

BACK PAPER

Registration No. :

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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) What is resonance ? Distinguish between amplitude resonance and velocity resonance.
  - (b) Explain why two independent sources of light of same wavelength cannot produce interference pattern.
  - (c) Write the differences between O-ray and E-ray.
  - (d) Why double refraction cannot occur along the optic axis of a crystal ?
  - (e) If  $\mathbf{E}$  is an electrostatic field then show that  $\nabla \times \mathbf{E} = 0$ .
  - (f) Can accelerated charged particle produce electromagnetic waves ? Give reasons.
  - (g) What is skin depth ? What are physical significance of skin depth ?
  - (h) Prove that the rest mass of photon is zero.
  - (i) State the de Broglie hypothesis.
  - (j) What is the role of operators in quantum mechanics ?
2. (a) The position of a particle is given by the expression  $x = 4 \cos(3\pi t + \pi)$ , where  $x$  is in meters and  $t$  is in seconds. Determine the frequency, period of motion, the phase constant, the position of the particle at  $t = 0.250$  sec. 3

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- (b) Derive the differential equation for damped vibration and solve the equation for critical damping. 4
- (c) What is coupled oscillation ? Define normal mode of vibration, normal coordinates and normal frequency of a coupled system. 3
3. (a) In Newton's Rings experiment the diameter of 5<sup>th</sup> dark ring is 0.336 cm and the diameter of 15<sup>th</sup> dark ring is 0.680 cm. Find the radius of the plano-convex lens if the wavelength of light used is 6850 Å. 4
- (b) Describe with necessary theory and experiment to determine the refractive index of transparent liquid by using Newton's ring. 4
- (c) Prove that energy is conserved in interference phenomena. 2
4. (a) Distinguish between the Fresnel and Fraunhofer diffraction. 3
- (b) What is a zone plate ? Show that zone plate acts like a convex lens. 2
- (c) Consider a diffraction grating of width 5 cm with slit width 0.0001 cm separated by a distance of 0.0002 cm. Wavelength of light used is  $5.5 \times 10^{-5}$  cm. What is corresponding grating element and the total number of lines in grating ? Find also the highest order of spectrum. 5
5. (a) State Brewster's law and hence prove that the angle between the reflected and refracted ray is  $90^\circ$ . 3
- (b) What is retardation plate ? Distinguish between quarter wave plate and half wave plate. 3
- (c) Describe how polarized light can be obtained with help of Nicol prism. 4
6. (a) Prove the transverse nature of electromagnetic waves. 4
- (b) State and prove Poynting's theorem. How does it describe the conservation of energy in electromagnetic field ? 6
7. (a) A ray of ultraviolet light of wavelength 3000 Å falls on a surface of a metal whose work function is 2.28 eV. This ejects an electron. What will be the velocity of emitted electron ? 3

- (b) If  $\psi(x) = Ae^{-m_0x^2/h}$ , find the expectation values of momentum and position. 4
- (c) State Heisenberg's uncertainty principle. Give the physical significance. 3
8. (a) What is potential step? How does quantum physics differ from classical physics in potential step problem? 3
- (b) What is wave function? Give the physical interpretation of wave function. 3
- (c) A beam of electrons of energy 15 eV is incident at the boundary of a step potential of height 5 eV. Find the fraction of the beam reflected and transmitted. 4