

Instructions to candidates

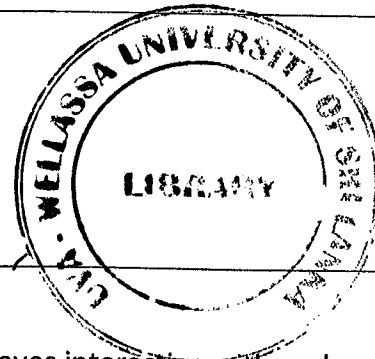
Duration: 02 hours

Number of questions: 04

Number of questions to be answered: 04

Mark allocation: 100

All symbols carry their usual meaning.



- 1.
- a. State the principle of superposition for two sinusoidal waves interacting with each other. (5 mark)
- b. Two sinusoidal waves travelling into the same direction (1-D) having displacements x_1 and x_2 with zero phase angle (i.e. $\phi = 0$) superpose with each other. Both waves are having same amplitudes (a) but different angular frequencies, ω_1 and ω_2 .
- i. Write the wave equations for displacements x_1 and x_2 in the sine form.
- ii. What is the resultant displacement X ?
- iii. Sketch the resultant wave in a graph X vs ωt and describe it.
- iv. Describe the situation when $\omega_1 = \omega_2$ (20 marks)
- 2.
- a. What is damped simple harmonic motion? (5 marks)
- b. Write the equation of motion for damped simple harmonic oscillator identifying all the parameters in the equation. (5 marks)
- c. By solving the equation, obtain an expression for the displacement $X (= x_1 + x_2)$ for a damped simple harmonic oscillator (all symbols have their usual meaning). (10 marks)

- d. For a damped oscillator with $m = 450 \text{ g}$, $k = 58 \text{ N/m}$, and $b = 80 \text{ g/s}$, calculate the period of the motion. How long does it take for the mechanical energy to drop to one-half its initial value?

(5 marks)

3.

- a. Explain the following concepts in light

(i) reflection, (ii) refraction, (iii) diffraction, (iv) interference, (v) dispersion

(10 marks)

- b. Give one example for each concept from the nature whose underlying principle are the phenomena you mentioned above.

(5 marks)

- c. State Huygen's principle for the propagation of wavelets.

(5 marks)

- d. One of the important properties of light is its speed. Design and explain an experiment to find the speed of light at home using readily available substances.

(5 marks)

4.

- a. Describe Young's double slit experiment. What kind of property of light is demonstrated by this experiment?

(10 mark)

- b. Derive an expression for θ to locate the 2nd order bright fringes in the interference pattern produced in a double slit experiment.

(5 marks)

- c. In a typical experiment, the light of wavelength of 546 nm is used to illuminate the first slit in the double slit experiment. If the slit separation is 12 mm and the double slit-screen separation is 55 cm , what is the distance on screen between adjacent maxima near the center of the interference pattern?

(5 marks)

- d. Explain how does Michelson Interferometer work with a diagram showing the instrument and the path of the light rays inside the instrument.

(5 marks)