PHYSICS
(PH-101, May 2005)

Time: 3 Hrs Max Marks: 60

Note: Section A is compulsory. Attempt any five questions from Section B and C taking at least two questions from each Section.

Section-A

1. (a) State the Ampere's circuital law in electromagnetism.
   (b) Define the magnetic induction and magnetization.
   (c) What is holography?
   (d) What is total internal reflection?
   (e) State Einstein's postulates of special theory of relativity.
   (f) Explain Moseley's law.
   (g) What is Compton Effect?
   (h) What is the effect of magnetic field on superconductivity?
   (i) What do you understand by Eigen values and Eigen functions?
   (j) Give some applications of ferrites.

Section-B

2. What is meant by dielectric polarization? Define the terms electric intensity E, electrical polarization P and electric displacement D and establish the relation.
   $D = \varepsilon_0 E + P$ where ε_0 is permittivity of vacuum.
3. What do you understand by magnetic materials? What are differences between hard and soft magnetic materials?
4. Explain the term spontaneous and simulated emission. Explain the construction and working of a Ruby Laser.
5. What is numerical aperture? Calculate the numerical aperture and acceptance angle for an optical fiber, given that refractive index of core and cladding are 1.45 and 1.40 respectively.

Section-C

6. On the basis of Lorentz transformation discuss the following effects:
   (a) Length contraction
   (b) time dilation
   A scientist observes that a certain atom 'A' moving to him with velocity 2×10^{10} cm/sec emits a partial 'B' which moves with velocity 2.8×10^{10} cm/sec with respect to atom. Calculate the velocity of the emitted particle relative to scientist.
7. Explain the production of characteristic X-ray spectra. An X-ray tube operated at 40 KV emits a continuous X-ray spectrum with a short wavelength limit $X_m = 0.310$ Å. Calculate the Plank's constant.
8. What is the need of Quantum Mechanics? Discuss Born's interpretation and normalization of wave function. At certain time, the normalized wave function of a particle moving along x-axis has the form given by
   $$\psi(x) = x + \beta \text{ for } -\beta < x < 0$$
   $$= -x + \beta \text{ for } 0 < x < \beta$$
   and zero else where. Find the value β of and the probability that the particle positions between $x = \beta/2$ and $x = \beta$
9. What is Miesnner effect? Show how London equations lead to this effect. A type-I superconductor with $T_C = 7K$ has shape $dB_T / d_T = -25mT/K = T_C$
   Estimate its critical field at 6K. Calculate the jump in specific heat at T_C.