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

Total number of printed pages – 4

B.Tech

BS 1102 (New)

Second Semester Examination – 2011

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

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(a) Two sinusoidal waves of the same frequency and having amplitudes A_1 and A_2 respectively superpose coherently. Write the expression for the maximum and minimum values of the intensity of the resultant wave.

(b) What is the magnitude of restoring force on an oscillator, when oscillator is at rest at its mean position ?

(c) Explain graphically the variation of fringe width with the distance in between the two coherent sources in a Young's double slit experiment.

(d) What is the maximum wavelength of a visible spectrum so that third order spectrum can be observed by a grating having 6000 lines/cm ?

(e) The refractive indices of glass and water are 1.54 and 1.33 respectively. For which case polarizing angle will be greater : For a beam incident from water to glass or for a beam incident from glass to water.

(f) Write the integral form of the Ampere's circuital law.

(g) Calculate the value of Poynting vector at the surface of the Sun, if the power radiated by the Sun is 3.8×10^{26} W and its radius is 7×10^{8} m.

P.T.O.

(h) Taking a solenoid vector $\vec{A} = (x+3y)\hat{i} + (2y+3z)\hat{j} + (x+az)\hat{k}$, find the value of the constant a.

(i) In Compton Effect, under what condition, the Compton shift is maximum. Explain with appropriate formula.

(j) The wave function ψ of a system is a linear combination (orthonormal set) $\psi = \frac{1}{\sqrt{3}}\phi_1 + \frac{1}{\sqrt{2}}\phi_2 \frac{1}{\sqrt{6}}\phi_3$. What is the probability that the system being in the state ϕ_2. What is total probability ?

2. (a) Write the differences between longitudinal wave and transverse wave. 4

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(b) The amplitude of an under damped oscillator falls to 1/10 of its initial value after 10 number of oscillations. If time period is 2 sec, calculate the 6

(i) Damping coefficient

(ii) Logarithmic decrement

(iii) Time during which energy falls to 1/10 of its original value.

3. (a) A Plano convex lens of radius 300 cm is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 8^{th} dark ring in the transmitted system is 0.72 cm. Calculate the wavelength of light used. 4

(b) On placing a thin sheet of mica of thickness 12×10^{-5} cm in the path of one of the interfering beams in a biprism arrangement. It is found that the central bright band shifts a distance equal to the width of a bright fringe. Calculate the refractive index of mica. 4

(c) What changes will be observed in Newton's ring with white light instead of monochromatic light ? 2

4. (a) Distinguish between a Zone plate and a convex lens. 4

(b) A biprism is placed at a distance of 5 cm in front of a narrow slit, illuminated by sodium light ($\lambda = 5890 \times 10^{-8}$ cm) and the distance between the virtual sources is found to be 0.05 cm. Find the width of fringes observed in an eyepiece at a distance of 75 cm from the biprism. 3

(c) Find the radius of the 1st half period zone on a zone plate, behaving like a convex lens of focal length 60 cm. ($\lambda = 6000$ Å) 3

5. (a) State and explain Brewster's law. Show that when light travelling in one transparent medium, meets another transparent medium at the polarizing angle, the reflected and transmitted rays are perpendicular to each other. 5

(b) The plane of vibration of incident ray makes an angle 60° with the optic axis. Compare the intensities of ordinary and extraordinary rays. 3

(c) Distinguish between ordinary ray and extraordinary ray. 2

6. (a) Using gauss divergence theorem, prove that the volume of a sphere of radius 'r' is $\frac{4}{3}\pi r^3$. 5

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(b) Calculate the value of $\vec{\nabla}.(r^3 \vec{r})$ where, r is a position vector. 2

(c) Distinguish between conduction current and displacement current. 3

7. (a) State Poynting theorem. Explain how the Poynting vector explains the energy flow. 4

(b) Define Poynting vector. Mention its dimension and S.I. unit. 3

(c) What is the physical significance of curl of a vector function ? 3

8. (a) A particle trapped in one dimensional box of length L is described by the wave function $\psi = x$. Normalize the wave function between "a" and "b". 3

(b) Write Plank's formula for spectral distribution of black body radiation. Hence explain how Wien's law and Rayleigh-Jean's law follow from it. 3

(c) Set up Schrödinger wave equation for a particle of mass m crossing a potential step.

$V(x) = 0$ for $x < 0$.

$= V_0$ for $x > 0$ from left. Obtain the solution. Indicate the reflected and transmitted part in it. 4

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