Preparatory Course (Physics)

(Major, 29-4-2008)

Duration: 2 Hr.

Max. Marks: 50

Attempt all questions.

1. Write with appropriate reasons whether the following statements are right or wrong:
   a) Diffraction effect is more dominant at shorter wavelength.
   b) A charged body can not attract another uncharged body.
   c) A positive charge projected along the axis of a current carrying solenoid moves toward the curved surface. (2×3)

2. a) Show that the average power ('P') delivered by a AC source in a LRC circuit is given by

$$P = \varepsilon_{rms}\, i_{rms} \cos(\phi).$$

   Define all parameters/ symbols in terms of circuit parameters (L, R, C, i, etc.) (4)

   b) What type of voltmeter can be used to measure AC voltage and why? (3)

3. a) A beam of light consisting of two wavelengths 560nm and 700nm is used to obtain interference fringes in a Young's double-slit arrangement. If the separation between slits is 1mm and the distance of the screen from the slit is 2 m, calculate the least distance from the central maxima where the bright fringes due to both wavelengths coincide. (4)

   b) Find the polarization state of the light which has x- and y- components of its electric field as

$$E_x = E_0 \sin(\omega t + kz) \quad \& \quad E_y = \frac{E_0}{2}\cos(\omega t + kz + \pi/2)$$ (4)

4. a) Write the name of 2 common dopants that can be used to dope the core of the standard pure silica clad fiber. (3)

   b) Two lenses, one made of crown glass and other of flint glass, are to be combined so that the combination is achromatic for blue and red light, and acts as convex lens of focal length of 35cm. Calculate the focal lengths of the components. (4)
   [Crown glass: $n_{yellow} = 1.52$, $n_{blue} - n_{red} = 0.01$; Flint glass: $n_{yellow} = 1.62$, $n_{blue} - n_{red} = 0.02$]

5. a) If the wavelength of the light falling on a metal surface is increased from 400nm to 410nm, what will be the corresponding change in the stopping potential for the photo current? (4)

b) A parallel plat capacitor having square plates of side 'a' and plate-separation 'd' as shown in Fig. 1. The gap between the plates is filled with a dielectric material of dielectric constant 'K' which varies parallel to an edge as $K = K_0 + \alpha x$, where, K_0 & α are constants and 'x' is the distance from the left end. Calculate the capacitance of this capacitor. (3)

6. a) A long cable of length 'L' carries current 'i' in one direction and uniformly distributed over its (circular) cross section. The current returns along the outer surface (there is a very thin insulating sheath separating the currents). If 'a' and 'b' are inner and outer radii of the cable such that b ~ a (i.e., (b-a) << L), find the self-inductance per unit length of the cable. (4)

b) Any two points P and Q of an uniform circular conductor of radius R and resistance per unit length σ are connected to a cell as shown in Fig. 2. Calculate the resultant magnetic field (B) at the center (C) of the conductor. (4)

7. a) Two small balls, each having mass 'm' and charge 'q', are suspended by two massless strings of length 'L' each. These strings are fixed at a point where a third charge 'q' is located. If in equilibrium position the angle between the strings is 'θ', find the value of charge 'q' in terms of other parameters. (4)

b) Find the electric field (E) using Gauss's law at a distance 'r' from the axis of the long wire having uniform linear charge density (λ). (3)

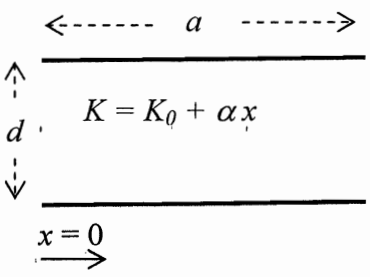

Fig. 1

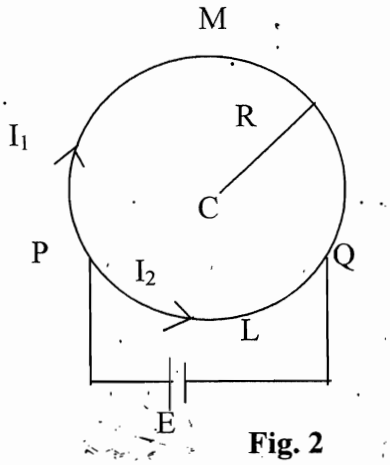

Fig. 2