FE102

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FE (Sem – I/II) (Revised Course 2016-17) EXAMINATION MAY/JUNE 2019
Applied Science (Physics)

[Duration : 3 Hours] **[Total Marks : 100]**

Please check whether you have got the right question paper.

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:

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

PART-A

(Answer Any Two Questions)

Q.1 a) With neat circuit diagram, explain magnetostriction method for production of ultrasonic waves. 05

b) What is continuity equation? Derive equation of continuity for excess carriers in semiconductor. 05

c) Derive an expression for fringe width in a wedge shaped film. 05

d) A magnetic material with susceptibility of -0.3×10^{-5} is subjected to magnetic field of strength 1000 A/m. calculates magnetization of the material. Also evaluate the magnetic flux density of the field inside the material. 05

Q.2 a) What are hard and soft magnetic materials? Compare them on the basis of hysteresis curve. Mention one example of each. 05

b) Explain construction and working of an electrostatic lens. 05

c) With the help of an experimental setup, explain the Newton's ring method to determine R.I of a liquid. 05

d) Find the diffusion coefficient for Germanium when the concentration gradient changes by 10^{15} over 1mm of length and the current constituted is 150 mA with cross sectional area $1cm^2$. 05

Q.3 a) Briefly explain physical origin of Hall Effect. Derive an expression for Hall voltage in terms of current through the semiconductor material. 05

b) Draw the block diagram of a CRO and briefly explain its application to measure amplitude of dc voltages. 05

c) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. Give two examples of each. 05

d) Fringes of equal thickness are observed in a thin glass wedge of refractive index 1.52 when viewed with light of wavelength 5893A. Calculate the wedge angle if the fringe spacing is 0.1mm. 05

PART-B

(Answer Any Two Questions)

Q.4 a) State and explain Mosley's law. Also give an account of scientific and industrial applications of x-rays. 05

b) Describe construction and working of He-Ne laser. In what way it differs from Ruby laser. (Any two differences) 05

c) Briefly explain the following 05
i) Meissner effect
ii) Silsbee effect

d) The transition temperature for lead is 7.2K however; at 5K it loses the superconducting property if subjected to magnetic field of 3.3×10^4 A/m. find the maximum value of H which will allow the metal to retain its superconductivity at 0K. 05

Q.5 a) Explain the term 'Numerical Aperture'. Hence derive an expression for numerical aperture of optical fibre in terms of fractional R.I. differences. 05

b) Briefly explain BCS theory of superconductivity. 05

c) With the help of neat diagram explain use of Bragg's x-ray spectrometer in determining interplanar distance in a crystalline solid. 05

d) A SI fibre has a normalized frequency $V = 26.6$ at 1300nm wavelength. If the core radius is 25μm, calculate the numerical aperture and number of guided mode. 05

Q.6 a) What is optical resonator? What role does it play in laser? 05

b) What is Compton Effect? Can you observe Compton Effect with white light? Explain your answer. Discuss different cases of Compton shift with regards to angle of scattering. 05

c) What are the types of optical fibre? Discuss each of them separately. Draw the necessary diagrams. 05

d) i) At what potential difference must an x-ray tube operate to produce x-rays with minimum wavelength of $0.01A^{\circ}$? 05
ii) What is the maximum frequency of the x-rays produced in a tube operating at 50KV?

PART-C

(Answer Any One Question)

Q.7 a) Explain the concept of carrier diffusion in a semiconductor. Derive the expression for diffusion current densities. 05

b) Discuss Type-II superconductor. What is its advantages over Type-I superconductor? 05

c) Explain the three level and four level pumping schemes. Why the four level pumping scheme is preferred over the three level pumping scheme. 05

d) White light falls normally on a soap film of thickness 5×10^{-5} cm. what wavelength within the visible spectrum will be strongly reflected, given that R.I. for soap film = 1.33, and range of visible spectrum $\lambda = 4000A^{\circ}\ to\ 7000A^{\circ}$. 05

Q.8 a) Briefly explain the working of a Magnetostatic focusing. 05

b) Draw and explain the structure of an optical cable. Give an account of transmission of light in it. 05

c) Obtain the condition of bright and dark interference due to reflected light from a parallel sided thin film. 05

d) If the potential difference applied across the x-ray tube is 5KV and the current through is 2mA. Calculate 05
i) The number of electrons striking the target per second
ii) The speed which they strike
iii) The shortest wavelength emitted.