

BACHELOR OF SCIENCE EXAMINATION , 2018 (OLD)

(Ist Year Year, 2nd Semester)

PHYSICS (Subsidiary)

Paper – S03

Time : Two Hours

Full Marks: 50

Answer any Five questions

1 a) What is simple Harmonic motion (SHM) ? Estimate the average kinetic and the potential energies for a particle executing SHM.

b) If the displacement of a particle at any instant is given by $x = a \cos \omega t + b \sin \omega t$, show that the motion of the particle is simple harmonic. [(1 + 3 + 3) + 3]

2(a) What is a plane progressive wave? Establish the differential equation that governs the propagation of one dimensional plane progressive wave.

(b) Obtain the expression for the velocity of a plane longitudinal wave propagating along a solid bar of Young's modulus Y .

c) Why sound waves cannot travel through vacuum? [(1+3) + 4 +2]

3(a) What are stationary waves? Show that the energy density in a stationary wave is twice than that of a progressive wave. Hence show that there is no transmission of energy in an ideal stationary wave.

(b) How you define the intensity level (IL) of a sound of intensity I . [(2+ 3 +3)+2]

4(a) Show that a stretched string of finite length and rigidly fixed at both ends can sustain only discrete mode of vibrations of certain frequencies.

(b) What is forced vibration? Set up the differential equation of a simple harmonic oscillator subjected to a damping force and external simple harmonic force. Solve the particular integral of the above equation to obtain the steady state solution of the above motion. [3 +2+2+3]

5 State and explain the Huygens principle of rectilinear propagation of light. What do you mean by a secondary source of light in this picture – explain with a diagram. Write down the lens-makers formula, clearly explaining the different sign conventions. What do you mean by the power of a lens and what unit is used to measure it?

[3 + 2 + 2+3]

6 State and explain Fermat's principle in the context of Geometrical Optics. Using Fermat's Principle as the guiding axiom, obtain the laws of refraction of light. (when it passes from a rarer to a denser medium). Define the "refractive index" μ of a medium. How does μ depend (if it does) on the wavelength of the light passing through the lens?

[2 + 6 + 2]

7 Write short Notes on (Any Two):

[5+ 5]

(a) Equivalent focal length of a system (or a combination) of lenses

(b) Dispersive power of a lens.

(c) Chromatic aberration in optical systems.

(d) The Doppler Effect.

8 (a) Let PQR be a right-angled prism (made out of a material whose refractive index $\mu = \sqrt{2}$, and right-angle being at the vertex Q). A parallel beam of light is incident from air at an angle α on the side PQ of the prism. The light undergoes total internal reflection in the prism at the face PR when α has a minimum value of 45° . Find the angle of the prism.

(b) What is the basic design of a telescope? What are the various types of telescopes in use today.

[7 + 3]