B. Tech. (1st / 2nd Year)

ENGINEERING PHYSICS

PH – 101

Roll No_____

MAY 2014

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section – A is **Compulsory.**
2) Attempt **Five** questions in all from Sections B & C.
3) Select at least **Two** questions from each of the Sections B & C.

Section – A

Q1) **(2 marks each)**

a) Will an atom having spherically symmetric charge distribution be polar or non-polar? Explain.

b) Explain briefly the concept of a ferromagnetic domain.

c) What do you understand by a metastable state?

d) What are the special features of optical fibre communications that make these so important?

e) Write the four Maxwell's equations in differential form.

f) State the postulates of the Special Theory of Relativity.

g) Why are X-rays used for crystal structure analysis?

h) Enumerate the important characteristics of a laser beam?

i) Explain the meaning of normalization of a wavefunction.

j) What is isotopic effect in superconductors?

Section – B

(8 marks each)

Q2) a) What is the effect of an electric field on a non-polar molecule? Define atomic polarisability and atomic dipole moment. What are their dimensions?

b) The plates of a parallel plate capacitor are separated by 6.0 mm thick material of dielectric constant 2.8. If the electric field strength inside the dielectric is 10^5 V/m, determine the magnitudes of polarization vector and displacement vector, and the energy density in the dielectric.

Q3) a) Distinguish between dia-, para-, and ferro-magnetic materials. How does the magnetic susceptibility of a paramagnetic substance vary with temperature?

b) Determine the magnetization and magnetic flux density in a diamagnetic material of susceptibility -0.4×10^{-5}, placed in a magnetic field of strength 10^4 A/m.

Q4) a) Describe the construction and working of a He-Ne laser.

b) How does a semiconductor laser differ from other lasers?

Q5) a) What is the meaning of allowed modes in an optical fibre? How are they related to normalized frequency? Distinguish between monomode and multimode fibres.

b) The refractive indices of the core and cladding of an optical fibre are 1.5 and 1.48, respectively. What is the fractional change in refractive index? Find the critical angle, the acceptance angle and numerical aperture for a light ray entering from air into the fibre.

Section – C

(8 marks each)

Q6) a) Define proper length and proper time. On the basis of Lorentz transformations, derive an expression for time dilation. Give an example to show that time dilation is a real effect.

b) Calculate the velocity of a particle if its kinetic energy is twice its rest mass energy.

Q7) a) Distinguish between continuous and characteristic X-ray spectra. How do you account for the origin of the characteristic X-rays?

b) Find the shortest wavelength of X-rays that can be produced in a tube with an operating voltage of 12.4 kV.

Q8) a) What is Compton scattering? Derive an expression for Compton shift in wavelength. Why can't Compton shift be observed with visible light?

b) The uncertainty in the position of a particle is equal to its de Broglie wavelength. Calculate the uncertainty in its velocity.

Q9) a) Derive the London equations and discuss how they explain the Meissner effect and flux penetration in a superconductor.

b) Determine the critical temperature and critical magnetic field at 4.2 K for a given superconducting material if the critical fields at 14.1 K and 12.9 K are respectively 1.41×10^5 A/m and 4.205×10^5 A/m.

END