Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B.Tech
BS 1102

Second Semester Examination – 2012

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) Why does the fringe width of Newton's ring decrease with the increase of diameter of the ring ?

   (b) Displacement associated with a wave is given by $y(x, t)=0.3\sin(\pi x - \pi/2\, t)$, where x is in cm and t is in seconds. Find amplitude, frequency and wave length of the wave.

   (c) A glass plate of refractive index 1.6 is to be used as a polarizer. Calculate angle of polarization and angle of refraction.

   (d) Explain how Newton's rings are helpful in the construction of zone plate.

   (e) Write the Maxwell's equation which support the idea of absence of magnetic monopoles.

   (f) What is vector potential ? Write its physical significance.

   (g) Write the condition for amplitude resonance and explain the sharpness of resonance.

   (h) Define 'black body radiations'. State the characteristics of black body radiations.

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(i) State the basic postulates of quantum mechanics.

(j) A proton at rest is subjected to a potential difference of 5 KV. Find the de-Broglie wave length.

2. (a) What is forced oscillation ? Write down the differential equation for forced vibration and explain each of the terms appearing in the equation. 4

(b) In Newton's rings experiment, the diameters of 5^{th} and 15^{th} dark rings are measured 0.336 cm and 0.590 cm respectively. If the radius of curvature of the curved surface of the plano-convex lens used be 100 cm, find the wave length of light used. 4

(c) In a plane diffraction grating, the width of each slit is equal to the width of the opaque space between the two adjacent slits. Find the missing order spectra. 3

3. (a) Show graphically the vibration of amplitude of an underdamped harmonic oscillator with time. 3

(b) Define normal modes of vibration and normal frequency of a coupled system. Show that in the normal mode of higher frequency two masses of the coupled oscillator are out of phase. 4

(c) Distinguish between Fresnel's and Fraunhoffin's diffraction. 3

4. (a) Describe the construction of Nicol prism. Describe how polarized light can be obtained by using Nicol prism. 5

(b) Evaluate the surface integral for the vector function $\vec{F} = 6x\hat{i} - 4y^2z\hat{j} + 6yz\hat{k}$ over the surface S, where S is the surface of the unit cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$ planes, using Gauss's divergence. 5

5. (a) What is retardation plate ? Distinguish between quarter-wave plate and half-wave plate. 3

(b) The refractive index of E-ray of O-ray are 1.65 and 1.45 respectively. Find the thickness of the material required for a quarter wave plate of light of wavelength 5000 $\mathring{A}$ 2

(c) State and prove Poynting's theorem. How does it describe the conservation of energy in electromagnetic field ? 5

6. (a) Find the conduction and displacement current density in a material having electrical conductivity $\sigma = 10^{-4}$ mho.m^{-1} and relative permittivity Er = 2.5. Given that the electric field in the material is $E=3\times10^{-4}\cos(5\times10^{5})t$ V.m^{-1}. 5

(b) Prove that the electromagnetic waves are transverse in nature. 5

7. (a) What is Compton effect ? Why does the unmodified line appear in Compton scattering ? 3

(b) A particle moving along the x-axis has the wave function $\psi(x) = bx$ between $x = 0$ and $x = 1$ and $\psi(x) = 0$ elsewhere. Find the expectation value $< x >$ of the particle's position. 3

(c) Prove that the wave function $\psi(x, t) = A\cos(kx - \omega t)$ does not satisfy the time dependent Schrodinger wave equation for a free particle. 4

8. (a) Find the energy expectation value of the system whose energy eigen values are 1 eV, 4 eV and 9 eV having probabilities 0.5. 0.35 and 0.15 respectively. 3

(b) What is potential step ? Explain how quantum physics differ from classical physics in potential step problem. 3

(c) 14 million electrons with energy of 2 eV are incident on a potential barrier of 4 eV high and 0.5 nm wide. Find how many electrons will tunnel through the barrier ? 4