Code No: **R231108** **R23** **SET - 1**

I B. Tech I Semester Regular Examinations, January-2024
ENGINEERING PHYSICS

(Common to CE, ME, ECE, IT, AME, Mining, Robotics, Agri E, ECE-Allied, CSE-Allied)

Time: 3 hours Max. Marks: 70

*Note: 1. Question paper consists of two parts (**Part-A** and **Part-B**)*
*2. All the questions in **Part-A** is Compulsory*
*3. Answer **ONE** Question from **Each Unit** in **Part-B***

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PART –A (20 Marks)

1.	a)	What is the significance of the intensity distribution in the interference pattern produced by the superposition of waves?	[2M]
	b)	Define diffraction grating.	[2M]
	c)	How are X-rays diffracted?	[2M]
	d)	What is a unit cell in crystallography?	[2M]
	e)	Write down the important applications of dielectric materials.	[2M]
	f)	What is Bohr magneton? Write down its significance.	[2M]
	g)	How can you say that matter waves are not electromagnetic waves?	[2M]
	h)	Explain Fermi Dirac distribution function.	[2M]
	i)	What does forbidden energy gap represents?	[2M]
	j)	How mobility of the charge carrier can be measured from Hall coefficient? Explain.	[2M]

PART – B (50 MARKS)

UNIT-I

2.	a)	Explain how Newton's rings are formed in reflected light. Derive expressions for diameters of dark and bright rings.	[7M]
	b)	A parallel beam of light of wavelength 6000AU is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is 50^o. Find the least thickness of the glass plate which will appear dark by reflection.	[3M]

(OR)

3	a)	Explain resolving power and dispersive power of grating.	[6M]
	b)	How do you distinguish between a quarter wave and half wave plate? Explain.	[4M]

UNIT-II

4.	a)	Classify various lattice types in the cubic crystal system and specify the effective number of lattice points per unit cell in each type.	[6M]
	b)	Define packing fraction and coordination number. Obtain the expression for packing fraction of SC crystal.	[4M]

(OR)

5.	a)	State and explain Bragg's law. Calculate the maximum order of diffraction if X-rays of wavelength 0.819Å is incident on a crystal of lattice spacing 0.282 nm.	[5M]
	b)	Describe the Laue method for determination of crystal structure.	[5M]
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UNIT-III

6. a) What is an Ionic polarization? Obtain an expression for Ionic polarizability. [5M]
   b) Obtain Clausius-Mossotti equation. [5M]

(OR)

7. a) Explain the B-H curve of Ferromagnetic material based on domain theory. [6M]
   b) Distinguish between Hard and Soft magnetic materials. [4M]

UNIT-IV

8. a) Obtain an expression for Schrodinger's time independent wave equation. [6M]
   b) State and explain Heisenberg's uncertainty Principle. [4M]

(OR)

9. a) Explain Fermi-Dirac distribution function. Explain how it varies with temperature with the help of plots. [6M]
   b) What are the postulates of quantum free electron theory? Explain. [4M]

UNIT-V

10. Obtain the expression for carrier concentration in an intrinsic semiconductor. [10M]

(OR)

11. What is the band theory of solids? Classify conductors, insulators and semiconductors on the basis of band theory of solids. [10M]

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*2. All the questions in **Part-A** is Compulsory*
*3. Answer **ONE** Question from **Each Unit** in **Part-B***

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PART –A (20 Marks)

1.	a)	What is the significance of coherence in interference of light?	[2M]
	b)	How polarized light can be identified?	[2M]
	c)	Name seven crystal systems.	[2M]
	d)	What is the significance of Miller indices?	[2M]
	e)	What are the magnetic domains?	[2M]
	f)	Define electric polarization of a dielectric material.	[2M]
	g)	What is wave particle duality?	[2M]
	h)	Write down the important postulations of quantum free electron theory.	[2M]
	i)	What are semiconducting materials? Give examples.	[2M]
	j)	Define Hall coefficient.	[2M]

PART – B (50 MARKS)

UNIT-I

2.	a)	Explain the conditions for the minima and maxima in the single-slit Fraunhofer diffraction pattern.	[6M]
	b)	Define dispersive power of a grating and obtain an expression for it.	[4M]

(OR)

3	a)	Describe any two methods of producing plane polarised light.	[6M]
	b)	Distinguish between polarized light and unpolarized light.	[4M]

UNIT-II

4.	a)	Determine the atomic radius and packing factor for BCC and FCC lattices.	[6M]
	b)	Draw (110) and (111) planes in the SC crystal. What do you infer from these diagrams?	[4M]

(OR)

5.	a)	Deduce Laue's equation of diffraction of X-rays and obtain Bragg's diffraction condition from them.	[6M]
	b)	Compare powder X-ray diffraction and single-crystal X-ray diffraction.	[4M]

UNIT-III

6.	a)	Explain electronic polarization and show that electronic polarizability is directly proportional to the volume of the atom.	[6M]
	b)	What is dielectric loss? Obtain an expression for Tangent loss.	[4M]

(OR)

7.	a)	Discuss temperature dependence of susceptibility of Para and Ferro magnetic materials.	[6M]
	b)	How magnetic moment arises in magnetic materials? Explain.	[4M]
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UNIT-IV

8. a) Solve the Schrodinger wave equation for a particle in a one-dimensional box. [6M]
   b) Explain the properties of matter waves. [4M]

(OR)

9. a) Obtain an expression for the electrical conductivity of a metal based on quantum free electron theory. [6M]
   b) Explain the drawbacks of classical free electron theory. [4M]

UNIT-V

10. Define electrical conductivity. Obtain the expression of electrical conductivity for intrinsic and extrinsic semiconductors. [10M]

(OR)

11. a) Obtain the expression for carrier concentration N- type semiconductor. [7M]
    b) Write any three applications of Hall effect. [3M]

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Code No: **R231108** **R23** **SET - 3**

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Time: 3 hours Max. Marks: 70

*Note: 1. Question paper consists of two parts (**Part-A** and **Part-B**)*
*2. All the questions in **Part-A** is Compulsory*
*3. Answer **ONE** Question from **Each Unit** in **Part-B***

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PART –A (20 Marks)

1.	a)	What is the necessary condition for Fraunhofer diffraction?	[2M]
	b)	Define plane of polarization and plane of vibration.	[2M]
	c)	What are crystallographic axes?	[2M]
	d)	Write down the limiting condition for Bragg's law of X-diffraction.	[2M]
	e)	What is dielectric loss?	[2M]
	f)	Relate relative permeability (μ_r) with magnetic susceptibility (χ_M).	[2M]
	g)	What are matter waves? Express their wavelength in terms of particle energy.	[2M]
	h)	What are the demerits of classical free electron theory?	[2M]
	i)	What are the extrinsic semiconductors?	[2M]
	j)	What does forbidden energy gap signifies?	[2M]

PART – B (50 MARKS)

UNIT-I

2.	a)	Describe how interference of light waves leads to the formation of bright and dark rings in Newton's Rings.	[6M]
	b)	Describe how Newton's Rings can be used to measure the refractive index of a material.	[4M]

(OR)

3	a)	What is double refraction? Explain the construction and working principle of a Nicol prism with a neat ray diagram.	[7M]
	b)	Find the thickness of the half wave plate, when the wavelength of light is equal to 5890AU. Given refractive indices of ordinary ray and extraordinary ray are 1.55 and 1.54, respectively.	[3M]

UNIT-II

4.	a)	Describe the seven crystal systems with diagrams.	[7M]
	b)	Draw the planes (101), (111) and (110) in SC crystal with neat diagrams.	[3M]

(OR)

5.	a)	Describe the powder method and determination of crystal structure with suitable diagrams.	[7M]
	b)	In first-order reflection from the plane of NaCl is obtained at an angle of 20^0 with the incident beam. If inter-atomic spacing is 2.5 Å, then calculate the wavelength of X-rays used.	[3M]

UNIT-III

6.	a)	Derive an expression for internal field for a dielectric material with cubic structure?	[6M]
	b)	Explain the frequency dependence of polarization.	[4M]

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(OR)

7. a) Elucidate the atomic origin of permanent magnetism in magnetic materials. [6M]
   b) What are the Ferro magnetic materials? Write down their properties. [4M]

UNIT-IV

8. a) Discuss the dual nature of matter waves with suitable examples. [6M]
   b) Explain the properties of wave function. [4M]

(OR)

9. Explain the meaning of density of states. Derive an expression for the number of allowed states per unit volume of a solid. [10M]

UNIT-V

10. Explain the concept of drift and diffusion currents in a semiconductor and how are they related to each other? [10M]

(OR)

11. a) What is Hall effect? Obtain the expression for Hall coefficient. [6M]
    b) Explain the applications of Hall effect. [4M]

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*2. All the questions in **Part-A** is Compulsory*
*3. Answer **ONE** Question from **Each Unit** in **Part-B***

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PART –A (20 Marks)

1.	a)	State the principle of superposition of light waves.	[2M]
	b)	When light waves bend around the obstacles? Explain.	[2M]
	c)	Define crystal planes.	[2M]
	d)	What are the important facts of Laue experiment for X-ray diffraction?	[2M]
	e)	Differentiate dielectric constant and dielectric susceptibility.	[2M]
	f)	Define residual magnetism and coercive force.	[2M]
	g)	What is the de Brogile hypothesis? Explain.	[2M]
	h)	What does Fermi Energy represent? Explain its significance.	[2M]
	i)	Draw the energy band diagram of an intrinsic semiconductor.	[2M]
	j)	How drift current is different from diffusion current? Explain.	[2M]

PART – B (50 MARKS)

UNIT-I

2.	a)	Derive the equation for the condition of constructive and destructive interference in a thin film with non-normal incidence.	[6M]
	b)	Provide examples of natural occurrences where colors in thin films are observed.	[4M]

(OR)

3	a)	Derive the expression for the intensity pattern in the Fraunhofer diffraction due to a double slit.	[6M]
	b)	Distinguish between the Fraunhofer and Fresnel diffraction.	[4M]

UNIT-II

4.	a)	Deduce an expression for the inter-planar distance in terms of Miller indices for a cubic structure.	[6M]
	b)	Define the unit cell and describe the lattice parameters.	[4M]

(OR)

5.	a)	Describe Bragg's spectrometer and explain how it is used to study the structure of crystals.	[7M]
	b)	X-rays of wavelength 0.3 Å are incident on a crystal with a lattice spacing 0.5 Å. Find the angles at which second and third order Bragg's diffraction maxim are observed.	[3M]

UNIT-III

6.	a)	Obtain relationship between the three electric vectors in a dielectric material.	[6M]
	b)	What are polar and non polar dielectric materials? Explain.	[4M]

(OR)
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7. a) Explain the atomic origin of Ferromagnetism? Differentiate between diamagnetic and paramagnetic materials. [6M]
   b) Distinguish between soft and hard magnetic materials. [4M]

UNIT-IV

8. a) Obtain an expression for Schrodinger's time dependent wave equation. [6M]
   b) Explain the physical significance of wave function. [4M]

(OR)

9. Discuss the merits and demerits of classical free electron theory. Explain the salient features of free electron theory. [10M]

UNIT-V

10. Discuss the energy band formation in pure semiconductor using energy band diagrams. Explain the formation of conduction and valance bands. [10M]

(OR)

11. a) Obtain the expression for carrier concentration in n-type semiconductor. [5M]
    b) What are drift and diffusion currents and derive their expressions. [5M]

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