



QUESTION BANK

Year / Semester: **I B.Tech II Semester**

Regulation: **R23**

Subject and Code: **23BSC113**

ENGINEERING PHYSICS

UNIT-I : Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films Newton's Rings- Determination of wavelength and refractive index. Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit– Diffraction Grating -Applications. Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates. -Applications

UNIT-II :Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes. X- ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

UNIT-III: Dielectric and Magnetic Materials

Dielectric Materials:

Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization –dielectric loss

Magnetic Materials:

Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT-IV: Quantum Mechanics and Free electron theory

Quantum Mechanics:

Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy.

UNIT-V:Semiconductors

Semiconductors:

Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation - Hall effect and its applications



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Max Marks: 10

S.No.	CO	Questions	BT
Unit I: (Wave Optics)			
1	1	Explain the phenomena of interference in parallel thin films and derive an expression for path difference	L1, L2
2	1	Explain the formation of parallel fringes in a uniform thin film and hence derive the conditions to get bright and dark fringes	L1, L2
3	1	Describe Newton's Rings experimental setup and hence explain the conditions to get bright and dark fringes	L1, L2
4	1	Calculate the wavelength of the monochromatic source by Newton's rings experiment	L1, L2
5	1	Describe Newton's Rings with suitable theory.	L1, L2
6	1	Calculate the refractive index of the given liquid by Newton's rings experiment	L1, L2
7	1	Explain Fraunhofer diffraction due to a single slit with necessary theory	L1, L2
8	1	Explain Fraunhofer diffraction due to double slit with necessary theory	L1, L2
9	1	A, Explain briefly about diffraction b. Give the difference between Fresnel and Fraunhofer diffraction	L1, L2
10	1	a) What is meant by Polarization, Explain about the types of polarization b) Explain briefly about double refraction	L1, L2
11	1	Explain the construction and working of Calcite crystal	L1, L2
S.No.	CO	Questions	BT
Unit II: (Crystallography and X-ray diffraction)			
1	2	Define the following terms with suitable diagrams: (a) Space lattice (b) Basis (c) Unit cell (d) Lattice parameters (e) Coordination number	L1
2	2	Define the following terms: a) Lattice Parameters b) Coordination number c) Packing fraction d) Atomic radius e) Primitive Cell	L1
3	2	Explain the seven crystal systems in three dimensions. Describe their lattice parameters and symmetry characteristics with neat sketches.	L2
4	2	Describe the 14 Bravais lattices and explain how they are classified	L2



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		under the seven crystal systems.	
5	2	Derive the expressions for coordination number and atomic packing fraction (APF) for: (a) Simple Cubic (SC) (b) Body-Centered Cubic (BCC)	L3
6	2	Derive the expressions for coordination number and atomic packing fraction (APF) for: (a) Body-Centered Cubic (BCC) (b) Face Centered Cubic (FCC)	L3
7	2	Show that the Face Centered Cubic (FCC) is possessing the closely packed structure by calculating the Packing fractions of SC, BCC and FCC	L3
8	2	State and derive Bragg's Law. Analyze how X-ray wavelength and interplanar spacing influence diffraction angles.	L4
9	2	Describe Laue's method for crystal structure determination. Discuss their principles, experimental setup, advantages, and limitations.	L3
10	2	Define the following terms: a) Crystalline solids b) Amorphous Solids c) Lattice d) Basis e) Unit Cell	L3
11	2	State Bragg's Law and Describe Laue's method for crystal structure determination.	L3
S.No.	CO	Questions	BT
Unit III: (Dielectric and Magnetic Materials)			
1	3	Define following terms a) Magnetic field b) Magnetic susceptibility c) Magnetic permeability (μ) d) Magnetic moment	L1
2	3	Define the following terms. (a) Magnetization (b) Bohr Magneton (c) Magnetic moment due to Nuclear Spin (d) Magnetic moment due to spin of electrons	L1
3	3	Explain in detail the Magnetic Hysteresis loop. Give its application.	L2
4	3	Differentiate between Hard and Soft Magnetic Materials.	L2
5	3	Classify Magnetic materials on the basis of magnetic moment.	L1



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6	3	Define the following terms. a) Magnetic dipole b) Relative Permeability c) Magnetic Flux Density d) Magnetic Flux and e) Magnetizing Field Strength.	L1
7	3	List out various polarization mechanisms and explain them briefly	L2
8	3	Derive an expression for Local field for a dielectric medium	L2
9	3	Derive Clausius- Mossotti relation.	L2
10	3	Define the following terms. a) Electric dipole b) Relative Permittivity c) Dielectric constant d) Polarization e) Polarizability	L1
11	3	Show that the Lorentz field of dielectric materials is $E_L = E + P/3\epsilon_0$	L3

S.No.	CO	Questions	BT
Unit IV: (Unit Name)			
1	4	Explain de Broglie hypothesis.	L2
2	4	Obtain expression for Schrodinger time independent wave equation and mention its applications.	L3
3	4	Deduce an expression for energy of an electron confined to a potential box of width 'a'.	L3
4	4	Obtain the eigen values and normalized wave functions for a particle in a one-dimensional infinite potential box of side 'a'.	L3
5	4	Derive an expression for electrical conductivity of a metal using quantum free electron theory.	L3



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6	4	What are matter waves? Explain the concept of matter waves.	L2
7	4	State Heisenberg's uncertainty Principle. Explain the Physical significance and properties of wave function.	L2
8	4	Explain Fermi-Dirac distribution function. Explain how it varies temperature with the help of plots.	L2,L3
9	4	Assuming the time independent Schrodinger's wave equation, discuss the solution for a particle in one-dimensional potential well of infinite height.	L2
10	4	Explain the Fermi-Dirac distribution function for electrons in a metal. Discuss the variation with temperature.	L2
11	4	a. Discuss salient features of Sommerfeld quantum theory of metals Derive an expression for electrical conductivity of a metal based on quantum free electron model.	L2 L3

S.No.	CO	Questions	BT
Unit V: (Unit Name)			
1	5	Explain the origin of energy bands in solids.	L2
2	5	Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.	L3
3	5	a. Distinguish between intrinsic and extrinsic semiconductors with suitable examples. b. Discuss the theory of intrinsic conductivity of a semiconductor.	L3
4	5	a. Describe the behavior and properties of conductors, semiconductors and insulator on the basis of band theory. b. Mark the Fermi level for an intrinsic semiconductor, p-type and n-type semiconductor.	L2 L3



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5	5	a. How does the Fermi level change with increase of temperature in the extrinsic semiconductors? b. Sketch the diagram for p-type and n-type semiconductor.	L1 L3
6	5	a. Explain drift and diffusion in a semiconductor. Derive Einstein's relation for charge carrier in a semiconductor.	L2 L3
7	5	a. State and explain Hall effect. List out the applications of Hall effect.	L1 L3
8	5	Compare elemental and compound semiconductor or Distinguish between indirect bandgap and direct bandgap of a semiconductor.	L4
9	5	What is Hall effect? Describe the expressions for Hall coefficient (R_H) and Hall Voltage (V_H) with proper diagram.	L2
10	5	Describe n-type and p-type semiconductors.	L2
11	5	Show that Fermi energy level lies in the middle of the energy gap.	L3

Note: L1-Remembering, L2-Understanding, L3-Appling, L4-Analyzing, L5-Evaluating, and L6-Creating

Instruction to Faculty Members:

The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).
2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).
3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).



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5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).

SITAMS