Registration No. :

First Semester Examination – 2012-13

PHYSICS – I

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2×10

    (a) What is the physical significance of damping coefficient ? What is its unit ?

    (b) Green light of wavelength 5100 Å from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away is 2 cm, find the slit separation.

    (c) How would you obtain Newton's ring with bright center ?

    (d) Distinguish between Fresnel's and Fraunhoffer classes of diffraction.

    (e) Explain why grating with larger number of lines are preferred ?

    (f) Compare the displacement current and conduction current.

    (g) Justify that classical physics is a limiting case of quantum physics.

    (h) State Planck's formula for black body radiation. Give the conditions under which Planck's formula reduces to Wein's law.

    (i) Normalize the wave function given by $\psi = Ae^{-ax}$, and obtain normalization constant, where A is constant.

    (j) Mention the characteristics of the wave function in quantum mechanics.

                                                                    P.T.O.

2. (a) What is forced vibration ? Write down the equation of motion of a forced oscillator. Give graphical representation of the variation of amplitude with frequency of external driving force in case of forced vibration for different values of damping.   4

   (b) Starting with the differential equation for a damped harmonic oscillator discuss under damped, critically damped and over damped oscillations. Represent these oscillation of displacement time graph.   6

3. (a) What are coherent sources ? Discuss why two independent sources of light of the same wavelength cannot produce interference fringes. Give a diagram showing clearly how coherent sources are produced in a biprism. Write the formula for fringe width.   5

   (b) It is observed that the nth and $(n + 1)^{th}$ bright rings due to wavelengths 5400 Å and 3600 Å are coinciding each other. If the radius of curvature of the lens is 100 cm, find the common diameter of these two.   5

4. (a) Give the theory of a diffraction grating. Describe, in detail, how you would use a transmission grating for measuring the wavelength of light.   4

   (b) A zone plate has principal focal length of 1 m for a monochromatic light having wavelength 3600 Å. Find the principal focal length for light of wavelength 5400 Å.   3

   (c) Deduce the missing orders for a double slit Fraunhofer diffraction pattern, if the slit widths are 0.16 mm and they are 0.8 mm apart.   3

5. (a) What is a Nicol Prism ? Give its construction. How it produces polarised light ? How is it used as a polariser and analyser ?   5

   (b) What is meant by optical activity ? Define specific rotation.   3

   (c) Calculate the thickness of mica sheet required for making a quarter wave plate for $\lambda = 6000$ Å, given $\mu_0 = 1.586$, $\mu_e = 1.592$ 2

6. (a) Find the volume of a sphere using Gauss divergence theorem.   3

   (b) Find the circulation of vector $P = ixy + jyz + kzx$ around a closed curve bounded by $x = 0$, $x = 2$, $y = -1$, $y = 1$, $z = 0$ and $z = 1.5$.   3

(c) State Maxwell's electromagnetic equation for an isotropic media. What are the significant conclusion drawn out of it ? 4

7. (a) An electromagnetic wave is propagated in free space with electric vector $E(y, t) = 10 \cos (ky - wt) j$. Calculate the average value of Poynting vector.

5

(b) What do you mean by vector potential and scalar potential. Obtain plane wave equation for electromagnetic wave in free space in terms of vector and scalar potential. 5

8. (a) What is Compton effect ? In Compton effect, under what condition the Compton shift is minimum ? 3

(b) Show that the de-Broglie's wavelength of a particle inside an infinite deep potential well is quantized. 5

(c) Find the uncertainity in velocity of a deuterium if it is bound inside a potential of 10^{-10} m. 2

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