DEPARTMENT

OF

PHYSICS AND MATERIALS SCIENCE

SYLLABUS

Approved in Academic Council held on 28.06.2023

Engineering Physics-I

COURSE CODE: 18B11PH111

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P : 3-1-0

Pre-requisite: None

Course Objectives:

I. To enable the students to get better understanding about electromagnetics and its applications in engineering.
II. To enable the students to get better understanding about physical optics and its applications in engineering.
III. At the conclusion of the course, the ability of students should have enhanced to think logically about the problems of science and technology and obtain their solutions.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will get better understanding about electromagnetics and its applications in engineering.	Familiarity and Assessment
CO-2	Students will get better understanding about physical optics and its applications in engineering.	Familiarity and Assessment
CO-3	Students will be able to enhance logical thinking about the problems of science and technology	Assessment and Implementation
CO-4	Students will be able to apply learned concepts to obtain solutions to the problems	Assessment and Implementation

Course Contents:

Unit	Contents	Lectures required
1	**Basics of Electromagnetics:** Vector algebra, Electromagnetic Operations (Curl, Divergence, etc), Basics of EM theory, Maxwells equations. EM waves in different mediums	**16**

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	(Conducting, Non Conducting). Concept of Poynting Vector and Theorem. Boundary conditions for EM transmissions. Applications of EM theory	
2	**EM to Optics:** Bridge from EM to Wave Optics	**2**
3	**Interference:** Superposition of Waves, Coherence, Concept of Interference (Real and Virtual Sources). Michelson Morley and Fabry–Pérot interferometer and their applications	**12**
4	**Diffraction:** Fraunhofer diffraction by single, double and N slits, Resolving and dispersive power of Diffraction elements. Application of Diffraction (WDM and other applications).	**6**
5	**Polarization:** Introduction, Difference between unpolarized and polarized light, Means of production of polarized light, Optical activity, specific rotation, Lorentz half shade and biquartz polarimeter. Application of Polarizations (Communication and other applications)	**6**
	Total Lectures	**42**

Suggested Text Book(s):

1. David J Griffiths, Introduction to Electrodynamics, Eastern Economy Editions, PHI, 4th edition (2012).
2. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson Pub. 2018.
3. A Textbook of Optics by N Subrahmanyam et. al and N. Subrahmanyam, 23rd Rev. Edn. 2006 Edition, Kindle Edition.
4. Fitzpatrick, R. "Electromagnetism and Optics (An Introductory Course)", 2017.

Suggested Reference Book(s):

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill, Addison-Wesley Press, 1981.
2. Optics, Ajoy Ghatak, Tata McGraw Hill, 5th addition, 2012.
3. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill, 1981.
4. Ajoy Ghatak, Optics, Tata McGraw Hill, 5th addition, 2012.
5. Vladimir V. Mitin, Dmitry I. Sementsov, An Introduction to Applied Electromagnetics and Optics, CRC Press, Taylor and Francis Group, 2017.

Other useful resource(s):

1. Link to topics related to course:
   i. https://nptel.ac.in/courses/122107035/
   ii. https://nptel.ac.in/courses/122103011/
   iii. https://nptel.ac.in/courses/122101002/28
   iv. https://nptel.ac.in/courses/122105023/

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
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 (Engineering Physics-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	**1.25**
CO-2	2	2	2	2	2	2				2		2	**2**
CO-3	3	2				2				2		2	**1.4**
CO-4	3	3				2				2		2	**1.5**
CO-5	3	3	3	3	3	3				3		3	**3**
Average	**2.6**	**2.4**	**2.5**	**2.5**	**2.5**	**2.2**				**2.2**		**2.2**	

Engineering Physics Lab-I

COURSE CODE: 18B17PH171

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

List of Experiments:

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

Suggested/Resources:

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

Basic Engineering Physics - I

COURSE CODE: 18B11PH112

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

Pre-requisite: None

Course Objectives:

1. To understand the general scientific concepts required for technology.
2. To apply the concepts in solving BT/BI engineering problems.
3. To explain scientifically the new developments in engineering and technology
4. To get familiarized with the concepts, theories, and models behind many technological applications.

Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understand the basic concepts of nature light and matter.	Familiarity
CO-2	Apply the concept of light in physical optics, lasers and Optical fibers.	Assessment and usage
CO-3	Acquire the fundamental knowledge of surface tension and plasma physics	Assessment and usage
CO-4	Familiarized with the basic concepts of biomaterials	Familiarity and assessment
CO-5	Familiarized with the basic concepts of nanotechnology	Familiarity

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Course Contents:

Unit	Contents	Lectures required
1	**Wave Optics: Interference, Diffraction and Polarization:** Wave nature of light, Particle nature of radiation, the wave nature of matter, Wave function, X-rays, Bragg's law. Interference by division of wave front, Interference by division of amplitude. Fraunhofer diffraction: Single slit, circular aperture, double slit, N-slit, resolving power and dispersive power of diffraction grating. Brewster's law, Malu's law, elliptically and circularly polarized light, optical activity, specific rotation.	16
2	**Lasers, Optical fibers and Plasma Physics:** Principle and working of laser, Different types of lasers (Three level and four level lasers). Optical Fibers: principle, types, material, mode, refractive index; Fibre loss, Expression for acceptance angle and numerical aperture. Application-Communication. Plasma Physics: Plasma state, types of plasma, applications of plasma.	10
3	**Biomaterials:** Introduction to Biomaterials: Biomaterial, Types of Biomaterials, Biocompatible, Biodegradable, Bio-resorbable Bio-inert Bio-active Biological materials, Pyrogenicity, Properties of Biomaterials, Interaction of biomaterials with bio-molecules, Performance and applications of Biomaterials.	8
4	**Introduction to Nanotechnology:** Origin of Nanotechnology, Nano Scale, Quantum Confinement, and Fabrication: Bottom-up and Top-down, Characterization, introduction to nano-biotechnology. Introduction to Active Colloids and Molecular motor proteins: functions, interaction and applications.	8
Total lectures		**42**

Suggested Text Book(s):

1. Brij Lal and Subramanyam, Optics, S. Chand & Company, 2012.
2. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson Pub. 2018.
3. Neeraj Mehta, Applied Physics for Engineers, PHI India Limited, 2011.
4. R S Burden , Surface Tension and the Spreading of Liquids, Cambridge University Press, 2014.
5. K. K. Chattopadhyay, Introduction to Nanoscience and Nanotechnology, PHI India, 2009.
6. NUCLEAR PHYSICS, D.C. Tayal, Himalaya Publishing House, 2018.

Suggested Reference Book(s):

1. Ajoy Ghatak, Optics, Tata McGraw Hill, 2005.
2. Arthur Beiser, Concepts of Modern Physics, McGraw Hill, 1994.

Other useful resource(s):

1. https://nptel.ac.in/courses/122107035/
2. https://nptel.ac.in/courses/122103011/
3. https://nptel.ac.in/courses/122103010/
4. https://nptel.ac.in/courses/118107015/
5. https://nptel.ac.in/courses/118102003/
6. https://nptel.ac.in/courses/122101002/27

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

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

Course outcomes (Basic Engineering Physics - I)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	2	2	1	1	-	-	-	-	2	**2.125**
CO-2	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
CO-3	3	2	2	2	2	1	1	-	-	-	-	2	**1.875**
CO-4	3	2	2	2	2	3	3	-	-	-	-	2	**1.875**
CO-5	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
Average	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**1.4**	**1.4**	**-**	**-**	**-**	**-**	**2.4**	

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Basic Engineering Physics Lab-I

COURSE CODE: 18B17PH172

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

Pre-requisite: None

Course Objectives:

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

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	Insight of core Basic Engineering Physics theory course to correlate their theoretical knowledge with experiment directly.	Familiarity
CO2	To demonstrate an ability to make physics measurements and understand the limits of precision in measurements.	Familiarity and Assessment
CO3	Working knowledge and principle of various instruments.	Assessment and usage
CO4	To demonstrates the ability to prepare a valid laboratory notebook.	Assessment and usage
CO5	To make students regular and punctual in performing experiments and to develop collaborative learning skills.	Assessment and usage

List of Experiments:

S.No	Description	Hours
1	To find the wavelength of sodium light using Fresnel's biprism.	**2**
2	To determine the wavelength of sodium light by measuring the diameters of Newton's rings.	**2**
3	To measure the wavelengths of certain lines in the spectrum of the mercury lamp using plane transmission grating.	**4**
4	To find the specific rotation of sugar solution by using a polarimeter.	**2**
5	To calculate the angle of prism and dispersive power of the materials of the prism with the help of spectrometer.	**4**

6	Studies for absorbance in liquids in support of Jablonski diagram.	**4**
7	Studies for excitation and emission in liquids in support of Jablonski diagram.	**2**
8	To determine coefficient of viscosity of water by Poiseuille's Method.	**2**
9	Viscosity To determine coefficient of viscosity of water by Poiseuille's Method.	**2**
10	Surface tension To measure the surface tension of a liquid and/or the interfacial tension between two liquids using tensiometer.	**2**
11	Surface tension To measure the surface tension between two surfaces using theta tensiometer	**2**
Total Lab hours		**28**

Suggested/Resources:

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

Evaluation Scheme:

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

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

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

Engineering Physics-II

Course code: 18B11PH211
Course credits: 3
Core/Elective: Core
L-T-P: 3-0-0
Pre-requisite: None

Course Objectives:

I. To offer a broad aspect of those areas of Physics which are specifically required as an essential background to engineering students for their studies in higher semesters.
II. To enable the students in gaining problem solving capability
III. To enable the students in acquiring better understanding about quantum science and application for future technology
IV. To familiarize students with quantum information technology
V. To make the students knowledgeable about the thermodynamics and statistics
VI. In conclusion, the ability of students should have enhanced to think logically about the problems of science and technology

Course Outcomes:

S.No.	Course Outcomes	Level of Attachment
CO-1	To learn fundamentals of quantum applications, quantum information theory	Familiarity
CO-2	Knowledge of physical interpretation, and ability to apply ideas to solve problems in science	Familiarity/Problems solving
CO-3	Learning about thermodynamical problems and associated applications for future technology	Familiarity/Problem solving
CO-4	To understand basics of statistical distribution and use of Maxwell's distribution, Bose-Einstein distribution, and Fermi-Dirac distribution	Familiarity/Analytical skills/Problems solving
CO-5	To develop ideas about problems associated to quantum information	Familiarity/Knowledge

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Course Contents:

Unit	Contents	Lecture required
1	Quantum nature of light:Photoelectric effect and Compton effect	**4**
2	Stability of atoms and Bohr's rules	**2**
3	Wave particle duality: de Broglie wavelength, phase and group velocity, Uncertainty principle, Double slit experiment	**4**
4	Schrodinger's equation,Physical interpretations of wave functions, elementary idea of operators, Eigenvalue problems	**4**
5	Solution of Schrodinger equations, simple boundary value problems, Harmonic Oscillator, Hydrogen atoms problems	**4**
6	Basics of quantum information: Hilbert's space, Dirac notation, Introduction to qubits, Quantum states, density operators, generalized measurements, quantum operations/channels, no-cloning theorem	**6**
7	Laws of thermodynamics, introduction to entropy, isothermal and adiabatic process, Reversible and irreversible processes. Carnot cycle andCarnot engine, Refrigerator, Clausius-Cleyperon equation	**10**
8	Introduction to macrostate, microstate, Classical and quantum statistics, Density of states M-B, B-E, and F-D statistical distribution, their applications	**8**
Total lectures		**42**

Suggested Text Book(s):

1. R. Eisberg and R. Resnick, "Quantum Physics" John Wiley, 2nd Edition, 2002.
2. J.J. Sakurai, Jim Napolitano "Modern quantum mechanics" 2nd Ed. I, 2011
3. Quantum information Theory, Mark M. Wilde, Cambridge University Press, 2012.
4. Brij Lal, N Subrahmanyam and P.S. Hemne, Heat Thermodynamics and Statistical Physics, S. Chand, 3rd edition, 2012.
5. Modern Quantum Mechanics and Quantum Information, by J S Faulkner Department of Physics, Florida Atlantic University, Boca Raton, Florida, FL, USA, IOP Publishing Ltd, 2021.

Suggested Reference Book(s):

1. Silvio R A, Salinass, Introduction to Statistical Physics, Springer Verlag, 2004.
2. Quantum Computation and Quantum Information, M. A. Nielsen &I.Chuang, Cambridge University Press, 2000.
3. Lakhanpal R C, Modern Approach to Statistical Physics and Thermodynamics, Modern Publishers, 2003.
4. Introduction to. Quantum Mechanics. David J. Griffiths. Reed College. Prentice Hall. Upper Saddle River, New Jersey 07458, 1994.

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5 Michael A. Nielsen, and Isaac L. Chuang. “Quantum Computation and Quantum Information: 10th Anniversary Edition”, Canbridge university press, 2010.

Other useful resource(s):

1. https://www.qi.damtp.cam.ac.uk/part-iii-quantum-information-theory
2. https://www.youtube.com/watch?v=bE5flUzaU1w
3. https://www.youtube.com/watch?v=EuYBGnsCj14

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

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

Course outcomes (Engineering Physics - II)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	2	2	1	1	-	-	-	-	2	**2.125**
CO-2	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
CO-3	3	2	2	2	2	1	1	-	-	-	-	2	**1.875**
CO-4	3	2	2	2	2	3	3	-	-	-	-	2	**1.875**
CO-5	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
Average	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**1.4**	**1.4**	**-**	**-**	**-**	**-**	**2.4**	

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Engineering Physics Lab-II

COURSE CODE: 18B17PH271

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

: 0-0-2

Pre-requisite: None

Course Objectives:

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

Course Outcomes:

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

List of Experiments:

S.No	Description	Hours
1	To determine the numerical aperture, of an optical fibre using LED as a light source.	**2**
2	To determine the attenuation coefficient, losses of an optical fiber	**2**

3	To measure resistivity of semiconductor using four probe methods.	**2**

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

Suggested/Resources:

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

Evaluation Scheme:

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

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	1	3	1	1	1	**2.00**
CO2	3	3	3	3	2	2	1	1	3	1	1	1	**2.00**
CO3	3	3	3	3	2	2	1	1	3	1	1	1	**2.00**
CO4	2	2	2	2	2	2	1	1	1	1	1	1	**1.5**
CO5	2	2	2	2	2	2	1	1	1	1	1	1	**1.5**

Average	**2.6**	**2.6**	**2.6**	**2.6**	**2.0**	**2.0**	**1.0**	**1.00**	**2.2**	**1.00**	**1.0**	**1.0**	

Bioinstrumentation Techniques

COURSE CODE: 18B11PH212

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P : 3-1-0

Pre-requisite: None

Course Objectives:

I. To learn concepts for strong foundation of biophysical methods and their application in the field of biotechnology.

II. Exposure to various instruments used in Biophysics.

III. To be able to use important biophysical methods to decipher problems relevant to biology.

IV. Understanding of the underlying theory of these methods and their practical applications in the laboratories.

V. Better understanding of the structure-function activity of biomolecules.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Basic concepts of spectroscopy, X-Ray Diffraction	Familiarity, assessment and usage
CO-2	Electron Microscopy, Electronic spectroscopy	Familiarity, assessment and usage
CO-3	Infrared spectroscopy, Raman Spectroscopy	Familiarity, assessment and usage
CO-4	Mass Spectroscopy and spin resonance spectroscopy	Familiarity, assessment and usage
CO-5	Particle analysis and Chromatography	Familiarity, assessment and usage

Course Contents:

https://www.spectroscopyonline.com/view/bioanalysis-instruments-0

Unit	Contents	Lectures Required
1	**Electron microscopy:** Optical to electron microscopy, Transmission electron microscope, Scanning electron Microscopy, Protein crystallography	**6**
2	**Electronic spectroscopy:** UV-VIS spectroscopy and Circular dichorism spectroscopy, Fluorescence Spectroscopy	**8**
3	**Infrared Spectroscopy and Raman Spectroscopy:** Fourier Transform Infrared Spectroscopy, Raman spectroscopy, Molecular polarisability, Applications in the field of biotechnology.	**8**
4	**Mass Spectroscopy and spin resonance spectroscopy:** Producing the ion, Detection of ions and Identifying of compounds. Analysis and applications. Interaction between spin and magnetic field, Nuclear Magnetic Resonance, NMR Applications in Biochemistry, Biophysics and Medicines.	**8**
5	**Imaging Techniques:** Fluorescence Microscopy, Fluorescence-activated Cell Sorting (FACS), Fluorescence In Situ Hybridization (FISH), X-rays, computed tomography (CT) scans, and magnetic resonance imaging (MRI) scans, X-rays, Atomic force microscopy **Particle Analysis:** Dynamic light scattering for size determination and zeta potential for surface charge determination: Concept and analysis	**12**
Total Lectures		**42**

Suggested Text Book(s):

1. C. N. Banwell, Fundamentals of Molecular Spectroscopy. McGraw-Hill, 1994.
2. Sune Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical applications, Springer Science & Business Media, 2012.
3. G. Aruldhas, Molecular structure and spectroscopy, PHI Learning Pvt. Ltd., 2007.
4. Wong J.Y., and Bronzino V. D. (Eds), "Biomaterials", CRC Press, Taylor and Francis, 2006.
5. Barbara H. Stuart , Infrared Spectroscopy: Fundamentals and Applications, Wiley, 2004.
6. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition, 2016.

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7. J. R. Lakowicz, Principles of Fluorescence Spectroscopy, Springer Science & Business Media, 2013.

Suggested Reference Book(s):

1. Brian C. Smith, Fundamentals of Fourier Transform Infrared Spectroscopy, Second Edition, CRC Press, 2011.
2. Shyam S. Mohapatra, Shivendu Ranjan, Nandita Dasgupta, Raghvendra Kumar Mishra, Sabu Thomas, In Micro and Nano Technologies, Characterization and Biology of Nanomaterials for Drug Delivery, Elsevier, Pages 375-424, ISBN 9780128140314, https://doi.org/10.1016/B978-0-12-814031-4.00014-3, 2019.
3. Nanomaterial Characterization: An Introduction, Editor(s): Ratna Tantra, (2016), ISBN:9781118753590, John Wiley & Sons, Inc. DOI:10.1002/9781118753460, 2016.

Other useful resource(s):

1. NPTEL course contents
2. Relevant research articles

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 (Bioinstrumentation Techniques)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	2	3	1	1	1	1	1	1	1	3	**1.75**
CO-2	3	3	3	3	2	1	1	1	2	1	1	3	**2.00**
CO-3	3	3	3	3	3	1	1	2	2	1	1	3	**2.16**
CO-4	3	3	3	3	3	2	2	2	2	1	2	3	**2.42**
CO-5	3	3	3	3	2	2	1	1	1	1	1	1	**1.83**
Average	**3.00**	**3.00**	**2.80**	**3.00**	**2.20**	**1.40**	**1.20**	**1.40**	**1.60**	**1.00**	**1.20**	**2.60**	

Approved in Academic Council held on 28.06.2023

Science and Technology of Materials

COURSE CODE: 18B1WPH531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (ECE)

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

I. To enable the students to get better understanding about materials, properties and their applications in engineering
II. To familiarize students for making proper selection of materials for different applications.
III. To enable the students to use the knowledge about materials for their projects and ultimately apply the materials knowledge in their respective professional career.
IV. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Computer-aided design, Computational Materials Science *etc*.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To learn the fundamentals and Science of Materials.	Familiarity
CO-2	To implement the concepts and theories for analyzing the behaviour of the materials.	Familiarity
CO-3	To execute the concepts and theories in solving the problems related to material properties and their applications.	Analytical & Computational skills
CO-4	To introduce innovations in areas like Semiconducting Materials, Optoelectronic Materials and Engineering Materials Science, etc.	Innovative Skills
CO-5	To analyze various materials for scientific and technical applications	Technical skills

Approved in Academic Council held on 28.06.2023

Course Contents:

Unit	Contents	Lectures required
1	Introduction to Dielectric materials, Capacitance, Polarization, Types of Polarization, Polarization mechanism & Dielectric Constant, Frequency Dependence of the Dielectric Constant, Ferro electricity, Piezoelectricity and pyro electricity, Applications of Dielectric Materials.	10
2	Introduction to Optoelectronic materials, Applications of Optical Phenomena Luminescence, Materials of Importance—Light-Emitting Diode Materials, photoconductivity	6
3	Semiconducting materials: Semiconductor basics, intrinsic and extrinsic semiconductors-n & p-type, Fermi level, carrier concentration, mobility, conductivity, p-n junctions-band diagram, forward and reverse I-V characteristics, C-V, Ideality factor, p-n-p and n-p-n transistor-basic concepts, Doping in solids	6
4	Introduction to Magnetic materials, Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Influence of Temperature on Magnetic Behavior; Domains and Hysteresis; Magnetic Anisotropy Applications in storage devices.	8
5	Introduction to Composite materials-Polymers & Ceramics, Various types of Polymers and their applications, Structure, Types, Properties and Applications of Ceramics, Electrical Conduction in Ceramics and Polymers. Applications.	6
6	New Engineering Materials: Metallic Glasses, Shape Memory Alloys, Memory Effect, Smart materials, Nano-materials- significance of nanoscale, 0, 1, 2 and 3- Dimensional nanostructures, Applications.	6
Total lectures		42

Suggested Text Book(s):

1. S. O. Pillai, "Solid State Physics", New age international publishers, 7th edition, 2016.
2. M.A. Wahab, "Solid State Physics:Structure and Properties of Materials", Narosa, 3rd edition, 2015.
3. S.M. Sze, " Physics of Semiconductor Devices", Wiley; Third edition, 2008.
4. William D. Callister, David G. Rethwisch, "Materials Science And Engineering: An Introduction " 10th Edition., Hoboken, Nj : Wiley, 2018.

Suggested Reference Book(s):

1. Charles Kittel, "Introduction to Solid State Physics". John Wiley & Sons, 8th edition 2005.
2. S. Sharma and J. Sharma, "Engineering Physics", Pearson India, 2018.

Other useful resource(s):

1. http://www.advancedsciencenews.com/best-of-advanced-optical-materials/
2. https://onlinecourses.nptel.ac.in/noc19_ph04/preview

EvaluationScheme:

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

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

Course outcomes (Science and Technology of Materials)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3										3	3
CO-2	3											3	3
CO-3	1	1	1									1	1
CO-4	2	2	2	2								2	2
CO-5	3	3	3	3					3			3	3
Average Score	2.4	2.25	2	2.5					3			2.4	2.425

Applied Materials Science

COURSE CODE: 18B1WPH532

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (CSE, IT)

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

I. To enable the students to get better understanding about materials, properties and their applications in engineering

II. To familiarize students for making proper selection of materials for different applications.

III. To enable the students to use the knowledge about materials for their projects and ultimately apply the materials knowledge in their respective professional career.

IV. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Computer-aided design, Computational Materials Science *etc*.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To learn the fundamentals and Science of Materials.	Familiarity
CO-2	To implement the concepts and theories for analyzing the behaviour of the materials.	Familiarity
CO-3	To execute the concepts and theories in solving the problems related to material properties and their applications.	Analytical & Computational skills
CO-4	To introduce innovations in areas like Display Technology , Thermoelectrics and Engineering Materials Science, etc.	Innovative Skills
CO-5	To analyze various materials for scientific and technical applications	Technical skills

Approved in Academic Council held on 28.06.2023

Course Contents:

Unit	Contents	Lectures required
1	Dielectrics: Polarization mechanism & Dielectric Constant, Behaviour of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, Piezoelectric and Pyroelectric materials, Applications of Dielectric Materials.	9
2	Polymers: Various types of Polymers and their applications; Mechanical behaviour of Polymers, synthesis of polymers. Conducting polymers.	4
3	Ceramics: Structure, Types, Properties and Applications of Ceramics; Mechanical behaviour and Processing of Ceramics.	3
4	Magnetism: Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Their properties and Applications; Hysteresis; Magnetic Storage devices.	7
5	Introduction to Thermoelectric materials, Figure of merit, Heat Capacity, Conductivity (electronic and thermal), Applications in sensors, energy harvesting etc. Display Devices: Fluorescent Materials, LED, LCD.	9
6	New Engineering Materials: Metallic Glasses, Shape Memory Alloys, Memory Effect, Smart materials, Nano-materials- significance of Nanoscale, 0l, 1,2 and 3-Dimensional nanostructures, Applications.	6
7	Computational Materials Science: Atomistic theory of matter – from electrons to interaction potentials, Electronic structure theory, computational toolbox, determination of band structure using codes.	4
Total lectures		42

Suggested Text Book(s):

1. S. O. Pillai, “Solid State Physics”, New age international publishers, 7th edition, 2016.
2. M.A. Wahab, “Solid State Physics: Structure and Properties of Materials”, Narosa, 3rd edition, 2015.
3. Richard M Martin, “Electronic Structure: Basic Theory and Practical Methods”; Cambridge University Press; 1st edition, 2008.
4. William D. Callister, David G. Rethwisch, “Materials Science And Engineering: An Introduction “ 10th Edition., Hoboken, Nj : Wiley, 2018.

Suggested Reference Book(s):

1. Charles Kittel, “Introduction to Solid State Physics” John Wiley & Sons, 8th edition, 2005.
2. George S. Nolas , Jeffrey Sharp , H. Julian Goldsmid, “Thermoelectrics: Basic Principles and New Materials Developments”, Springer Berlin, Heidelberg, 2010.
3. S. Sharma and J. Sharma, Engineering Physics, Pearson India, 2018.

Other useful resource(s):

Approved in Academic Council held on 28.06.2023

1. http://www.advancedsciencenews.com/best-of-advanced-optical-materials/
2. https://onlinecourses.nptel.ac.in/noc19_ph04/preview

Evaluation Scheme:

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

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

Course outcomes (Applied Materials Science)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3										3	3
CO-2	3											3	3
CO-3	1	1	1									1	1
CO-4	2	2	2	2								2	2
CO-5	3	3	3	3					3			3	3
Average Score	2.4	2.25	2	2.5					3			2.4	2.425

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Nanotechnology

COURSE CODE: 18B1WPH731
COURSE CREDITS: 3
CORE/ELECTIVE: Elective
L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To provide basic knowledge of nanoscience & technology.
2. To make students familiar with synthesis techniques of nanomaterials
3. To make students familiar with characterization techniques and tools.
4. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, etc.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will be able to learn basics of nanotechnology.	Familiarity
CO-2	Synthesis of nanomaterials based on requirement.	Familiarity and Assessment
CO-3	Characterization techniques and tools.	Assessment
CO-4	Students will learn the effect of nano-transformation on properties of materials.	Familiarity, Assessment and Usage
CO-5	Applications of nanotechnology in their respective fields as well as in interdisciplinary science and engineering.	Assessment and Usage

Course Contents:

Unit	Content	Lectures required
1	Introduction to Nanotechnology: Surface energy. Nanoparticles etc.	**5**
2	Synthesis of nanomaterials: Different approaches of synthesis (chemical, mechanical, etc.)	**9**
3	Characterization techniques: SEM, STM, AFM, X-ray diffraction, etc.	**10**
4	Properties of nanomaterials: Electronic, magnetic, optical, chemical and mechanical properties.	**12**
5	Applications of nanomaterials: Nanostructured materials in memory and electronic devices and for magnetic recording, sensors and interfaces, Biological applications.	**6**
Total Lectures		**42**

Suggested Text Book(s):

1. Michael Köhler, Wolfgang Fritzsche, Nanotechnology An Introduction to Nanostructuring Techniques,

Wiley, 2nd edition, (2008).

2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition (2011).
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley, (2003).

Suggested Reference Book(s):

1. Zheng Cui,Micro-Nanofabrication: Technologies and Applications , Springer; (2005).
2. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg (2017).
3. Guozhong Cao and Ying Wang, World Scientific Series in Nanoscience and Nanotechnology: Volume 2 , Nanostructures and Nanomaterials, Synthesis, Properties, and Applications, 2nd Edition (2011).

Other useful resource(s):

1. NPTEL course contents links
2. https://nanohub.org/groups/education
3. All relevant research articles

Evalution Scheme:

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

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

Course outcomes (Nanoscience and Technology)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	3	3	3	2	1	2	1	1	1	1	1.91
CO-2	3	3	2	2	3	1	2	2	1	1	1	1	1.83
CO-3	3	3	3	3	3	2	1	1	1	1	1	1	1.91
CO-4	3	2	3	2	2	1	1	1	1	1	1	1	1.58
CO-5	3	3	3	3	3	3	2	2	2	2	2	2	2.5

Average	3.00	2.60	2.80	2.60	2.80	1.80	1.40	1.60	1.20	1.20	1.20	1.20	

Optical Fiber Network Design

COURSE CODE: 18B1WPH732

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. Learn to analyze algorithms for Time and Space Complexity
2. Learn asymptotic notations for performance analysis of algorithms.
3. Learn various computing algorithms and data structure used in solving complex problems.
4. Apply important algorithmic design paradigms and method of analysis.
5. Synthesize efficient algorithm design in common engineering design situations.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To revise and understand about the basic working of optical fibers	Familiarity
CO-2	To design the basic structure of optical fibers	Assessment
CO-3	To understand the layout of optical fiber networks.	Assessment
CO-4	Apply CO-02 and 03 to design and understand working of optical fiber networks.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Basics of fiber optics:** Propagation, Dispersion, Attenuation and loss limits, Wave propagation in step index fibers, fiber gratings, Nonlinear effects in Fibre	10
2	**Optical fiber components** Optical fiber splices, connectors, couplers, Transmitters and Receivers	5
3	**Optical Link design:** Data Coding, Source selection, Power Budget, Optical amplifiers, dispersion compensation, Solitons, Soliton link Design	10
4	**Single wavelength fiber optic networks:** Network topologies, Standard fiber networks, FDDI networks, SONET/SDH	10
5	**Wavelength division multiplexing:** Selective WDM, Broad band WDM, Multiplexers, sources, nonlinearity in WDM links, WDM and optical amplifiers, Multipoint, Multi wavelength networks	7
Total lectures		**42**

Suggested Text Book(s):

1. Gerd Keiser: Optical Fiber Communication, 4th Edition, Tata McGraw-Hill Ltd., 2008.
2. A. Ghatak, K. Thyagarajan: Introduction To Fiber Optics, Foundation Books, 2002.
3. J. M. Senior: Optical Fiber Communications Principles and Practice, 2nd Edition, Prentice Hall India Pvt. Ltd., 2004.

Suggested Reference Book(s):

1. Govind P Agrawal: Fiber-Optic Communication Systems, John Wiley & Sons Asia, 2003.

Other useful resource(s):

1. Link to NPTEL course contents: https://nptel.ac.in/courses/106104019/
2. Link to topics related to course:
   i. https://nptel.ac.in/courses/106104019/1
   ii. https://nptel.ac.in/courses/106104019/4
   iii. https://nptel.ac.in/courses/106104019/26
   iv. https://nptel.ac.in/courses/106104019/2Ev

Evaluation Scheme:

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

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

Course outcomes (Parallel and Distributed Algorithms)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	**1.72**
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	**2.00**
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	**1.75**
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	**2.08**
Average	**2.0**	**2.5**	**2.5**	**2.5**	**2.5**	**1.0**	**1.0**	**1.0**	**2.0**	**2.25**	**1.5**	**2.0**	

Optoelectronic Devices

COURSE CODE: 18B1WPH831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: Engineering Physics-II

Course Objectives:

1. To enable the students to get better understanding about Photonic materials and their applications.
2. To familiarize students for making proper selection of Microwave devices for different applications.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To define and explain the physics governing laser behaviour and light matter interaction.	Familiarity
CO-2	To calculate properties of and design modern optical waveguides, microwave waveguides, photonic crystals fibers and microwave hybrid circuits.	Problem Solving/ Assesment
CO-3	To approach and solve new problems in a range of advanced topics in Non linear optics	Usage
CO-4	To understand important and unique engineering issues at microwave and millimeter wave frequencies.	Familiarity
CO-5	To learn the applications of the microwave devices in the design of useful systems such as radars, receivers, etc.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Photonics:** Optical sources, modulators and detectors: Introduction, laser sources, semiconductor sources, electro-optic modulator, magneto- optic modulator, and acousto-optic modulator. Photoconductive detectors, photodiodes.	10
2	**Waveguides:** Optical waveguides: Introduction, planar waveguides, integrated optics, cylindrical waveguides, optical fibers for communication, photonic crystal fibers.	4
3	**Non-linear optics:** Introduction, formalism of non-linear optics, second harmonic generation and phase matching, optical mixing, intensity dependent refractive index, non-linear effects in photonic crystal fibers. Antireflective coating, optical fiber current measurement, integrated optical spectrum analyzer, holography, optical fiber amplifier, optical fiber laser.	10
4	**Microwave waveguides:** Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits.	2

5	**Microwave transistors and diodes:** Introduction, microwave bipolar transistor & microwave tunnel diodes, IMPATT diodes, Transferred electron devices (TED), Quantum electron devices, and hot electron devices.	**9**
6	**Microwave field effect transistor:** Introduction, junction field effect transistor, MESFET, MOSFET, HEMTS, CCDs, Transistors as memory devices.	**4**
7	**Microwave linear beam tubes (O-type):** Introduction, triode, tetrode, pentode, Klystron. Microwave crossed field tubes (M-type): Introduction, Magnetron oscillator, cylindrical magnetron, linear magnetron, voltage tunable magnetron, and frequency-agile coaxial magnetron	**3**
Total lectures		**42**

Suggested Text Book(s):

1. Chi H. Lee, Microwave Photonics, CRC Press, 2nd edition (2013).
2. Samuel Y. Liao, Microwave Devices & circuits , Prinston Hall 3rd edition (2015)..
3. Ralf Menzel, Photonics: Linear and Nonlinear Interactions of Laser Light and Matter, Springer Berlin Heidelberg 1st edition (2007).
4. S. M. Sze, Semiconductor Devices, John Wiley & Sons, 3rd edition (2006).

Suggested Reference Book(s):

1. Chuang, Shun Lien,Physics of Photonic Devices, John Wiley & Sons, 2nd edition (2009).
2. Sisodia M L, Microwave Circuits and Passive Devices, New Age International Publishers (2002).

Other useful resource(s):

1. Link to topics related to course:
   i. https://nptel.ac.in/courses/115102026/
   ii. https://nptel.ac.in/courses/115101008/
   iii. https://nptel.ac.in/courses/108101112/

Evaluation Scheme:

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

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

Course outcomes (Photonics and Microwave Devices)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	1	1	-	2				2		2	1.5
CO-2	3	3	3	3	2	2				2		2	2.5
CO-3	3	3	3	3	2	2				2		2	2.5
CO-4	3	2	1	1	1	2				1		2	1.6
CO-5	3	3	3	3	2	3				2		3	2.7
Average	2.8	2.6	2.2	2.2	1.4	2.2				1.8		2.2	

Approved in Academic Council held on 28.06.2023

BIOSENSORS

COURSE CODE: 21B1WPH831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (OPEN)

L-T-P: 3-0-0

Pre-requisite: None

Course Description:

Biomaterials science, the study of the application of materials to problems in biology and medicine, is characterized by medical needs, basic research, and advanced technological development. Biomaterials directly impact many disciplines within the field of biomedical engineering. This interdisciplinary course introduces biomaterials research as related to medicine and biotechnology, emphasizing the interactions between materials and biological structures. Fundamental issues related to the function of biomaterials are explored based on their biocompatibility, stability, interfaces, and behavior in the body. Biomaterials testing methods, interaction with proteins and cells, cardiovascular, drug delivery, regulatory issues, and emerging research directions will also be discussed.

Course Objectives:

Over the last few years, there has been a significant shift in the understanding of the structure, function and behaviour of biomaterials, with the introduction of new types of biomaterials, extended clinical applications and indeed entirely new concepts of what constitutes a biomaterial. The objectives of this new course are

I. To explore and introduce these new concepts of biomaterials science.

II. The subject matter will build upon the principles of materials science on the one hand, including materials chemistry and nanoscale materials, and the principles of biology and disease on the other hand, including cell biology and immunology and drug and gene therapies.

II. The overall aim will be to develop an understanding of the roles of materials science and biology principles in the structure and function of clinical biomaterials and the relationship between these properties and the current and future profile of health care products.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Development insight to the basics of biosensing technology. Significance of Biosensors	Familiarity
CO-2	Fundamentals principles and Applications of Biosensors	Familiarity
CO-3	Understanding of Biosensing Technology	Analytical skills

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CO-4	Various strategies to apply the scientific theory and mechanisms to practical issues	Innovative Skills
CO-5	The students will be exposed to recent publications that highlight key advances in this field and learn how various chemical, biological and engineering concepts are used in synergy to achieve state-of-the-art sensing	Innovative Skills

Course Contents:

Unit	Contents	Lectures required
1	Introduction to Biosensor/sensor, Definitions, History, concepts and Biosensors-Advantages and limitations. Fundamental elements of biosensor devices and design considerations, calibration, dynamic range, signal to noise, sensitivity. Fundamentals of surfaces and interfaces, modifications of sensor surface.	**8**
2	Aspect of the sensors : Recognition event and element : Catalytic, Single and multiple enzyme, Transducers Method of immobilization and Enzyme Kinetics: adsorption, encapsulation, covalent attachment, diffusion issues. Bio Affinity: Labeled and Label free, whole cell sensing, Generations of Biosensor	**10**
3	Electrochemistry for biosensors: Red-ox potentials, membrane potential, Electrochemical Biosensors: potentiometric biosensors (ISE's and ISFETs); amperometric biosensors, Conductimetric and Impedimetric Biosensors. Applications	**12**
4	Optical Biosensor: fundamentals of optics- sources, detectors, and optical circuits; detection of absorbance, reflectance, and fluorescence; Surface plasmon resonance (SPR) based devices. Lab-on-a-chip: TAS and m-TAS devices, Sensors based on Fiber Optic. Applications	**7**
5	Nanomaterials in Biosensors: Quantum dots, Carbon based Nano Material such as CNT etc., Metal oxide based nano particles, Multifunctional nanomaterials, Core/shell nanoparticle system	**5**
Total lectures		**42**

Suggested Text Book(s):

1. Brian R Eggins - Biosensors an Introduction , First edition, John Wiley & Sons Publishers, 1996.
2. Loic J Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition, Marcel Dekker,Inc, 1991.
3. Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, 1993.
4. Introduction to Biosensors by Jeong-Yeol Yoon; Publisher: Springer-Verlag New York Ed.1
5. Recognition Receptors in Biosens.by Mohammed Zourob; Publisher: Springer-Verlag New York Ed.13, 2010.

6. Novel Approaches in Biosensors and Rapid Diagnostic Assays by Zvi Liron; Publisher: Springer US Ed.1, 2012.

Suggested Reference Book(s):

1. Handbook of Chemical and Biological Sensors, Richard F Taylor; IOP Publishing Ltd; Edition Year: 1996
2. Handbook of Biosensors and Biosensor Kinetics; Ajit Sadana & Neeti Sadana, Elsevier; Edition Year: 2011
3. Biosensors; Jonathan M. Cooper; Oxford University Press; Edition Year: 2003
4. Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.
5. Graham Ramsay - Commercial Biosensors, First edition, John Wiley & Sons, Inc. 1998.
6. Tran Minh Canh - Sensor Physics & Technology - Biosensors , First Edition, Champan & Hall, 1993.
7. Pasquarelli A, Biosensors And Biochips, Springer, 2021.

Other useful resource(s):

https://onlinecourses.nptel.ac.in/noc22_ph01/preview
https://onlinecourses.nptel.ac.in/noc22_ee50/preview

Evaluation Scheme:

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

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

Course outcomes (Biosensors)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3										3	3
CO-2	3											3	3
CO-3	1	1	1									1	1
CO-4	2	2	2	2								2	2
CO-5	3	3	3	3					3			3	3
Average Score	2.4	2.25	2	2.5					3			2.4	2.425

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Computational Nanostructure and Nanotechnology

Course code: 21B1WPH832
Course credits: 3 (3-0-0)
Core/Elective: Open Elective
L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

(1) To introduce students with science and technology involved with materials of nano dimension using computational methods
(2) To enable the students in gaining problem solving capability
(3) To familiarize students with numerical methods to solve real materials problem at very basic level
(4) To enhance student's ability to think about problems in nanotechnology to take future broader challenges in the area of science

Course Outcome:

S.No.	Course Outcomes	Level of Attachment
CO-1	To learn fundamentals and science about materials with nano-dimension	Familiarity
CO-2	Learn writing programs to address physical properties of materials	Assessment and usage
CO-3	Learning computational methods and theories for solving science of materials	Assessment and usage
CO-4	Learning various computational tools to solve real material problems that may open a broader career opportunities	Assessment and usage
CO-5	To develop ideas about problems in real materials	Familiarity

Course Contents:

Unit	Contents	Lecture required
1	**Introduction: Quantum dots**, Bulk, quantum well, quantum wire and quantum dots; properties of nano materials in short; example of application of nanomaterials	4
2	**Typical nano materials:**Graphene, Carbon nanotubes, nanocomposite, Light emitting diodes	2
3	**Basic quantum mechanical ideas:** Time-independent Schrodinger equation**,** eigenvalue problems	9
4	**Numerical programming:** Solve eigenvalue problem using numerical methods	5
5	**Basic solid-state physics:** Crystal structure, Block wave function, **Some numerical exercises**	4

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6	**Theory of many-electron system:** Introduction to Hartree-Fock theory and Density functional theory,	6
7	**Exercises on numerical software: Density functional theory (DFT) software;** Tools to understand the behavior of nano materials, TB-LMTO-ASA/quantum espresso, installation, simulation of crystal structures	7
8	**Density functional theory running:** practically understanding DOS and band structure of any material,	8
Total lectures		40

Suggested/Resources:

1. Nanotechnology: An Introduction, by Jeremy Ramsden, 2011, Elsevier Publishers.
2. Electronic Structure: Basic Theory and Practical Methods, Cambridge University Press, by Richard M. Martin
3. Computational Quantum Mechanics, Springer International Publishing, by Joshua Izaac, Jingbo Wang

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

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

Course outcomes (Basic Engineering Physics - I)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	2	2	1	1	-	-	-	-	2	**2.125**
CO-2	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**

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CO-3	3	2	2	2	2	1	1	-	-	-	-	2	**1.875**
CO-4	3	2	2	2	2	3	3	-	-	-	-	2	**1.875**
CO-5	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
Average	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**1.4**	**1.4**	**-**	**-**	**-**	**-**	**2.4**	

Computational Nanotechnology

Course code: 22B1WPH731
Course credits: 3 (3-0-0)
Core/Elective: Elective (Open)
L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

I. To introduce students with science and technology involved with materials of nano dimension using computational methods

II. To enable the students in gaining problem solving capability

III. To familiarize students with numerical methods to solve real materials problem at very basic level

IV. To enhance student's ability to think about problems in nanotechnology to take future broader challenges in the area of science

Course Outcome:

S.No.	Course Outcomes	Level of Attachment
CO-1	To learn fundamentals and science aboutmaterialswith nano-dimension	Familiarity
CO-2	Learn writing programs to address physical properties of materials	Assessment and usage
CO-3	Learning computational methods and theories for solving science of materials	Assessment and usage
CO-4	Learning various computational tools to solve real material problems that may open a broader career opportunities	Assessment and usage
CO-5	To develop ideas about problems in real materials	Familiarity

Course Contents:

Unit	Contents	Lecture required
1	**Introduction: Quantum dots**, Bulk, quantum well, quantum wire and quantum dots; properties of nanomaterials in short; example of application of nanomaterials	**4**
2	**Typical nanomaterials:** Graphene, Carbon nanotubes, nanocomposite, Light emitting diodes	**2**

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3	**Basic quantum mechanical ideas:** Time-independent Schrodinger equation**,** eigenvalue problems	**11**
4	**Numerical programming:** Solve eigenvalue problem using numerical methods, Algorithm development and understanding	**5**
5	**Basic solid-state physics:** Crystal structure, Block wave function, **Some numerical exercises**	**4**
6	**Theory of many-electron system:** Introduction to Hartree-Fock theory and Density functional theory,	**6**
7	**Exercises on numerical software:** Density functional theory (DFT) software; Tools to understand the behavior of nanomaterials, TB-LMTO-ASA/quantum espresso, installation, simulation of crystal structures	**7**
8	**Density functional theory running:** practically understanding DOS and band structure of any material	**8**
Total lectures		**42**

Suggested Text Book(s):

1. Introduction to Computation and Programming Using Python: With Application to Understanding Data; (2nd Ed) John V. Guttag, MIT Press Ltd, 2016.
2. KONSTANTINOS N. ANAGNOSTOPOULOS, "Computational Physics A: Practical Introduction to Computational Physics and Scientific Computing", National Technical University of Athens, Publisher Lulu.com , 2016.
3. K.K. Chattopadhyay and A.N. Banerjee Introduction to Nanoscience and Nanotechnology, by, PHI Learning pvt Ltd., 2009.
4. Jay Wang,Computational Modeling and Visualization of Physical Systems with Python, Wiley-VCH. ISBN: 978-1-119-17918-4, 2016.
5. Rubin H. Landau, Manuel J. Páez, Cristian C. Bordeianu, Computational Physics: Problem Solving with Python, 3rd Edition, Wiley-VCH. ISBN: 978-3-527-41315-7, 2015.

Suggested Reference Book(s):

1. Jeremy Ramsden, Nanotechnology: An Introduction, 2011, Elsevier Publishers, 2011.
2. Richard M. Martin, "Electronic Structure: Basic Theory and Practical Methods", Cambridge University Press, 2012.
3. Joshua Izaac, Jingbo Wang, "Computational Quantum Mechanics", Springer International Publishing, 2019.
4. , Anthony Scopatz and Kathryn D. Huff., "Effective Computation in Physics. Field Guide to Research with Python" O'Reilly, 2015.
5. Rubin Landau, Manuel J. Páez, and Cristian C. Bordeianu, " Survey of Computational Physics", Princeton University Press. Free online ComPADRE edition and PDF, 2022.
6. William R Gibbs, "Computation in Modern Physics" 3rd Edition, (New Mexico State University, USA), World Scientific Publishing Co Pte Ltd; 3rd edition, 2006.

Other useful resource(s):
https://www2.fkf.mpg.de/andersen/LMTODOC/LMTODOC.html

https://www.youtube.com/watch?v=pOtnzAXlXvI&list=PLwdnzlV3ogoUY43XoMwVVCWDSImC9mVQB

https://www.youtube.com/watch?v=mLZTDccwtfg&list=PLy0giqEzkJNiUkrNqszvG39J9hHTEWRa5

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 (3) -10 Quizzes(2) -10 Attendance - 5

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

Course outcomes (Computational Nanotechnology)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	2	2	1	1	-	-	-	-	2	**2.125**
CO-2	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
CO-3	3	2	2	2	2	1	1	-	-	-	-	2	**1.875**
CO-4	3	2	2	2	2	3	3	-	-	-	-	2	**1.875**
CO-5	2	3	3	3	3	1	1	-	-	-	-	3	**2.375**
Average	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**1.4**	**1.4**	**-**	**-**	**-**	**-**	**2.4**	

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Biomaterials

COURSE CODE: 23B1WPH631
COURSE CREDITS: 3
CORE/ELECTIVE: Elective (OPEN)
L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

I. To apply basic physics know how to state of the art bio-based issues.
II. Experimental data analysis.
III. Apply the knowledge of Physics to design experimental bio-based components.
IV. Concept of alloying composites, compatibility, biodegradability, etc.
V. To study innovative materials for artificial tissue materials /organs.
VI. Concept of nano materials in biotechnology

COURSE CONTENTS

We have designed our courses keeping in mind the expectations of aspiring students for the studies. The present curriculum is quite compatible to the national level syllabi followed in UGC & AICTE recognized Universities/institutions. Written below are the individual contents of the courses and special highlights has been done on the percentage compatibility with other institutions

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To study the characteristics and classification of Biomaterials	Familiarity
CO-2	To explore different metals and ceramics used as biomaterials	Familiarity
CO-3	To study different polymeric materials and composites that could be used as implants and transplants	Analytical & Computational skills
CO-4	Artificial organ developed using these materials	Innovative Skills
CO-5	Use of nanotechnology for biomaterials	Technical skills

Course Contents:

Unit	Contents	Lectures required
1	Structure of Bio-Materials and Bio-Compatibility: Definition and classification of bio-materials, mechanical properties, visco-elasticity, surface properties, Chemical, Thermal, Electrical and Optical properties, body response to implants, blood compatibility.	10
2	Implant Materials (Metals and Ceramics): Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyl-apatite glass ceramics carbons, medical applications.	8
3	Implant Materials (Polymeric and Composite): Polymerization, polyolefin, polyamides, Acrylic, polymers, rubbers, high strength thermoplastics, medical applications.	8
4	Tissue Replacement Implants: Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.	8
5	Artificial Organs: Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants	8
Total lectures		**42**

Suggested Text Book(s):

1. PART J.B., "Biomaterials Science and Engineering", Plenum Press, 1984

2. Wong J.Y., and Bronzino V. D. (Eds), "Biomaterials", CRC Press, Taylor and Francis, 2006.

3. Pignatello R., (Editor), "Biomaterials Science and Engineering", InTech Publishing, 2011.

4. Ludwig Erik Aguilar "Biomaterial Science: Anatomy and Physiology Aspects" Walter de Gruyter GmbH & Co KG, 2022.

Suggested Reference Book(s):

2. Ratner B.B., Hoffman A.S., Schoen F. J., Lemnos J. E., "Biomaterials Science: An Introduction to Materials in Medicine", Elsevier Academic Press, 2004.

3. Lakes, R. and Bronzino *J. D., The Biomedical Engineering Handbook: Second Edition.* Boca Raton: CRC Press LLC, 2000.

4. Park J. and Lakes R. S., "Biomaterials: An introduction", Springer, 2007.

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Other useful resource(s):

https://nptel.ac.in/courses/102106057
https://nptel.ac.in/courses/113104009

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 (Biomaterials)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3										3	3
CO-2	3											3	3
CO-3	1	1	1									1	1
CO-4	2	2	2	2								2	2
CO-5	3	3	3	3					3			3	3
Average Score	2.4	2.25	2	2.5					3			2.4	2.425