*Total number of printed pages – 8* **B. Tech**

**BSCP 2101**

## Second Semester Examination – 2008

### 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 for the questions.*

1. Answer the following questions : 2 × 10

   (a) Two waves each of equal amplitude and equal frequency pass through a point in the medium in the same direction with phase difference of 60°. Calculate the amplitude of the resultant wave at this point.

   (b) Newton's ring experiment was conducted first in air medium then in water medium (i.e. water is inserted in between the plano-convex lens and glass plate.) What happens to the diameter of a particular ring ?

   (c) A particle is trapped in an infinite deep potential well has de Broglie wavelength $\lambda$ in the ground state. What is the wave-length of the particle in the next excited state ?

   (d) In a Nicol prism $\mu_E$ and $\mu_O$ are the refractive indices for E-ray and O-ray respectively. If $\mu_B$ is the refractive index of the Canada balsam, write a relation between $\mu_E$, $\mu_O$ and $\mu_B$.

   (e) In single slit diffraction pattern orange light is replaced by red light without changing the experimental setup. What will happen to the diffraction pattern ?

(f) The parallel plate capacitor has plates each of area $2m^2$ and the plates are separated by a dielectric of thickness 1 mm, dielectric constant 3. The potential difference and conduction current in the connecting wire at certain instant of time is 100 V and 2 mA respectively. Find out the displacement current flowing between the two plates of the capacitor.

(g) Prove that plasma frequency is approximately equal to $9\sqrt{N}$, where 'N' is the electron density in the plasma medium.

(h) Write down the time independent Schrödinger's equation for a free particle of mass m and energy E moving in XY-plane

(i) Compute the de Broglie wavelength of bike having mass 100kg and moving with speed 100km / hour.



(j) Explain why in potential step problem time independent Schrödinger's equation is taken.

2. (a) Give a comparison between conduction current and displacement current. 3

(b) Give a graphical comparison among the following four types of harmonic motions : 3

(i) Simple harmonic motion

(ii) Under damped harmonic motion

(iii) Over damped harmonic motion

(iv) Critically damped harmonic motion.

(c) How you will know with naked eye the given specimen is an ordinary glass piece or a grating ? 2

(d) The critical angle in certain substance is given to be 42°. Calculate the polarizing angle. 2

3. (a) What is the color of the central fringe in Young' double slit experiment when white light source is used ? 2

(b) The electric vector component of a plane electromagnetic vector propagating in a non-magnetic medium is given by $\vec{E} = \hat{y}\, 60\cos(10^8 t + 2z)\text{V/m}$ Symbols have their usual meanings. Find the relative permittivity of the medium and magnetic vector component of the wave. 4

(c) What do you mean by wave function ? What are the characteristic of wave function of matter wave ? 1+3

4. (a) Explain the presence of only odd numbered foci a zone plate. 3

(b) The shapes of the interference fringes obtained in Young's double slit experiment are actually hyperbolae. Derive an approximate expression for eccentricity of the hyperbolic fringe. 5

(c) The electric component vector of a plane electromagnetic wave propagating in a



nonmagnetic medium is given by $\vec{E} = \hat{y}\, 40\cos(10^8 t + 4z)\text{V/m}$. Find the direction of propagation. 2

5. (a) Describe in detail the construction and working of a Laurent's half-shade polarimeter. Explain how you would use it to determine the specific rotation of sugar solution. 6

(b) An electron is trapped completely in a one dimensional region of width 1 $\text{Å}$. How much energy must be supplied to excite the electron from ground state to first excited state ? 2

(c) How does quantum physics differs from classical physics in potential step problems. 2

6. (a) In Newton's ring experiment in laboratory sodium vapor lamp having two wavelengths 5890 $\text{Å}$ and 5896 $\text{Å}$ is used. If it is found that nth dark ring due to 5860 $\text{Å}$

coincides with (n+2)nd dark ring due to 5890 $\mathring{A}$, then calculate the radii of nth dark rings due to 5896 $\mathring{A}$ and 5890 $\mathring{A}$. The radius of curvature of the plano-convex lens used is 200 cm. 4

(b) Explain how displacement and velocity graph of a simple harmonic oscillator is elliptical. 3

(c) Derive a relation between magnitudes of electric vector and magnetic vector. 3

7. (a) A sodium vapour light containing two wavelengths 5890 $\mathring{A}$ and 5890 $\mathring{A}$ is incident normally on a plane transmission grating having 15000lines / inch. A lens of focal length 100 cm is used to observe the spectrum on a screen. Calculate the distance between the two lines in the first order spectrum. 5

(b) How can you get a scalar function from a vector field and how can you get a vector function from a scalar field ? Give physical examples of both the cases. 3



(c) An electromagnetic wave is propagating in a medium in such a manner that electric vector of the wave satisfies the differential wave equation $\nabla^2 E = \mu\varepsilon \frac{\partial^2 E}{\partial t^2}$. How much energy will be absorbed by the medium in 20 seconds ? 2

8. (a) If $\mu$ is refractive index of a potential step for the case $E > V_o$ then prove that the transmission coefficient for the incident particles $\left| \frac{4\mu}{(1+\mu)^2} \right|$. 4

(b) What is the physical significance of gradient of a scalar function ? 2

(c) Two simple harmonic oscillators of different masses oscillate separately under the action of same restoring force at frequencies 3Hz and 5Hz. Calculate the ratio of their masses. 2

(d) Distinguish between plane of polarization and plane of vibration. 2