Roll No. _____

Total No. of Questions : 5] [Total No. of Pages : 4

[2068]

B.E. I-Year I-Semester Examination, June-2008

PHYSICS

(Common to all branches of Engineering)

1E1003S

Time : 3 Hours **Maximum Marks : 80**

Minimum Passing Marks : 24

Instructions to Candidates:

*Attempt overall **5** questions selecting **One** question from each unit. All questions carry **equal** marks.*

Unit - I

1. i) What will be effect on Newton's rings if :

a) A little oil ($\mu = 1.65$) is introduced between the lens ($\mu = 1.5$) and the glass plate ($\mu = 1.75$),

b) A plane mirror is placed instead of the glass plate below the plano convex lens,

c) A plano-convex lens of small radius is used,

d) The plano convex lens is raised by height Δh from the surface of plane glass plate **(2+2+2+2=8)**

ii) Interference fringes are produced by monochromatic light falling normally on wedge shaped film of cellophase whose refractive index is 1.4. The angle of wedge is 40 seconds and distance between successive fringes is 1.25 mm. Calculate wave length of the light used. **(3)**

iii) Distinguish between plane, circuilarly and elliptically polarized light. How would you produce circularly polarized light. Draw necessary diagrams also **(5)**

1. b) i) With schematic diagram, explain the working of a Michelson interferometer. Obtain the expression for radii of circular interference fringes. How shall you use to measure wave length seperation between two closed spaced spectral lines. **(2+2+2+2=8)**

ii) A polaroid examines two adjescent plane polarized beams A and B whose plane of polarization are mutually perpendicular. In one position of the analyzer the beam B shows zero intensity. From this position, a rotation of 30^{o} shows that two beams have equal intensity. What is the ratio of intensity of two beams. **(3)**

iii) Give a schematic diagram of Babinet compensator. How elliptically polarized light is produced using a Babinet compensator. **(5)**

Unit - II

2. a) i) Discuss the phenomenon of Fraunhofer's differaction at a single slit and derive expression for the intensity of diffracted light. Show that the relative intensity of successive maxima are nearly $1 : \frac{9}{4\pi^2} : \frac{4}{49}\pi^2 .....$ **(2+3+3=8)**

ii) A grating has 9600 lines uniformly spaced over a width of 3.0 cm and is illuminated by light from mercury vapour lamp. Find

a) disperson in the third order in the vicinity of green line of wave length $5460\,\overset{o}{A}$,

b) resolving power of grating in fifth order **(2+2=4)**

iii) State the principle of holography. Discuss construction and reproduction of a hologram **(1+3=4)**

2. b) i) Give theory of plane transmission grating and show how will you determine wave length of light. **(6+2=8)**

ii) What must be minimum number of lines per cm in half inch width grating to resolve the D_1 and D_2 lines of sodium in the first order $\left(\lambda_{D_1} = 5896\,\overset{o}{A},\ \lambda_{D_2} = 5890\,\overset{o}{A}\right)$ **(4)**

iii) What is holographic microscopy. With illustrative diagram show outlay of a holographic microscope and explain its working. **(4)**

Unit - III

3. a) i) Explain coherence length and coherence time **(2+2=4)**

ii) What do yo understand by spontaneous emission and stimulated emission. Obtain a relation for Einstein coefficients A and B for spontaneous and stimulated emission. What are essential requirements for Laser action. **(2+4+2=8)**

iii) An optical fibre has refractive index of core to be 1.5 and the refractive index difference of core cladding to be 0.01. Determine numerical and maximum angle of acceptance. **(2+2=4)**

3. b) i) Show that visibility is a measure of degree of coherence. **(4)**

ii) What do you understand by population inversion. With help of energy level diagram explain how population inversion is achieved to He-Ne Laser. **(2+4=6)**

iii) What do you mean by numerical aperture of an optical fiber. Derive an expression for one numerical aperture of a step index optical fibre. **(2+4=6)**

Unit - IV

4. a) i) Write down Schrodinger's time dependent and time independent wave equations. Give physical significance of wave function **(2+2=4)**

ii) What do you mean by quantum mechanical tunnelling. Show that the tunning probability is given by the expression

$$T = \frac{1}{1+\left[\frac{U_0^2}{4(U_0-E)\,\mathrm{Sin}h^2\,\alpha a}\right]}$$

Where U_0 = height of the rectangular potential barrier. Draw graphs showing variation of T with particle energy E and barrier width *a*. **(2+4+2=8)**

iii) X-ray photon of wave length $0.3\,\mathring{A}$ is scattered through an angle of 60^O by a free electron. Find wave length of scattered photon and recoil energy of electron. **(4)**

4. b) i) The wave function of a particle in its ground state in one demensional box of length L is given by $\psi = \sqrt{\frac{2}{L}} \, Sin \, \frac{\pi n}{L}$. Calculate probability of finding the particle with in an interval of $1\,\mathring{A}$ at the centre of box of length $L = 10\,\mathring{A}$. **(4)**

ii) Write down basic postulates of sommerfield's free electron gas model. Show that the number of energy states per unit energy is given by $g(E) = \frac{4\pi V}{h^3} (2m)^{3/2} E^{\frac{1}{2}}$. What do you mean by Fermi energy level.

(3+4+1=8)

iii) With help of suitable diagrams explain the phenominon of Quantum mechanical tunneling in α–decay process. **(4)**

Unit - V

5. a) i) Give basic postulates of special theory of relativity. Derive Lorentz transformation equations. **(2+4=6)**

ii) In Laboratory frame of reference, particle A moves along X-direction with velocity 0.5c and particle B moves along Y - direction with velocity 0.4C. Determine velocity of particle B relative to A. **(4)**

iii) Give basic principle of Geiger-Muller counter. How quenching is achieved in Geiger-Muller counter. **(3+3=6)**

5. b) i) Show that mass of a body moving relativistic velocity $(v \sim c)$ is given by

$$m = m_o \Big/ \sqrt{1 - v^2/c^2}$$ **(4)**

ii) Show that $x^2 + y^2 + z^2 - c^2t^2$ is invarient under Lorentz transformations **(4)**

iii) An observer on the earth finds that a rocket takes $2\mu S$ to its entire length across a reference mark. If proper length of the rocket is 50 meter then what is its velocity relative to earth **(4)**

iv) Explain construction and working of a scintillation counter. **(4)**
