# DEPARTMENT

# OF

# PHYSICS AND MATERIALS SCIENCE

# SYLLABUS

# Engineering Physics-I

COURSE CODE: 18B11PH111

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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**Pre-requisite:** None

**Course Objectives:**

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

**Course Outcomes:**

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

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Interference:** Introduction, Young's double slit experiment, Phase difference and Path Difference, Coherence, Analytical treatment of interference, Methods of interference (division of wave front & division of amplitude) Applications of interference in the field of engineering, Scientific applications of interference. | 8 |
| 2 | **Diffrection:** Introduction, Difference between interference and diffraction, Fresnel and Fraunhoffer class of diffraction, Diffraction grating, Applications of diffraction grating, Resolving and dispersive power of an optical instrument. | 6 |
| 3 | **Polarization:** Introduction, Difference between unpolarized and polarized light, Means of production of polarized light, Optical activity, specific rotation, Lorentz half shade and biquartz polarimeter. | 4 |
| 4 | **Atomic Physics:** Introduction, Quantum numbers, spin and orbital angular momentum, Atoms in magnetic field, Zeeman effect, Atoms in electric field, Stark effect. | 4 |
| 5 | **Quantum Physics:** Wave particle duality, uncertainty principle and its applications, wave function, Schrodinger equation and its solutions, Particle in a box, Harmonic Oscillator | 6 |
| 6 | **Lasers:** Principle and working of laser, Different types of lasers (Three level and four level lasers). | 2 |
| 7 | **Thermal Physics:** Introduction, Zeroth law of Thermodynamics. First law of thermodynamics, Specific heat relation, Work done during an isothermal and adiabatic process. Second law of thermodynamics, concept of entropy, entropy for an ideal gas, Third law of thermodynamics, Principle of increase of entropy or degradation of energy, Reversible and irreversible processes. Carnot cycle and Carnot engine, Refrigerator, Clausius-Cleyperon equation, Thermodynamic Potentials, Maxwell's equations. | 8 |
| 8 | **Relativistic Mechanics**: Inertial & non-inertial frames, Michelson-Morley experiment, Einstein's postulates. Lorentz transformation, equations. Length contraction & Time dilation, Addition of velocities; Variation of mass with velocity Mass energy equivalence. | 4 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

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

**Suggested Reference Book(s):**

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

**Other useful resource(s):**

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

**Evaluation Scheme:**

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

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

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

## Engineering Physics Lab-I

COURSE CODE: 18B17PH171

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 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

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**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 and lasers. | Assessment |
| CO-3 | Acquire the fundamental knowledge of viscosity and surface tension. | Familiarity |
| CO-4 | Familiarized with the basic concepts of nuclear physics and nanotechnology. | Familiarity |
| CO-5 | Execute the concepts and theories in solving the problems. | Usages |

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| **1** | **Nature of light and matter:** The electromagnetic spectrum, Particle nature of radiation- The Photoelectric effect, Compton Effect. X-rays (continuous and characteristic), X-ray diffraction- Bragg's law. The origin of quantum theory- Planck's hypothesis, the wave nature of matter- wave-particle duality, matter waves (de Broglie hypothesis). Wave function - its physical interpretation, Schrodinger equation (only) and its significance. | **10** |

| | | |
|---|---|---|
| **2** | **Interference:** Coherence and coherent sources, Interference by division of wavefront (Young's double slit experiment, Fresnel's' biprism), Interference by division of amplitude (Thin film, Newton's rings, Michelson's Interferometer). | **6** |
| **3** | **Diffraction:** Fresnel and Fraunhofer types of diffraction, Fraunhofer diffraction: Single slit, circular aperture, double slit. Diffraction grating - wavelength determination, resolving power and dispersive power. | **6** |
| **4** | **Polarization:** Types of polarization, Brewster's law, Malu's law, e-ray and O-ray, Nicol prism, quarter-wave and half - wave plates, elliptically and circularly polarized light, optical activity, specific rotation. | **4** |
| **5** | **Lasers:** N Principle and working of laser, Different types of lasers (Three level and four level lasers). | **3** |
| **6** | **Viscosity and Surface tension:** Viscosity, Coefficient of viscosity, Poiseulle's equation, Surface tension, Angle of contact, Methods for measuring surface tension, Interfacial surface tension. | **3** |
| **7** | **Nuclear Physics:** Basics concepts: Nuclear radius, Binding energy, Radioactive decay. Significance of nuclear physics for biology, Applications of nuclear physics in medicine and agriculture. | **6** |
| **8** | **Introduction to Nanotechnology:** Origin of Nanotechnology, Nano Scale, Surface to Volume Ratio, Quantum Confinement, Fabrication: Bottom-up and Top-down, Characterization, Nanobiotechnology. | **4** |
| **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<br>Quizzes (2) - 5<br>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** | |

# Basic Engineering Physics Lab-I

COURSE CODE: 18B17PH172

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

## Course Objectives:

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

## Course Outcomes:

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO1 | 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 | Assessment and usage |

| | | |
|---|---|---|
| | experiments and to develop collaborative learning skills. | |

**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

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**Pre-requisite:** None

**Course Objectives:**

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

**Course Outcomes:**

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

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Electromagnetism:** Basic knowledge of fields, gradient, divergence and curl, Coulomb's law and related numerical, electric flux, Gauss's law for the charge inside and outside the Gaussian surface, applications of Gauss law: spherical and cylindrical symmetries, electric field due to charged conductor, force per unit area on the surface of the charged conductor, treatment of electrostatic problems by solution of Laplace and Poisson's equations. Biot Savart law, Ampere's law, Maxwell's equations in free space and dielectric media, energy in electromagnetic waves (Poynting vector and Poynting theorem), plane electromagnetic waves in free space, transverse nature, wave impedance and energy flow, energy density and energy flux (Poynting vector) in an electromagnetic field, radiation pressure. | 12 |
| 2 | **Statistical Physics & Applications:** Introduction, macrostates, microstates, thermodynamic probability, distribution of n-particles in k-cells, phase space, minimum volume, classical and quantum statistics: common approach to three statistics, Maxwell-Boltzmann (ideal gas), Bose-Einstein (photon gas), Fermi-Dirac distributions (electron gas), Compton effect. | 10 |
| 3 | **Optical Fiber Communication:** Light propagation in fibers, Step index and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode fibers and their propagation characteristics, Fiber losses and optical fiber applications. | 4 |
| 4 | **Solid State Physics:** Basic ideas of bonding, ionic bonding, covalent bonding (hybridization), metallic bonding, dispersion bonds, dipole bonds, hydrogen bonds, Lattice points and space lattice, basis and crystal structure, unit cell and primitive cell, seven crystal systems and fourteen Bravais space lattice, coordination number, nearest neighbour distance, atomic radius, atomic packing factor in crystal structure, calculation of lattice constant, lattice planes and Miller indices, separation between lattice planes.<br>X-ray diffraction, Bragg's law of X-ray diffraction, Bragg's x-ray spectrometer, powder crystal method, rotating crystal method.<br>Electronic conduction in metals, classical free electron theory, quantum theory of free electrons, band theory of solids, distinction between metals, semiconductors and insulators, intrinsic and extrinsic semiconductors, carrier concentration in thermal equilibrium in intrinsic semiconductor, Fermi level and energy band diagram in intrinsic semiconductor, energy band diagram and Fermi level in extrinsic semiconductors, effect of temperature on extrinsic semiconductor, electrical conductivity of intrinsic semiconductor and extrinsic semiconductor, Hall effect, allied parameters and its applications. | 16 |
| **Total lectures** | | **42** |

**Suggested Text Book(s):**

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

**Suggested Reference Book(s):**

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

**Other useful resource(s):**

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

**Evaluation Scheme:**

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

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

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

## Engineering Physics Lab-II

COURSE CODE: 18B17PH271

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

### Course Objectives:

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

### Course Outcomes:

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

**List of Experiments**:

| S.No | Description | Hours |
|---|---|---|
| **1** | To determine the numerical aperture, of an optical fibre using LED as a light source. | **2** |
| **2** | To determine the attenuation coefficient, losses of an optical fiber | **2** |
| **3** | To measure resistivity of semiconductor using four probe methods. | **2** |
| **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: 18B1WPH212

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

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**Pre-requisite:** None

**Course Objectives:**

1. To learn concepts for strong foundation of biophysical methods and their application in the field of biotechnology.
2. Exposure to various instruments used in Biophysics.
3. To be able to use important biophysical methods to decipher problems relevant to biology.
4. Understanding of the underlying theory of these methods and their practical applications in the laboratories.
5. Better understanding of the structure-function activity of biomolecules.

**Course Outcomes:**

| S.No. | Course Outcomes | Level of Attainment |
|---|---|---|
| CO-1 | Knowledge about different degrees of freedom of biological molecules with varying energy of the electromagnetic spectrum. | Familiarity |
| CO-2 | Basic underlying techniques of the analytical instruments, their principle and working. | Familiarity |
| CO-3 | Information about different spectroscopic Techniques (microwave, Raman, FTIR, Electronic, Electronic, ESR, NMR etc). | Familiarity and assessment |
| CO-4 | Strong foundation of biophysical methods and their practical application in the field of bioinformatics and biotechnology. | Assessment and Usage |
| CO-5 | Complete understanding of the structure-function activity of biomolecules | Usage |

**Course Contents:**

| Unit | Contents | Lectures Required |
|---|---|---|
| 1 | Basic concepts: Quantization of energy, Regions of the electromagnetic spectrum, | 3 |

| | | |
|---|---|---|
| | Representation of spectra, Basic elements of practical spectroscopy, The width and intensity of spectral lines. Crystal structure. | |
| **2** | Electron Microscopy: Transmission electron microscope. Scanning electron Microscope, Tunneling Electron microscope and Atomic Force microscope. | **5** |
| **3** | Electronic Spectroscopy: Electronic Spectra of Diatomic molecules, Frank-Condon Principle, Dissociation energy, shape of molecular orbitals, Classification of states of diatomic molecules, Electronic spectra of polyatomic molecules. Analysis by Electronic spectroscopy, Fluorescence Spectroscopy | **8** |
| **4** | Infrared Spectroscopy: Vibration of diatomic molecules, Simple Harmonic Oscillator, Anharmonic oscillator, Vibration rotation spectra of diatomic molecules, Vibration of polyatomic molecules, Fourier Transform Infrared Spectroscopy, Analysis of Infrared techniques. | **6** |
| **5** | Raman Spectroscopy: Raman effect, Molecular polarisability, Rotational and vibrational Raman Spectra, Structure determination from Raman and Infrared spectroscopy. | **4** |
| **6** | Mass Spectroscopy: Basics of the technique, Producing the ion, Detection of ions and Identifying of compounds. Analysis and application. | **3** |
| **7** | Spin Resonance Spectroscopy: Interaction between spin and magnetic field, Nuclear Magnetic Resonance, Chemical Shift, Analysis by NMR Technique, NMR Applications in Biochemistry, Biophysics and Medicines. Electron Spin Resonance Spectroscopy and applications. | **5** |
| **8** | Microwave spectroscopy: Rotation of molecules, Rotational spectra of rigid diatomic molecule, Rigid and Non rigid, Polyatomic –Molecules, Analysis by microwave spectroscopy Technique. | **4** |
| **9** | Chromatography: Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, affinity, GC, HPLC, FPLC; Electro-chromatography | **4** |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**


1. C. N. Banwell, Fundamentals of Molecular Spectroscopy. McGraw-Hill, (1994).
2. Sune Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical applications, Springer Science & Business Media (2012).
3. G. Aruldhas, Molecular structure and spectroscopy, PHI Learning Pvt. Ltd. (2007).
4. Charles H. Townes, A. L. Schawlow, Microwave Spectroscopy, Dover Publications Inc.(1975).
5. Barbara H. Stuart , Infrared Spectroscopy: Fundamentals and Applications, Wiley (2004).

6. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016).

**Suggested Reference Book(s):**

1. Brian C. Smith, Fundamentals of Fourier Transform Infrared Spectroscopy, Second Edition, CRC Press (2011).
2. Walter Gordy, Microwave Spectroscopy, Springer Berlin Heidelberg (1957).

**Other useful resource(s):**

1. NPTEL course contents
2. Relevant research articles

**Evaluation Scheme:**

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

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

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

# Applied Materials Science

COURSE CODE: 18B1WPH532

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (CSE, IT)

L-T-P: 3-0-0

**Pre-requisite:** None

**Course Objectives:**

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

**Course Outcomes:**

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

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| **1** | Dielectrics: Polarization mechanism & Dielectric Constant, Behavior of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, Piezoelectric effect; Applications of Dielectric Materials. | **12** |
| **2** | Polymers: Various types of Polymers and their applications; Mechanical behaviour of Polymers, synthesis of polymers. Conducting polymers | **4** |
| **3** | Ceramics: Structure, Types, Properties and Applications of Ceramics; Mechanical 2behaviour and Processing of Ceramics | **3** |
| **4** | Magnetism: Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Their properties and Applications; Hysteresis; Applications. | **9** |
| **5** | Superconductivity: Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; High temperature Superconductors and their Applications. | **6** |
| **6** | Optical fibres: Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode. | **4** |
| **7** | New Engineering Materials: Metallic Glasses, Shape Memory Alloys, Memory Effect, Nano-materials- significance of 2anoscale, 0-Dimensional, 1-Dimensional, 2- Dimensional, 3- Dimensional nanostructures, Applications. | **4** |
| **Total lectures** | | **42** |

### Suggested Text Book(s):


1. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)
2. William D. Callister and David G. Rethwisch, Materials science and engineering: an introduction, John Wiley & Sons, 8th edition (2010).
3. M.A. Wahab, Solid State Physics:Structure and Properties of Materials, Narosa, 3rd edition, (2015).


### Suggested Reference Book(s):


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


### Other useful resource(s):

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

### Evaluation Scheme:

| S. No | Exam | Marks | Duration | Coverage / Scope of Examination |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | T-1 | 15 | 1 Hour. | Syllabus covered upto T-1 |
| 2 | T-2 | 25 | 1.5 Hours | Syllabus covered upto T-2 |
| 3. | T-3 | 35 | 2 Hours | Entire Syllabus |
| 4. | Teaching Assessment | 25 | Entire Semester | Assignment (2) - 10<br>Quizzes(2) -10<br>Attendance - 5 |

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

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

# Science and Technology of Materials

COURSE CODE: 18B1WPH531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE (ECE)

L-T-P: 3-1-0

**Pre-requisite:** None

**Course Objectives:**

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

**Course Outcomes:**

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

## Course Contents:

| Unit | Contents | Lectures required |
|---|---|---|
| **1** | Introduction to Dielectric materials, Capacitance, Polarization, Types of Polarization, Polarization mechanism & Dielectric Constant, Frequency Dependence of the Dielectric Constant, Ferroelectricity, Piezoelectricity Applications of Dielectric Materials. | **10** |
| **2** | Introduction to Optoelectronic materials, Applications of Optical Phenomena Luminescence, Materials of Importance—Light-Emitting Diode Materials, photoconductivity, Lasers, Optical Fibers in Communications | **6** |
| **3** | Introduction to Thermoelectric materials, Figure of merit, Heat Capacity, Conductivity (electronic and thermal), Applications in sensors, energy harvesting etc. | **6** |
| **4** | Introduction to Magnetic materials, Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Influence of Temperature on Magnetic Behavior; Domains and Hysteresis; Magnetic Anisotropy Applications in storage devices. | **8** |
| **5** | Introduction to Superconducting materials, Superconductivity Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; High temperature Superconductors and their Applications. | **4** |
| **6** | Introduction to Composite materials-Polymers & Ceramics, Various types of Polymers and their applications, Structure, Types, Properties and Applications of Ceramics, Electrical Conduction in Ceramics and Polymers. Applications. | **8** |
| **Total lectures** | | **42** |

## Suggested Text Book(s):


1. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)
2. William D. Callister and David G. Rethwisch, Materials science and engineering: an introduction, John Wiley & Sons, 8th edition (2010).
3. M.A. Wahab, Solid State Physics:Structure and Properties of Materials, Narosa, 3rd edition, (2015).


## Suggested Reference Book(s):


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


## Other useful resource(s):

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

**EvaluationScheme:**

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

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

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

# Nanotechnology

COURSE CODE: 18B1WPH731
COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

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

**Course Outcomes:**

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

**Course Contents:**

| Unit | Content | Lectures required |
|---|---|---|
| **1** | Introduction to Nanotechnology: Surface energy. Nanoparticles etc. | **5** |
| **2** | Synthesis of nanomaterials: Different approaches of synthesis (chemical, mechanical, etc.) | **9** |

| | | |
|---|---|---|
| **3** | Characterization techniques: SEM, STM, AFM, X-ray diffraction, etc. | **10** |
| **4** | Properties of nanomaterials: Electronic, magnetic, optical, chemical and mechanical properties. | **12** |
| **5** | Applications of nanomaterials: Nanostructured materials in memory and electronic devices and for magnetic recording, sensors and interfaces, Biological applications. | **6** |
| **Total Lectures** | | **42** |

**Suggested Text Book(s):**

1. Michael Köhler, Wolfgang Fritzsche, Nanotechnology An Introduction to Nanostructuring Techniques, Wiley, 2nd edition, (2008).
2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition (2011).
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley, (2003).

**Suggested Reference Book(s):**

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

**Other useful resource(s):**

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

**Evalution Scheme:**

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

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

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

| **Course outcomes (Nanoscience and Technology)** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **Average** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1.91 |
| CO-2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1.83 |
| CO-3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1.91 |
| CO-4 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.58 |
| CO-5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 |
| Average | 3.00 | 2.60 | 2.80 | 2.60 | 2.80 | 1.80 | 1.40 | 1.60 | 1.20 | 1.20 | 1.20 | 1.20 | |

# Optical Fiber Network Design

COURSE CODE: 18B1WPH732

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. Learn to analyze algorithms for Time and Space Complexity
2. Learn asymptotic notations for performance analysis of algorithms.
3. Learn various computing algorithms and data structure used in solving 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<br>Quizzes (2) - 10<br>Attendance - 5 |

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

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

# Optoelectronic Devices

COURSE CODE: 18B1WPH831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Engineering Physics-II

**Course Objectives:**

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

**Course Outcomes:**

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

**Course Contents:**

| Unit | Contents | Lectures required |
|---|---|---|
| 1 | **Photonics:** Optical sources, modulators and detectors: Introduction, laser sources, semiconductor sources, electro-optic modulator, magneto-optic modulator, and acousto-optic modulator. Photoconductive detectors, photodiodes. | 10 |
| 2 | **Waveguides:** Optical waveguides: Introduction, planar waveguides, integrated optics, cylindrical waveguides, optical fibers for communication, photonic crystal fibers. | 4 |
| 3 | **Non-linear optics:** Introduction, formalism of non-linear optics, second harmonic generation and phase matching, optical mixing, intensity dependent refractive index, non-linear effects in photonic crystal fibers. Antireflective coating, optical fiber current measurement, integrated optical spectrum analyzer, holography, optical fiber amplifier, optical fiber laser. | 10 |
| 4 | **Microwave waveguides:** Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits. | 2 |
| 5 | **Microwave transistors and diodes:** Introduction, microwave bipolar transistor & microwave tunnel diodes, IMPATT diodes, Transferred electron devices (TED), Quantum electron devices, and hot electron devices. | 9 |
| 6 | **Microwave field effect transistor:** Introduction, junction field effect transistor, MESFET, MOSFET, HEMTS, CCDs, Transistors as memory devices. | 4 |
| 7 | **Microwave linear beam tubes (O-type):** Introduction, triode, tetrode, pentode, Klystron. Microwave crossed field tubes (M-type): Introduction, Magnetron oscillator, cylindrical magnetron, linear magnetron, voltage tunable magnetron, and frequency-agile coaxial magnetron | 3 |
| **Total lectures** | | 42 |

**Suggested Text Book(s):**

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

**Suggested Reference Book(s):**

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

**Other useful resource(s):**

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

**Evaluation Scheme:**

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

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

| Course outcomes (Photonics and Microwave Devices ) | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 2 | 1 | 1 | - | 2 | | | | 2 | | 2 | 1.5 |
| CO-2 | 3 | 3 | 3 | 3 | 2 | 2 | | | | 2 | | 2 | 2.5 |
| CO-3 | 3 | 3 | 3 | 3 | 2 | 2 | | | | 2 | | 2 | 2.5 |
| 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 | |