduction to Probability with R, 1st Edition, Reprint, Chapman & Hall/CRC, 2011
5. Kabacoff, R. I., R in Action, Dream Tech Press, 2nd Edition, 2015.
6. Ugarte, M. D., Militino, A. F., and Arnholt, A. T., Probability and Statistics with R, CRC press, 2008

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 (R-Software Lab)	**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	3	2	3	3	3	2	3	2	3	**2.50**
CO-2	3	2	1	2	2	2	3	3	2	2	2	3	**2.25**
CO-3	3	2	2	3	2	3	3	3	2	3	3	3	**2.67**
CO-4	3	2	2	3	2	3	3	3	2	3	3	3	**2.67**
CO-5	3	1	3	2	2	3	3	3	2	3	3	3	**2.58**
Average	**3.00**	**1.60**	**2.00**	**2.60**	**2.00**	**2.80**	**3.00**	**3.00**	**2.00**	**2.80**	**2.60**	**3.00**	

Competitive Programming -II

COURSE CODE: XXXXXXXX

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

Pre-requisite: Software Development Fundamentals, Data Structures

Course Objectives:

1. To develop analytical problem-solving skills.
2. To strengthen the programming skills.
3. To Design and implement optimized solutions using appropriate data structures.
4. To prepare students for national and international programming contests
5. To enhance technical coding ability for placement and interviews.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO1	Implement and use programming concepts.	Apply
CO2	Analyze the time and space complexity of different algorithms.	Analyze
CO3	Implement non-linear data structures such as trees and graphs.	Apply
CO4	Design and develop optimized and real-time solutions using appropriate algorithms and data structures.	Create
CO5	Prepare for technical interviews by solving coding-related problems with realistic constraints.	Create, Evaluate
CO6	Participate confidently in online programming contests.	Apply

List of Experiments

S. No	Description	Hours
1	**Linked Lists:** Reversal, merging, cycle detection, Intersection, palindrome check	**4**

2	**Stacks & Queues:** Balanced parentheses, Next greater/smaller element, Implement stack/queue using array/linked list, Queue using stacks and vice versa, infix-postfix conversion	**4**
3	**Sorting Algorithms:** Bubble Sort, Selection Sort, Insertion Sort	**4**
4	**Trees:** Binary Tree, BST basics, Tree traversals (Inorder, Preorder, Postorder), Lowest Common Ancestor (LCA)	**6**
5	**Hashing:** Frequency count, duplicates, subarray sum	**4**
6	**Graphs:** BFS and DFS, Detect cycle in a graph, Shortest Path (Dijkstra, Bellman-Ford), Topological Sort, Minimum Spanning Tree (Prim's, Kruskal's), Union-Find / Disjoint Set.	**6**
Total Lab hours		**28**

Suggested/Resources:

1. "Cracking the Coding Interview", by Gayle Laakmann McDowell, CareerCup; 6th edition.
2. "Competitive Programming 3", Steven Halim, Lulu.
3. "Programming interviews exposed: secrets to landing your next job", by John Mongan, Giguère E., and N. Kindler, John Wiley & Sons, 2013.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, third edition. MIT Press, 2009.

Online Practice Platforms:

1. GeeksforGeeks C/C++ Placement Practice – Topic-wise questions with solutions.
2. InterviewBit / LeetCode / HackerRank

Evaluation Scheme:

1	Mid Sem. Evaluation (50-question test)	20 Marks
2	End Sem. Evaluation (Through Online Assessment test)	20 Marks
3	Attendance	10 Marks
4	Assignments (Including weekly contests on Online Platforms)	20 Marks
5	Daily Lab Assessments (including Mock tests, Timely submission of codes, Passing of test cases)	30 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	Average
CO-1	3	2	1	-	1	-	-	3	-	-	-	**2**
CO-2	3	2	2	1	2	-	-	3	-	-	-	**2.2**
CO-3	3	3	2	2	-	-	-	3	-	-	-	**2.6**
CO-4	3	3	3	2	2	-	-	3	-	-	-	**2.7**
CO-5	3	2	3	2	2	-	-	3	-	-	-	**2.5**
CO-6	3	3	2	3	2	-	-	3	-	-	-	**2.7**
Average	**3**	**2.5**	**2.2**	**2**	**1.8**	-	-	**3**	-	-	-	