

B. Sc. S.Y. (CBCS Pattern) Sem-IV
USPHT07 - Physics Paper-I (Waves, Acoustics & Laser)

P. Pages : 3

Time : Three Hours



GUG/S/19/12016

Max. Marks : 50

- Notes : 1. All questions are compulsory.
2. Draw neat and well labelled diagrams wherever necessary.

1. Either:

- a) i) State the principle of superposition of two waves. 1
- ii) Find the resultant of two S.H.Ms. at right angles to each other having period in the ratio 1:2 different amplitudes and α phase difference of zero or π radian between them. 3
- iii) Derive the resultant motion of the particle. When two simple harmonic motions having the same phase but slightly different frequencies along the same line. 3
- iv) Two SHMs acting simultaneously on a particle are given by the equations. 3
- $$y_1 = 2\sin(\omega t + \pi/6) \text{ and } y_2 = 3\sin\left(\omega t + \frac{\pi}{3}\right)$$
- Find the amplitude of resultant vibration.

OR

- b) a) What are Lissajous's figure? Describe the experimental arrangement to obtain Lissajous's figures using CRO. 2½
- b) Obtain an expression for the resultant of two S. H. Ms perpendicular to each other having frequencies are in the ratio 1:1. 2½
- c) State the applications of Lissajou's figures. 2½
- d) Describe an optical method for obtaining Lissajou's figures. 2½

2. Either:-

- a) i) Distinguish between transverse wave and longitudinal wave. 2
- ii) Derive an expression for the velocity of transverse waves on a string. 4
- iii) What are standing waves? State the characteristics of standing waves. 2
- iv) A string is stretched with a force of 500 N. Its linear mass density is 0.05 kg/m. One end of the string is oscillating with an amplitude fo 0.025 m and frequency 200 Hz, so that the travelling waves are set up in the positive X – direction. Calculate the velocity of the wave. 2

OR

- b) a) State Fourier's theorem obtain an expression for the Fourier's coefficients. 2½
- b) Discuss the application of Fourier's theorem for the analysis of a square wave. 2½
- c) Expand $f(x) = x$ for $-\pi < x < \pi$ in Fourier series. 2½
- d) What are the limitations of Fourier's theorem. 2½

3. Either:-

- a) i) What are ultrasonic waves? 1
- ii) What are the properties of Ultrasonic waves? 3
- iii) Explain the production of Ultrasonic waves using piezoelectric effect. 4
- iv) Calculate the fundamental frequency of Ultrasonic produced by a quartz crystal of thickness 0.5 mm. The value of Young's Modulus for quartz is 8×10^{11} dynes/cm² and density 2.65gm/cm³. 2

OR

- b) a) Derive Sabine's reverberation formula. 2½
- b) What are the requirements of good auditorium? 2½
- c) Explain the characteristics of musical sound. 2½
- d) A hall of volume 1000 m³ is found to have a reverberation time 2 second. If the area of sound absorbing surface is 350 m², calculate the average absorption coefficient. 2½

4. Either:-

- a) i) Explain the principle, construction and working of a Ruby laser. 6
- ii) What is difference between spatial and temporal coherence? 2
- iii) Find the coherence length of a laser source of monochromatic light with frequency width 10,000 Hz. 2

OR

- b) a) Explain spontaneous and stimulated emission. 2½
- b) What are the applications of lasers? 2½
- c) What is meant by the action of 'Pumping'? Give methods of optical pumping briefly. 2½
- d) For a red cadmium line of wavelength 6438Å and the coherence length 38 cm deduce the order of magnitude of a) coherence time and b) spectral width of the line. 2½

5. Solve **any ten** of the following.

- a) Draw graphically the resultant of two SHMs of the same frequency acting at right angles to each other with a phase difference of $\frac{\pi}{2}$ 1
- b) What are beats? 1
- c) What are the uses of Lissajous figures? 1
- d) What is progressive wave? 1
- e) Define the terms phase velocity and group velocity. 1
- f) Define wave intensity of wave. 1
- g) What is infrasonic wave? 1
- h) What are bel and decibel? 1
- i) Define reverberation time. 1
- j) What is coherence? 1
- k) What is the need of population inversion in laser? 1
- l) State the characteristics of laser beam. 1
