SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES (SITAMS)
AUTONOMOUS - NAAC ACCREDITED
Awarded 'A' Grade by Technical Education, Govt. of A.P.
Approved by AICTE, New Delhi & Permanently Affiliated to JNTUA, Ananthapuramu
An ISO 9001:2015 Certified Institution
ESTD: 1998
Counselling Code: SSCC

Department Of Science and Humanities

APPLIED PHYSICS

QUESTION BANK

(Common to EEE, ECE, CSE and AI &ML Branches)

Regulations : R20

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Sreenivasa Institute of Technology and Management Studies
(AUTONOMOUS)

I-B.Tech	Applied Physics	L	T	P/D	C
20BSC113	(Common to EEE, ECE, CSE & AI Branches)	3	0	-	3

Course Objectives

1. To identify the importance and applications Wave Optics in various Streams of Engineering
2. To understand the working principle and applications of Lasers and Optical fibers.
3. To elucidate the importance, properties and applications of Magnetic materials and dielectrics
4. To use ideas with mathematical solutions to Quantum mechanics and its applications in various atomic phenomena
5. To provide knowledge about semiconductors and Nanomaterials

UNIT-I: WAVE OPTICS (8 Hours)

Interference- Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings – Determination of wavelength and refractive index.

Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit – Grating spectrum.

UNIT-II LASERS AND FIBER OPTICS (10 Hours)

Lasers-Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Applications of lasers.

Fiber Optics-Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers – Applications.

UNIT-III DIEECTRIC MATERIALS AND MAGNETIC MATERIALS (10 Hours)

Dielectric Materials-Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

Magnetic Materials-Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and Permeability – Origin of permanent magnetic moment – Classification of magnetic materials: Dia, para & Ferro-Domain concept of Ferromagnetism (Qualitative) – Hysteresis – Soft and Hard magnetic materials.

UNIT IV: QUANTUM MECHANICS, FREE ELECTRON THEORY AND BAND THEORY OF SOLIDS

(10 Hours)

Quantum Mechanics- Dual nature of matter – Schrodinger's time independent and dependent wave equation – Significance of wave function – Particle in a one-dimensional infinite potential well. Free Electron Theory-Classical free electron theory (Merits and demerits only) – Quantum free electron theory – Equation for electrical conductivity based on quantum free electron theory – Fermi-Dirac distribution – Density of states – Fermi energy.

Band theory of Solids- Bloch's Theorem (Qualitative) – Kronig-Penney model (Qualitative) – E vs K diagram – Classification of crystalline solids – Effective mass of electron – m^* vs K diagram – Concept of hole.

UNIT V: SEMICONDUCTOR PHYSICS & NANOMATERIALS **(10 Hours)**

Semiconductor Physics: Introduction- Intrinsic and extrinsic semiconductors (Qualitative Analysis) – Carrier transport in Semiconductors - Drift & Diffusion –Einstein Equation – Direct and indirect band Gap Semiconductors-Hall Effect and its applications.

Nanomaterials –Types of Nano materials (One dimensional, Two dimensional and Three-dimensional Nano materials) - Significance of nanoscale- surface to, volume ratio –Quantum Confinement effect-Synthesis of Nanomaterials - Ball milling Method - Chemical vapour deposition methods –Optical, thermal, mechanical and electrical properties of nano materials - Applications of Nanomaterials.

On successful completion of the course the students will be able to		POs related to COs
CO1	Identify the importance and applications Wave Optics in various Streams of Engineering	PO1,PO2
CO2	Understand the working principle and applications of Lasers and Optical fibers	PO1,PO2
CO3	To elucidate the importance, properties and applications of Magnetic materials and dielectrics	PO1,PO2
CO4	Use ideas with mathematical solutions to Quantum mechanics and its applications in various atomic phenomena	PO1,PO2
CO5	Provide knowledge about semiconductors and Nanomaterials	PO1,PO2,PO12

UNIT-I: WAVE OPTICS		
PART-A (Two Marks Questions)		
Q.No	**Question**	**PO attainment**
1	Define Superposition Principle	PO1
2	Define the condition for maximum displacement in Superposition Principle	PO1
3	Define the condition for minimum displacement in Superposition Principle	PO1
4	Define interference.	PO1
5	Differentiate between constructive interference and destructive interference.	PO1
6	Define constructive interference.	PO1
7	Define destructive Interference	PO1
8	Define the characteristics of coherence Source	PO1
9	Give the expression of path difference between the two rays reflected from the uniform thin film	PO1
10	Give the condition for constructive and destructive interreference in the uniform thin film	PO1
11	List two important conditions to produce sustained Interference.	PO1
12	Name the type of light source used in Newton's rings formation.	PO1
13	Describe the conditions to obtain dark and bright rings?	PO1
14	Explain Why the central spot is dark in the Newton's rings formed by reflected light.	PO1
15	Explain why Newton's rings consists of concentric rings.	PO1
16	Define diffraction?	PO1
17	Which type of source and wavefronts are used in Fresnel Diffraction	PO1
18	Which type of source and wavefronts are used in Frauhnofer's Diffraction	
19	Differentiate between Fresnel's diffraction and Frauhnofer's diffraction	PO1
20	Define diffraction grating?	PO1
	PART-B (Marks-10)	
1	Explain the phenomena of interference in two parallel thin films.	PO1.PO2
2	Derive an expression for the path difference in two parallel thin films.	PO1.PO2
3	Explain the formation of parallel fringes in a uniform thin film and hence give the conditions to get bright and dark fringes	PO1.PO2
4	Describe Newton's Rings experimental setup and hence explain the conditions to get bright and dark fringes	PO1.PO2
5	Calculate the wavelength of the monochromatic source by Newton's rings experiment	PO1.PO2
6	Calculate the refractive index of the given liquid by Newton's rings experiment	PO1.PO2
7	Distinguish between Fresnel diffraction and Fraunhofer diffraction.	PO1.PO2
8	Explain Fraunhofer diffraction due to a single slit with necessary theory.	PO1.PO2
9	What is Diffraction grating? Explain.	PO1.PO2
10	Differentiate between diffraction and interference	PO1.PO2

UNIT-II LASERS & FIBER OPTICS		
PART-A (Two Marks Questions)		
Q.No	**Question**	**PO attainment**
1	Give the important properties of LASER	PO1
2	Give the drawbacks of conventional light sources compare to LASERs	PO1
3	Define the process of absorption	PO1
4	Define the process of spontaneous emission	PO1
5	Define the process of stimulated emission	PO1
6	Differentiate between spontaneous emission and stimulated emission.	PO1
7	Explain What is population inversion?	PO1
8	Name the important components of laser device.	PO1
9	List out applications of Lasers.	PO1
10	Who invented Helium-Neon Laser?	PO1
11	Explain what is an optical fiber?	PO1
12	Name the principle of optical fiber?	PO1
13	Name the parts in optical fiber.	PO1
14	Define numerical aperture.	PO1
15	Define acceptance angle.	PO1
16	List out the applications of optical fiber.	PO1
17	Name the types of optical fibers.	PO1
18	List the advantages of optical fibers?	PO1
19	Differentiate between single mode step index and Multi mode Step index fibers.	PO1
20	Contrast step index and graded index fibers.	PO1
	PART-B (Marks-10)	
1	Explain the terms 1.Absorption 2. Spontaneous emission 3. Stimulated emission	PO1.PO2
2	What is mean by Pumping mechanism elaborately discuss about various types of pumping mechanisms to achieve Population inversion	PO1.PO2
3	Explain the construction and working of a He-Ne Laser with suitable diagrams.	PO1.PO2
4	Explain the construction and working of Nd: YAG With the help of suitable diagram.	PO1.PO2
5	What is the acceptance angle of an optical fiber and derive an expression for it.	PO1.PO2
6	Define the following terms for an optical fiber • Cone acceptance • Numerical aperture • acceptance angle and Fractional refractive index change	PO1.PO2
7	What is Total internal reflection? Discuss its importance in optical fibers.	PO1.PO2
8	Describe the different types of optical fibers with neat Diagrams.	PO1.PO2
9	Differentiate between light propagation in (i)Step Index Fiber (ii)Graded Index fiber.	PO1.PO2
10	Explain in detail the optical communication system with a neat block diagram.	PO1.PO2

UNIT-III DIELECTRIC MATERIALS & MAGNETIC MATERIALS		
PART-A (Two Marks Questions)		
Q.No	**Question**	**PO attainment**
1	What is electric dipole?	PO1
2	Define electric dipole moment	PO1
3	What is polarization?	PO1
4	Define is electronic polarization	PO1
5	Define is ionic polarization	PO1
6	Define is orientation polarization	PO1
7	What is Claussius -Mosotti equation?	PO1
8	What is polarizability?	PO1
9	What is magnetic dipole?	PO1
10	Define orbital Magnetic Moment	PO1
11	Define spin Magnetic Moment	PO1
12	Define magnetic susceptibility.	PO1
13	Define magnetic permeability.	PO1
14	What are diamagnetic materials.	PO1
15	What are paramagnetic materials.	PO1
16	What are ferromagnetic materials.	PO1
17	Explain magnetic hysteresis.	PO1
18	Differentiate Soft and Hard magnetic materials.	PO1
19	List the examples for soft and hard magnetic materials.	PO1
20	List the applications of soft and hard magnetic materials.	PO1
	PART-B (Marks-10)	
1	Define following terms a) Magnetic Dipole b) Magnetic moment b) Magnetic susceptibility (χ) d) Magnetic permeability (μ) e) Relative permeability (μ_r)	PO1.PO2
2	Explain elaborately about I. Paramagnetic materials II. Diamagnetic materials III. Ferromagnetic materials	PO1.PO2
3	Differentiate between Hard and Soft Magnetic Materials	PO1.PO2
4	What is mean by Magnetic Hysteresis? Explain in detail the Magnetic Hysteresis loop.	PO1.PO2
5	Classify Magnetic materials on the basis of magnetic moment.	PO1.PO2
6	Explain the following Terms a) Electric Dipole b) Electric Dipole moment c) Polarization d) Polarizability e) Polarization Vector	PO1.PO2
7	Explain elaborately about a) Electronic Polarization b) Ionic Polarization c)Orientation Polarization	PO1.PO2
8	What is an Internal Field? Derive an Expression for Internal field	PO1.PO2
9	Derive Clausius-Mossotti equation	PO1.PO2
10	Explain the terms a) Dielectric polarization b) Dielectric polarizability c) Susceptibility d) Permittivity e) Dielectric constant	PO1.PO2

UNIT IV: QUANTUM MECHANICS, FREE ELECTRON AND BAND THEORY OF SOLIDES		
PART-A (Two Marks Questions)		
Q.No	**Question**	**PO attainment**
1	Define a) Particles b) Waves	PO1
2	Define De Broglie's hypothesis.	PO1
3	List two properties of matter waves	PO1
4	Give the expression for calculating wavelength of an election	PO1
5	Determine wavelength of an electron accelerated through a potential of 1600V.	PO1
6	Give the ground state energy of an electron which is kept in ac potential box of length "a"	PO1
7	Recite Schrödinger's time independent equation	PO1
8	Explain the significance of wave function.	PO1
9	List two merits of Classical free electron theory	PO1
10	List two demerits of Classical free electron theory	PO1
11	List two merits of Quantum free electron theory	PO1
12	List two demerits of Quantum free electron theory	PO1
13	Give the expression for the electrical conductivity of Quantum free electron theory and explain the terms	PO1
14	Outline the expression for Eigen values of an electron in one dimensional box.	PO1
15	Define Fermi Dirac Distribution	PO1
16	What is Fermi Level	PO1
17	Give the Expression of Fermi-Dirac Probability distribution Function	PO1
18	Show that the energy levels below Fermilevel is completely occupied at 0K by Fermi-Dirac Probability distribution Function	
19	Show that the energy levels above Fermilevel is completely emptys at 0K by Fermi-Dirac Probability distribution Function	PO1
20	Define the nature of potential inside the solid according to Kronig-Penny Model	PO1
	PART-B (Marks-10)	
1	Explain De Broglie's Hypothesis	PO1.PO2
2	Define matter waves? Explain their properties.	PO1.PO2
3	Show that the wavelength λ associated with an electron of mass 'm' and kinetic energy 'E' is $\lambda = \frac{h}{\sqrt{2mE}}$	PO1.PO2
4	Show that the wavelength of an electron accelerated by a potential difference 'v' volts, is $\lambda = \frac{12.27}{\sqrt{V}}$ Å	PO1.PO2
5	Explain the concept of particle wave duality and obtain an expression for the wavelength of matter waves associated with a particle of mass "m" moving with velocity "v".	PO1.PO2
6	Describe time independent Schrodinger's wave equation for free particle.	PO1.PO2
7	Show that the energies of a particle in a one-dimensional box are quantized.	PO1.PO2
8	Derive an equation for electrical conductivity based on quantum free electron theory	PO1.PO2
9	Define Fermi-Dirac distribution and explain elaborately the distribution of electrons at various energy levels at different temperature	PO1.PO2
10	Explain about the behavior of the electron which is moving in a periodic potential according to Kronig-Penney model	PO1.PO2

UNIT V: SEMICONDUCTOR PHYSICS & NANOMATERIALS		
PART-A (Two Marks Questions)		
Q.No	**Question**	**PO attainment**
1	What sare intrinsic semiconductors.	PO1
2	Define extrinsic semiconductors.	PO1
3	Define Hall Effect.	PO1
4	Define the terms drift current density in semiconductors	PO1
	Define the diffusion current density in semiconductors	
5	Give the Einstein's relation and explain the terms	PO1
6	List applications of Hall Effect.	PO1
7	Differentiate between direct band gap and indirect band gap semiconductors.	PO1
8	Define nanomaterials	PO1
9	Describe the significance of nanoscale	PO1
10	Explain quantum confinement.	PO1
11	Name the Types of Nano materials.	PO1
12	Show how surface to volume ratio change for nanoscale	PO1
13	Show how the thermal properties vary in nanomaterials	PO1
14	Define Top-Down Approach	PO1
15	Define Bottom-Up Approach	PO1
16	Explain how the optical properties vary in nanoparticles.	PO1
17	List two applications of nanomaterials.	PO1
18	Mention advantages of ball milling method	
19	Explain how the mechanical properties vary in nanomaterials?	PO1
20	Explain how the electrical properties vary in nanomaterials?	PO1
	PART-B (Marks-10)	
1	Explain about Intrinsic Semiconductors and their conductivity at T=0K and T> 0K	PO1.PO2
2	Describe elaborately about Extrinsic semiconductors and the types of extrinsic Semiconductors	PO1.PO2
3	Derive an expression for Drift and Diffusion current densities in a semiconductor	PO1.PO2
4	What is Hall effect? Derive an Expression for Hall Voltage.	PO1.PO2
5	Derive Eisenstein's relation for the semiconductor	PO1.PO2
6	Describe nanomaterials? Give the types of nanomaterials	PO1.PO2
7	Describe in detail the ball milling method of nanomaterials fabrication.	PO1.PO2
8	a) Explain how nanomaterials are fabricated using chemical vapour deposition method. b) Mention three applications of nanomaterials.	PO1.PO2
9	Explain the Basic principle of nanomaterials.	PO1.PO2
10	Explain the a) Optical b) Electrical c) Thermal d) mechanical Properties of materials	PO1.PO2