F.E. Semester – I (RC 2019-20) Examination, Nov/Dec 2019
PHYSICS

Duration: 03 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	=	6.626×10^{-34} J-s
Electron charge	=	1.6×10^{-19} C
Boltzmann's constant	=	1.38×10^{-23} J/K
Electron mass	=	9.1×10^{-31} kg
Rydberg constant	=	1.097×10^{7} /m
Velocity of light	=	3×10^{8} m/s

Part – A

Answer **any two** questions:

1. a) With a neat ray diagram explain interference in a parallel thin film for reflected light and obtain the conditions for maximas and minimas. (5)
   b) Explain paramagnetism. Give 5 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. Given, density of iron = 7.8×10^{3} kg/m^3, Young's modulus of iron = 11.5×10^{10} N/m^2. (5)

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 2.5×10^{9} /m^3. The mobilities of electrons and holes are 0.36 m^2/V.s and 0.17 m^2/V.s respectively. Calculate its conductivity. Also calculate the current density if an electric field of 1000 V/m is applied across it. (5)
3. a) What is Hall Effect? Obtain expression for Hall voltage and Hall Coefficient. (5)
   b) Explain the following applications of US waves: (5)
      (i) Detection of flaws in metals
      (ii) SONAR
   c) Draw a neat block diagram of CRO. Explain the purpose of the time base circuit in the CRO. (5)
   d) A parallel beam of monochromatic light of wavelength 6000 Å is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is

45˚. Calculate the smallest thickness of the plate which would appear dark by reflection. (5)

Part – B

Answer **any two** questions:

4. a) Explain the process of stimulated emission of radiation and how it can be used for light amplification. (5)
   b) Derive Bragg's Law of X-ray diffraction. Draw necessary diagram. (5)
   c) What is Compton effect? With neat diagram describe the experiment used to study Compton effect. (5)
   d) 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)

5. a) Derive expression for Acceptance Angle of an optical fibre. What is acceptance cone? (5)
   b) Explain the origin of characteristic and continuous X-ray spectra. (5)
   c) State de Broglie's hypothesis. What is de Broglie's wavelength? State properties of matter waves. (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 57°C is 6328 Å. (5)

6. a) With neat diagram explain construction & working of Ruby laser. What are its drawbacks? (5)
   b) With neat diagrams explain the different types of optical fibres. (5)
   c) State Moseley's Law and explain its significance. (5)
   d) A photon of 2 Å strikes an electron at rest and is scattered at an angle of 90˚. Find the wavelength of the photon after collision. Also calculate Compton shift. (5)

Part – C

Answer **any one** question:

7. a) Show that the diameter of dark rings in Newton's Rings for reflected light is proportional to the square root of natural numbers. (5)
   b) What is an optical resonator and why is it required in a laser? (5)
   c) With block diagram explain the use of optical fibres in communication. Give any two advantages of optical fibres over copper wires for communication. (5)
   d) Identify the target element used in the x-ray tube if the wavelength of the $K\alpha$ line emitted is 1.55 Å. Take nuclear screening constant as unity. (5)

8. a) Derive an expression for conductivity of a semiconductor in terms of mobility of charge carriers. (5)
   b) What are soft and hard magnetic materials? Give their properties and applications. (5)
   c) Give an explanation of the Compton effect with respect to modified and un-modified component. (5)

d) 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 Å

Frequency of ultrasonic transducer = 1 MHz

Angle of diffraction for 2nd order maxima = 5°36´

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