



### SECTION-B

- 2
  - a) A hollow sphere of radius 10 cm is charged with a charge of  $1 \times 10^{-8} \text{C}$ . Find the potential (i) at its surface (ii) at a distance 30 cm from the spheres centre. (3)
  - b) State and explain modified Ampere's law and discuss its importance in reference to electrodynamics. (5)
- 3
  - a) Explain diamagnetism and ferromagnetism on the basis of magnetic domains of the atom. (4)
  - b) "*Soft magnetic materials have thin hysteresis loop*". Comment and justify your answer. (4)
- 4
  - a) "*Stimulated emission is a must for laser transitions*". Comment and justify your answer. (4)
  - b) The half width of the gain profile of a laser material is about  $10^{-3} \text{nm}$ . What should be the maximum length of the cavity to have a single longitudinal mode oscillation? (4)
- 5
  - a) If fractional difference between the core and cladding refractive indices of a fibre is 0.015 and numerical aperture is 0.25, calculate the refractive index of core and cladding material. (4)
  - b) Explain how a glass fibre guides light from one end to the other. (4)

### SECTION-C

- 6
  - a) A clock keeps correct time. With what speed should it be moved relative to an observer so that it may appear to lose 1 minute in 20 hours? (3)
  - b) Deduce the expression of length contraction using concept of Lorentz transformations. (5)
7.
  - a) The first order reflection from the plane of a crystal is obtained at an angle of  $25^\circ$  with the incident beam. If inter atomic spacing is  $3\text{\AA}$ , then calculate the wavelength of X-rays used. (4)
  - b) What do you understand by crystallography? Where do we use it? (4)
- 8
  - a) A particle of mass  $5 \times 10^{-26} \text{Kg}$  is accelerated to one-fifth of velocity of light. If the velocity can be measured with an accuracy of 98%, what will be the uncertainty in its position? (4)
  - b) Develop the Hamiltonian operator of free particle moving in one dimension under the influence of zero potential energy. (4)
- 9
  - a) Define Meissner effect and discuss its usefulness in reference to superconductivity. (4)
  - b) Write a brief note on high temperature superconductors. (4)