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

Total number of printed pages – 3

B. Tech

BS 1102

First Semester (Back / Special) Examination – 2013

PHYSICS – I

QUESTION CODE : D171

Full Marks – 70

Time : 3 Hours

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

1. Answer the following questions : 2×10

   (a) Calculate the KE of an electron having de Broglie wavelength of 1000 Å.

   (b) State Gauss divergence theorem.

   (c) Distinguish between quarter-wave plate and half-wave plate.

   (d) Why double refraction cannot occur along optic axis of a crystal.

   (e) The equation for displacement of a point of a damped oscillator is given by $x = 6e^{-0.3st} \sin(\pi/2)\, t$ m. Find the velocity of the oscillating point at $t = T/4$.

   (f) Evaluate the Q-factor of a damped oscillator with resonant frequency 500 Hz and damping coefficient 0.5 per second.

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

   (h) Distinguish between Fresnel diffraction and Fraunhoffer diffraction.

   (i) Write down Maxwell's electromagnetic wave equations in integral form in vacuum.

   (j) Give a relation between classical physics and quantum physics.

2. (a) Define forced vibration. Write down the equation of forced vibration and solve the equation of motion. 4

(b) Establish the condition for amplitude resonance and explain the sharpness of amplitude resonance. 3

(c) Electrons cannot stay within the nucleus. Justify by using Heisenberg's uncertainty principle. 3

3. (a) Explain the Fraunhoffer diffraction at a single slit and hence find the conditions for maxima and minima. 6

(b) An object illuminated by 5000 $\mathring{A}$ wavelength of light is placed at 60 cm from a zone plate and its image is obtained at 30 cm from the plate. Calculate the number of Fresnel zones in a radius of 5 cm of the plate. 4

4. (a) Give the theory of plane transmission grating. How it can be used to find wavelength of light and in what respect determination of wavelength gives better results than those obtained by interference phenomenon ? 6

(b) A beam of monochromatic light when incident normally on a diffraction grating 2500 lines/cm. The first order spectral one is observed at an angle 10.18^0. Calculate the wavelength of incident light. 4

5. (a) What is Nicol Prism ? Discuss its principle. Discuss Nicol prism as polarizer and analyzer. 3

(b) Show that $\nabla \times \nabla \varphi = 0$ 3

(c) Derive Poynting theorem. Write physical significance of Poynting theorem. 4

6. (a) Derive electromagnetic wave equation in free space in terms of vector potential and scalar potential. 6

(b) What is Compton effect ? How does it support the quantum nature of radiation. 4

7. (a) Using Gauss divergence theorem, prove that volume of a sphere is $\frac{4}{3}\pi r^2$. 5

(b) The electric field between two parallel metal plates of area 1 cm^2 changes at the rate of 1.2×10^8 V/ms. Calculate the displacement current. 5

8. (a) State Heisenberg's uncertainty principle. Using this principle show that an electron cannot exist inside the nucleus. 5

(b) A wave function is given by $\psi = A \sin\left(\frac{2n\pi x}{L}\right)$ in region $0 \leq x \leq L$. Find the normalization constant and normalized wave function. 5