APPLIED PHYSICS

B.Tech. I Year

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	TOTAL
	Basic Sciences	3	1	0	4	40	60	100
Contact Classes: 48	Tutorial Classes: 16	Practical Classes: Nil				Total Classes:64		

Course Objectives:

The objectives of this course for the student are to:

1. Understand the basic principles of quantum physics and band theory of solids.
2. Understand the underlying mechanism involved in construction and working principles of various semiconductor devices.
3. Study the fundamental concepts related to the dielectric, magnetic and energy materials.
4. Identify the importance of nanoscale, quantum confinement and various fabrications techniques.
5. Study the characteristics of lasers and optical fibres

Course Outcomes: Upon graduation he student will be able to:

1. Analyze the concepts of Quantum mechanics and visualize the difference between conductor, semiconductor, and an insulator by classification of solids.
2. Identify the role of semiconductor devices in science and engineering Applications.
3. Explore the fundamental properties of dielectric and magnetic materials.
4. Appreciate the features and applications of Nanomaterials.
5. Analyze various aspects of Lasers and Optical fiber and their applications in diverse fields.

UNIT - I: QUANTUM PHYSICS AND SOLIDS

Quantum Mechanics: Introduction to quantum physics, Blackbody radiation – Stefan-Boltzmann's law, Planck's radiation law-Wein's and Rayleigh-Jean's law, Photoelectric effect, Matter Waves, de- Broglie Hypothesis, Davisson and Germer experiment, Heisenberg uncertainty principle, Time independent Schrodinger wave equation, Born interpretation of the wave function, Particle in one dimensional potential box.

Solids: Classical & Quantum free electron theory (Qualitative), Bloch's theorem, Kronig-Penney model, E-K diagram, Effective mass of electron, Origin of energy bands- classification of solids.

UNIT - II: SEMICONDUCTORS AND DEVICES

Intrinsic and extrinsic semiconductors (Qualitative) – Hall effect - direct and indirect band gap semiconductors - construction, principle of operation and I-V characteristics of P-N Junction diode, Zener diode, bipolar junction Transistor (BJT), LED, PIN diode, avalanche photo diode (APD) and solar cells, their structure, materials, working principle and I-V characteristics.

UNIT - III: DIELECTRIC AND MAGNETIC MATERIALS

Dielectric Materials: Basic definitions, Types of polarizations (qualitative) - Langevin-Debye equation, Internal fields in a solid, Clausius-Mossotti equation ferroelectric, piezoelectric, and pyroelectric materials – applications, liquid crystal displays (LCD) and crystal oscillators.

Magnetic Materials: Basic definitions, Classification of magnetic materials, Domain theory, Hysteresis - soft and hard magnetic materials, magnetostriction, magneto resistance - applications - magnetic field sensors and multiferroics.

UNIT-IV :NANOTECHNOLOGY

Nanoscale, Quantum Confinement, Surface to volume ratio, Bottom-Up Fabrication: Sol-Gel – Precipitation- Combustion methods, Top-Down Fabrication: Ball Milling - Physical Vapor Deposition (PVD) - Chemical Vapor Deposition (CVD), Characterization Techniques: XRD, SEM &TEM, Applications of Nanomaterials.

UNIT - V: LASER AND FIBER OPTICS

Lasers: Laser beam characteristics, Three quantum processes, Einstein coefficients and their relations, Population Inversion, Lasing action, Pumping methods, Ruby laser, He-Ne Laser , CO2 Laser, Nd-Yag Laser, semiconductor laser-applications of laser.

Fiber Optics: Introduction to optical fiber- advantages of optical Fibers - total internal reflection, construction of optical fiber - acceptance angle - numerical aperture- classification of optical fibers losses in optical fiber - optical fiber for communication system - applications.

TEXT BOOKS:

1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy" A Text book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.
2. Engineering Physics by Shatendra Sharma and Jyotsna Sharma, Pearson Publication,2019
3. Semiconductor Physics and Devices- Basic Principle – Donald A, Neamen, Mc Graw Hill, 4 thEdition,2021.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2ndEdition,2022.
5. Essentials of Nanoscience & Nanotechnology by Narasimha Reddy Katta, Typical Creatives NANO DIGEST, 1st Edition, 2021.

6. Modern Engineering Physics by Dr. K. Vijay Kumar, Dr. Chandralingam, S.ChandPublications,

REFERENCE BOOKS:

1. Quantum Physics, H.C. Verma, TBS Publication, 2nd Edition 2012.
2. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons,11th Edition, 2018.
3. Introduction to Solid State Physics, Charles Kittel, Wiley Eastern, 2019.
4. Elementary Solid State Physics, S.L. Gupta and V. Kumar, Pragathi Prakashan, 2019. 5. A.K. Bhandhopadhya - Nano Materials, New Age International, 1stEdition, 2007.
6. Energy Materials a Short Introduction to Functional Materials for Energy Conversion and Storage Aliaksandr S. Bandarenka, CRC Press Taylor & Francis Group
7. Energy Materials, Taylor & Francis Group, 1st Edition, 2022.

APPLIED PHYSICS LAB

B.Tech. I Year:

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
	Basic Sciences	L	T	P	1	CIA	SEE	TOTAL
		0	0	2		40	60	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 32				Total Classes:32		

Course Objectives: The objectives of this course for the student to

1. Capable of handling instruments related to the Hall effect and photoelectric effect experiments and their measurements.

2. Understand the characteristics of various devices such as PN junction diode, Zener diode, BJT, LED, solar cell, lasers and optical fiber and measurement of energy gap and resistivity of semiconductor materials.

3. Able to measure the characteristics of dielectric constant of a given material.

4. Study the behavior of B-H curve of ferromagnetic materials.

5. Understanding the method of least squares fitting.

Course Outcomes: The students will be able to:

1. Know the determination of the Planck's constant using Photo electric effect and identify the material whether it is n-type or p-type by Hall experiment.

2. Appreciate quantum physics in semiconductor devices and optoelectronics.

3. Gain the knowledge of applications of dielectric constant.

4. Understand the variation of magnetic field and behavior of hysteresis curve.

5. Carried out data analysis**.**

LIST OF EXPERIMENTS:

1. Determination of work function and Planck's constant using photoelectric effect.

2. Determination of Hall co-efficient and carrier concentration of a given semiconductor.

3. Characteristics of series and parallel LCR circuits.

4. V-I characteristics of a p-n junction diode and Zener diode

5. Input and output characteristics of BJT (CE, CB & CC configurations)

6. a) V-I and L-I characteristics of light emitting diode (LED)

   b) V-I Characteristics of solar cell

7. Determination of Energy gap of a semiconductor.

8. Determination of the resistivity of semiconductor by two probe method.

9. Study B-H curve of a magnetic material.

10. Determination of dielectric constant of a given material

11. a) Determination of the beam divergence of the given LASER beam

    b) Determination of Acceptance Angle and Numerical Aperture of an optical fiber.

12. Understanding the method of least squares – torsional pendulum as an example.

Note: Any 8 experiments are to be performed.

REFERENCE BOOK: S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.