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F.E. Semester-I (Revised Course 2016-17)
EXAMINATION FEBRUARY 2021
Applied Science (Physics)

[Duration : Two Hours] **[Total Marks :60]**

Instructions:
1. Answer THREE FULL QUESTIONS with ONE QUESTION FROM EACH PART.
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

Q.1 a) With the help of an experimental setup, explain the Newton's ring method to determine R.I. of a liquid. (5)

b) Draw the block diagram of a CRO and briefly explain its application to measure amplitude of dc voltages. (5)

c) Derive an expression for fringe width in a wedge shaped film. (5)

d) Find the diffusion coefficient for Germanium when the concentration gradient changes by 10^{15} over 1mm of length and the current constituted is 140 mA with cross sectional area 1.1 cm^2. (5)

Q.2 a) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. Give two examples of each. (5)

b) Briefly explain physical origin of Hall Effect. Derive an expression for Hall voltage in terms of current through the semiconductor material. (5)

c) With neat circuit diagram, explain magnetostriction method for production of ultrasonic waves. (5)

d) Fringes of equal thickness are observed in a thin glass wedge of refractive index 1.52 when viewed with light of wavelength 5890 A^0. Calculate the wedge angle if the fringe spacing is 0.12 mm. (5)

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Q.3 a) Explain construction and working of an electrostatic electron lens. (5)

b) What is continuity equation? Derive equation of continuity for excess carriers in a semiconductor. (10)

c) What are hard and soft magnetic materials? Compare them on the basis of hysteresis curve. Mention one example of each. (5)

PART B

Q.4 a) What are SI and GRIN optical fibres? Draw their R.I. profile. (5)

b) Describe construction and working of Ruby laser with necessary diagrams. (5)

c) Photon of initial energy 90 KeV undergoes Compton scattering at an angle 55^0. Find the energy of the scattered photon and The recoil energy of the electron. (5)

d) State and explain Moseley's law. Give its significance. (5)

Q.5 a) What are characteristics x-rays? Explain its origin. (5)

b) Write three advantages of optical fibres over conventional cables. Explain the use of fibre optics in scientific field. (5)

c) A SI fibre has a core R.I. of 1.45 and the cladding R.I. of 1.42. Find (i) the numerical aperture, (ii) the relative index difference and (iii) the acceptance angle. (5)

d) Briefly explain Type-I and Type-II superconductors. (5)

Q.6 a) Derive the expression for numerical aperture of a step index fibre. (5)

b) What is population inversion and why is it necessary for light amplification? Why is population inversion sometimes called negative temperature state? (5)

c) Define the term "Mode of propagation" in an optical fibre. With neat diagrams explain different types of optical fibres. (5)

d) A photon of wavelength $0.045Å^0$ strikes an electron at rest and is scattered at an angle of 70^0 to the original direction. Find the wavelength and speed of the scattered photon. (5)

PART C

Q.7 a) Discuss BCS theory of superconductivity. (5)

b) Derive an expression for conductivity of a semiconductor in terms of mobility of charge carries. (5)

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c) Describe acoustic diffraction method to find velocity of ultrasonic waves in liquid. (5)

d) The relative population of two energy states in a Laser that emits wavelength 6250 A^0 is 2.359×10^{-34}. Find the temperature at which the laser emits light. (5)

Q.8 a) Describe the Davisson-Germer experiment to prove that electrons behave like waves. (5)

b) Explain the origin of continuous spectrum. Also give an account of cut-off wavelength in it. (5)

c) What is x-ray diffraction? With neat diagram explain the working of Bragg's spectrometer. (5)

d) White light is incident on a transparent film of refractive index 1.30 and thickness 1.55 μm at an angle of 50^0. When the reflected light is examined a dark band corresponding to 500 nm is seen. Find the order of the band. (5)