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

Total Number of Pages: 2

B.Tech.

BSCP2101(Old)

First Semester Examination – 2010

PHYSICS – I (Old Course)

Time: 3 Hours

Max. Marks: 70

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) A one dimensional simple harmonic oscillator, with amplitude 1 cm, has total energy of 1 mJ. Find the force constant of the oscillator.

(b) Two sinusoidal waves having the same frequency, the same amplitude of 2 cm and phase difference of 120^{o} superpose. Find the amplitude of the resulting wave.

(c) In a Young's double slit interference experiment, the fringe width is 0.3 mm. What would be the fringe width if the distance between the slit is doubled and the distance between the screen and the slit is also doubled?

(d) In a Fresnel's zone plate, the radius of the first transparent zone is 0.6 mm. Find the radius of the second transparent zone.

(e) State Brewster's law of polarisation of light.

(f) State Gauss divergence theorem in vector calculus.

(g) Write the Maxwell's electromagnetic equation, which involves the curl of magnetic induction, in free space in the absence of sources of charges and currents.

(h) The de Broglie wavelength of a particle, moving with non-relativistic speed, is 0.1 mm. What would be its de Broglie wavelength if its kinetic energy is doubled?

(i) According to Bohr's theory of hydrogen atom, the radius of the electronic orbit in the ground state is 0.5 Å. Find the radius of the orbit in the first excited state.

(j) A stream of mono-energetic, quantum mechanical particles is incident on a one dimensional potential step, whose height is less than the energy of the particles. If the transmission coefficient is 0.42, find the reflection coefficient.

2. Set up the differential equation for a one dimensional oscillator, subject to damping force proportional to velocity and an external periodic force. Derive the condition of resonance. How does the maximum amplitude at resonance depend on the damping constant? 3+5+2

3. (a) Describe with neat diagram, the Newton's ring arrangement for determination of wavelength of monochromatic light. Obtain an expression for the wavelength in terms of the diameter of the rings. 4+3

(b) Mention the conditions for production and observation of sustained interference pattern. 3

4. (a) Differentiate between Frasnel and Fraunhoffer diffraction. Find the conditions for the principal maximum and the secondary maxima in the single slit diffraction pattern. 2+5

(b) A plane diffraction grating has 5500 rulings per centimetre. Find the maximum order of the spectrum that can be observed if monochromatic light of wavelength 5800 Å is incident normally on the grating. 3

5. What do you mean by double refraction? Give the construction and working of Nicol prism. Explain its use as an analyser of polarised light. 2+5+3

6. (a) State Ampere's circuital law. Explain its modification due to the displacement current. Hence derive the corresponding Maxwell's electromagnetic equation. 2+2+3

(b) A vector field is given by $\vec{A} = \hat{i}2xy + \hat{j}x^2y + \hat{k}xyz$. Find the divergence and the curl of the vector at the point (1, 1, –1). 3

7. (a) Starting from Maxwell's electromagnetic equations in vacuum in the absence of any charge or current, derive the wave equations for the electric and magnetic fields. 7

(b) Show that for a scalar function $f(x, y, z)$, curl.grad.$f = 0$. 3

8. (a) State and explain Heisenberg's uncertainty principle. Illustrate with example. 5

(b) Mention the experimentaliy observed facts about photoelectric effect and the failure of the classical laws to explain them. Show how the Einstein's photoelectric equation explains them. 5
