

- NOTE: i) All Questions are compulsory  
ii) Figures to the right indicate full marks  
iii) Use of non-programmable calculators is allowed

Q.1] Answer the following: -(Any Three)

[15Marks]

- a) A particle is subjected to two perpendicular SHM's  $x = A \cos \omega t$  and  $y = A \cos(\omega t - \frac{\pi}{4})$   
Find trajectory of the particle.
- b) Explain the concept of centre of mass of a system of particles.
- c) Define Simple Harmonic Motion. Show that a particle whose potential energy is  $\frac{1}{2} kx^2$  where  $k$  is a constant executes SHM.
- d) Four masses 1kg, 2kg, 3kg and 4kg are located at  $(-1, -2, 2)$ ,  $(3, 2, -1)$ ,  $(1, -2, 4)$  and  $(3, 1, 2)$  respectively. Find the centre of mass of this system.

Q.2] Answer the following: -(Any Three)

[15Marks]

- a) If the two lenses  $L_1$  &  $L_2$  of focal length  $f_1$  and  $f_2$  are placed coaxially parallel to each other along the optic axis then derive an expression for equivalent focal length of a combination.
- b) Explain the term "deviation in case of lens". Hence prove that the deviation does not depend on the position of object.
- c) With a suitable ray diagram, explain spherical Abberation of lens. State the method of reducing it.
- d) Describe how will you determine Refractive Index of prism using spectrometer.

Q.3] Answer the following: -(Any Three)

[15Marks]

- a) Draw labelled diagram of the following:  
i) Laser cutter and ii) A typical communication system
- b) Explain the following terms: i) Monochromaticity



### ii) Directionality

### iii) Coherence

#### iv) Intensity and Power

c) Explain recording of the Hologram.

d) Calculate the numerical aperture of a step index fibre for an optical fibre that have a core of refractive index 1.5 and cladding of index 1.48. also determine the maximum angle for entrance of light if the fibre is put in air

**Q.4] Answer the following: --(Any Three)**

**[15Marks]**

a) Determine :

i) The critical angle of reflection for core-cladding boundary and ii) The angle of the fiber.

Given : Refractive index of core = 1.5  
Refractive index of cladding = 1.4

Given : Refractive index of core =  $n_1 = 1.4$

Refractive index of cladding =  $n_2 = 1.3$

b) Give a brief account of lasers.

c) A particle is subjected to two parallel SHM's given by, and  $x_1 = 4 \sin\left(2\pi t + \frac{\pi}{2}\right)$  and  $x_2 = 3 \sin\left(2\pi t - \frac{\pi}{2}\right)$  in cm. Write the equation of the resultant SHM.

d) Two parallel simple harmonic motion described by

$$x_1 = A_1 \sin(\omega t + \phi_1) \quad \text{and} \quad x_2 = A_2 \sin(\omega t + \phi_2)$$

are superimposed on a particle. Show that the amplitude of the resultant SHM is equal to:

i)  $A_1 + A_2$  when the component...

i)  $A_1 + A_2$  when the component motions are in phase and

ii) A1-A2 when they are in opposite phase.

e) Explain Schuster's method.

f) Derive an expression for kinetic energy of a system of a particle in Centre of mass co-ordinate system.

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