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**F.E Sem-I (Revised Course 2019-2020)**  
**EXAMINATION NOV/DEC 2019**

**Physics**

**[Duration : Three Hours]****[Total Marks:100]****Instructions:**

- 1) Answer **any two** questions from part – A and part – B **each**. And **any one** question from part –C.
- 2) **Assume** additional data, if required.
- 3) **Draw** diagrams **wherever** required.

**Physical constants:**

Planck's constant	$= 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$
Electron charge	$= 1.6 \times 10^{-19} \text{ C}$
Boltzmann's constant	$= 1.38 \times 10^{-23} \text{ J/K}$
Electron Mass	$= 9.1 \times 10^{-31} \text{ kg}$
Rydberg constant	$= 1.097 \times 10^7 / \text{m}$
Velocity of light	$= 3 \times 10^8 \text{ m/s}$

**Part – A**

Answer any two questions:

- Q.1
- a) With a neat ray diagram explain interference in a parallel thin film for reflected light and obtain the conditions for maxima and minima. (5)
  - b) Explain paramagnetism. Give 3 properties of paramagnetic materials. (5)
  - c) Based on the band theory of solids distinguish between the different types of materials. Give two examples of each. (5)
  - d) What is magnetostriction? Calculate the natural frequency of an iron rod of length 8 cm and comment on whether it can be used to generate USW using magnetostriction oscillator. (5)  
 Given, density of iron  $= 7.8 \times 10^3 \text{ kg/m}^3$ , Young's modules of iron  $= 11.5 \times 10^{10} \text{ N/m}^2$ .
- Q.2
- a) With neat circuit diagram explain working of piezoelectric oscillator for production of ultrasonic waves. (5)
  - b) With diagram explain hysteresis loop. What is retentivity and coercivity? (5)
  - c) Explain interference in wedge shaped film and hence derive expression for fringe width. Draw diagrams where necessary. (5)
  - d) A pure germanium semiconductor has carrier concentration of electrons as  $2.5 \times 10^9 / \text{m}^3$ . The motilities of electrons and holes are  $0.36 \text{ m}^2/\text{V.s}$  and  $0.17 \text{ m}^2/\text{V.s}$  respectively. Calculate its conductivity. Also calculate the current density if an electric field of  $1000 \text{ V/m}$  is applied across it. (5)





- Q.3
- What is Hall Effect? Obtain expression for Hall voltage and Hall Coefficient. (5)
  - Explain the following applications of US waves: (5)
    - Detection of flaws in metals.
    - SONAR
  - Draw a neat block diagram of CRO. Explain the purpose of the time base circuit in the CRO. (5)
  - A parallel beam of monochromatic light of wavelength  $6000 \text{ \AA}$  is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is  $45^\circ$ . Calculate the smallest thickness of the plate which would appear dark by reflection. (5)

Part – B

Answer any two questions:

- Q.4
- Explain the process of stimulated emission of radiation and how it can be used for light amplification. (5)
  - Derive Bragg's Law of X-ray diffraction. Draw necessary diagram. (5)
  - What is Compton Effect? With neat diagram describe the experiment used to study Compton Effect. (5)
  - For a step-index fibre, core R.I. is 1.5 and cladding R.I. is 1.48. Calculate its critical angle, acceptance angle and numerical aperture. (5)
- Q.5
- Derive expression for Acceptance Angle of an optical fibre. What is acceptance cone? (5)
  - Explain the origin of characteristic and continuous X-ray spectra. (5)
  - State de Broglie's hypothesis. What is de Broglie's wavelength? State properties of matter waves. (5)
  - 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  $57^\circ\text{C}$  is  $6328 \text{ \AA}$ . (5)
- Q.6
- With neat diagram explain construction & working of Ruby laser. What are its drawbacks? (5)
  - With neat diagrams explain the different types of optical fibres. (5)
  - State Moseley's Law explain its significance. (5)
  - A photon of  $2 \text{ \AA}$  strikes an electron at rest and is scattered at an angle of  $90^\circ$ . Find the wavelength of the photon after collision. Also calculate Compton shift. (5)

Part – C

Answer any one questions:

- Q.7
- Show that the diameter of dark rings in Newton's Rings for reflected light is proportional to the square root of natural numbers. (5)
  - Explain any 3 methods of detection of ultrasonic waves. (5)
  - With block diagram explain the use of optical fibres in communication. Give any two advantages of optical fibres over copper wires for communication. (5)
  - Identify the target element used in the x-ray tube if the wavelength of the  $K\alpha$  line emitted is  $1.55 \text{ \AA}$ . Take nuclear screening constant as unity. (5)



- Q.8
- Derive an expression for conductivity of a semiconductor in terms of mobility of charge carriers. (5)
  - What are soft and hard magnetic materials? Give their properties and applications. (5)
  - Give an explanation of the Compton Effect with respect to modified and unmodified component. (5)
  - Calculate the velocity of ultrasonic waves in a liquid used in an acoustic diffraction experiment using the following data: (5)
    - Wavelength of light used =  $6000\text{\AA}$
    - Frequency of ultrasonic transducer = 1 MHz
    - Angle of diffraction for 2nd order maxima =  $5^\circ 36'$