| Registration No. : | | | | | | | | | | |
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Total number of printed pages - 3

B. Tech BS 1102

Second Semester Regular Examination – 2014 PHYSICS - I

BRANCH(S): ALL

QUESTION CODE: F 460

Full Marks - 70

Time: 3 Hours

Answer Question No. 1 which is compulsory and any five from the rest.

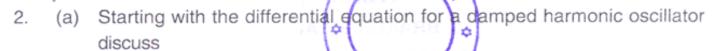
The figures in the right-hand margin indicate marks.

Answer the following questions :

2×10

- (a) If two pendulums ,each of mass 0.60 kg and length 1 meter, are connected by a spring of spring constant of 0.3 Nm⁻¹, find the normal mode of frequencies of coupled oscillator.
- (b) Write down the differential form of Maxwell's equations in a charge free non conducting medium.
- (c) What is double refraction? Why double refraction cannot occur along the optic axis of a crystal?
- (d) The ratio of intensities of two waves that produce interference pattern is 16:1. Deduce the ratio of maximum to minimum intensities in fringe system.
- (e) How many orders will be visible if the wavelength of the incident radiation is 0.000 Å and the number of lines on the grating is 2620 in one inch?
- (f) If the angle between a polarizer and analyser is 60°, what will be the intensity of transmitted light for original intensity of incident light as I₀?
- (g) Find the value of ∇r^{-n} , where $r = \sqrt{x^2 + y^2 + z^2}$.
- (h) Show that the rest mass of a photon is zero.

- (i) What is the magnitude of Poynting vector at the surface of a long cylindrical wire of radius R, length L carrying a current I, when its ends are kept at a potential difference V.
- (j) Prove that $\left[\hat{x}, \hat{p}\right] = \frac{ih}{2\pi}$.



- (i) under damped
- (ii) critically damped
- (iii) over damped oscillation

Draw the displacement-time graph for all the cases.

Light sources emitting the light of wavelengths $\lambda_1 = 6.0 \times 10^{-7} m$ and $\lambda_2 = 4.8 \times 10^{-7} m$ is used to obtain Newton's rings in reflected light. It is

6

2

3

- found that the nth dark ring of λ_1 coincides with $(n+1)^{th}$ dark ring of λ_2 . If the radius of curvature of the curved surface of the lens is 0.96 m. Calculate the diameter of $(n+1)^{th}$ dark ring of λ_2 .
- (a) What is Quality factor? Discuss the effect of quality factor on the motion of a under-damped oscillator.
 - (b) What is the physical significance of damping coefficient? What is its unit?

(c) Explain the formation of interference fringes by means of Fresnel's biprism when a monochromatic source of light is used, and derive the expression for the fringe width.

- (a) What is a zone plate and how is it made? Explain how a zone plate acts like a convergent lens having multiple foci. Derive an expression for its focal length.
 - (b) What is a Nicol Prism. Describe the construction and use of a Nicol Prism.

(c) Using gauss divergence theorem show that volume of a sphere is $4.1888r^3$.

BS 1102 2 Contd.

- (a) Explain the Fraunhofer diffraction due to a single slit. Hence find the conditions for principal maxima and minima.
 - (b) State Brewster's law. Hence show that at polarizing angle, the reflected and refracted rays are perpendicular to each other.
 3
 - (c) State Poynting theorem. What are the dimension and unit of Poynting vector?
- 6. (a) If $\mathbf{A} = \hat{i}yz + \hat{j}xz + \hat{k}xy$, then find the value of $\oint_c \mathbf{A} \cdot d\mathbf{l}$. Where C is along the perimeter of a rectangular area bounded by x=0, x=a and y=0, y=b. 4
 - (b) Derive the electromagnetic wave equations for magnetic field in vacuum. 4
 - (c) Define scalar and vector potentials. 2
- 7. (a) What are the characteristic features of a wave function 2
 - (b) Find the value of A for $\psi = A\cos^2 x$ for $-\frac{\pi}{2} < x \neq \frac{\pi}{2}$.
 - (c) State Heisenberg's uncertainty principle. Hence show that the ground state energy of a linear harmonic oscillator is $\frac{1}{4\pi}h\omega$.
- 8. (a) For wave function $\psi(x) = \sqrt{\frac{2}{L}} \sin \frac{\pi x}{L}$, 0 < x < L, find the expectation value of \hat{p}^2 .
 - (b) The energy of an electron constrained to move in a one dimensional box of length 4 Aº is 9.664 × 10⁻¹⁷ J. Find out the order of excited state and the momentum of the electron in that state.
 5
 Given h = 6.63 × 10⁻³⁴ J sec.