FE1903

Total No. of Printed Pages:3

F.E Sem-I (Revised Course 2019-2020)
EXAMINATION FEBRUARY 2023
Physics

[Time: 3 Hours] **[Max. Marks:100]**

Instructions:
1. Answer **any two** questions from **Part-A** and **Part-B** each and **any one** from **Part-C.**
2. Assume additional data, **if required.**

Physical constants:
1. Planck's constant = 6.626 x10^{-34} J-s
2. Electron charge = 1.6 x 10^{-19} C
3. Boltzmann's constant =1.38 x 10^{-23} J/K
4. Electron mass = 9.1 x 10^{-31} kg
5. Rydberg constant = 1.097 x 10^{7}/m
6. Velocity of light = 3x 10^{8} m/s

Part - A (Answer any two questions)

Q1 a) Based on band theory of solids, distinguish between different types of materials. Give two examples of each. 5

b) Briefly explain the types of magnetic materials with three examples of each. 5

c) Show that the diameters of bright circular Newton's Rings for reflected light are proportional to the square root of odd natural numbers. 5

d) What is magnetostriction? Calculate the natural frequency of an iron rod of lengthy 8.2 cm and comment on whether it can be used to generate USW using a magnetostriction oscillator. 5
Given: density of iron= 7.6 x 10^{3} kg/m^{3} and Young's modulus of iron= 11.6 x 10^{10}N/m^{2}

Q2 a) Wirth a neat ray diagram, explain interference in a thin parallel film for reflected light and obtain the condition for maxima and minima. 5

b) With neat circuit diagram, explain the working of Piezoelectric oscillator for production of USW. 5

c) What is Hall Effect? Explain its origin and obtain an expression for Hall Voltage. 5

	d)	Find the relative permeability of a ferromagnetic material when a magnetic field of strength 300 A/m produces magnetization of 4100 A/m in it.	5
Q3	a)	With diagram, explain hysteresis loop. Also discuss retentivity and coercivity in it.	5
	b)	With a neat diagram, explain how the Newton's Rings set up can be used to determine refractive index of a thin transparent liquid.	5
	c)	Describe following applications of USW: i) Echo sounding in marine application ii) cavitation	5
	d)	A pure germanium semiconductor has carrier concentration of electrons as 2.4 x 10^9 /m^3. The mobility of electrons and holes are 0.34m^2 /V.s and 0.11m^2/V.s respectively. Calculate conductivity of this material; also determine current density if an electric field of 1200 V/m is applied across it.	5

Part-B (Answer any two questions)

Q4	a)	What is X-Ray diffraction? Obtain Bragg's Law of X-Ray diffraction.	5
	b)	Explain Acceptance cone of optical fibre. Derive an expression for numerical aperture of an optical fibre in terms of refractive indices of core and cladding material.	5
	c)	Write down three characteristic properties of laser; also discuss two industrial applications of laser.	5
	d)	Calculate de broglie wavelength of: i) a cricket ball of mass 1 kg moving with a speed of 19m/sec. ii) an electron with energy 50keV.	5
Q5	a)	With neat diagrams, explain step index and graded index optical fibres.	5
	b)	State and explain Mosley's Law. Write down two physical significance of Mosley's Law.	5
	c)	Describe an experiment to demonstrate the wave nature of an electron.	5
	d)	What is population inversion? Determine the ratio of population of two energy levels out of which one corresponds to a metastable state if the wavelength of light emitted at 50°c is 6337A°.	5

Q6	a)	Explain origin of characteristic X-Ray spectra.	5
	b)	With a neat diagram, explain structure of an optical fibre cable. How does light propagate through it?	5
	c)	With diagram, explain 3-level pumping scheme. What are its drawbacks?	5
	d)	For a SI fibre, refractive indices of core and cladding are 1.5 and 1.48 respectively. Calculate its critical angle, acceptance angle and numerical aperture.	5

Part-C (Answer anyone question)

Q7	a)	Explain any three methods of detection of USW.	5
	b)	Draw a neat block diagram of CRO and explain its application to measure frequency of ac signal.	5
	c)	Briefly explain construction and working of He-Ne laser.	5
	d)	A parallel beam of monochromatic light of wavelength 5890 A° is incident on a thin glass plate of refractive index 1.38 such that angle of refraction into the plate is 45°. Calculate the smallest thickness of the glass plate which would appear dark by reflection.	5
Q8	a)	Explain interference in wedge shaped film and obtain expression for fringe width.	5
	b)	What is Compton effect? Using the theory of elastic collision, obtain expression for Compton shift.	10
	c)	Identify the target element used in X-Ray tube if the wavelength of Kα line emitted is 1.65A°. Given: Nuclear screening constant is unity.	5