

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

P. Pages : 3

Time : Three Hours



**GUG/S/23/12016**

Max. Marks : 50

- Notes : 1. All questions are compulsory.  
2. Draw neat labelled diagram wherever necessary.

**Either:**

1. a) i) What are Lissajous' figures? 1
- ii) Find the resultant of two simple harmonic motions of equal frequency when they act at right angles to one another. Discuss the different important cases. 4
- iii) Explain the formation of Lissajous' figures by CRO. 2
- iv) Lissajous' figures are produced with two tuning forks whose frequencies are approximately in the ratio 2:1. It takes 6 seconds to go through a cycle of changes. On loading slightly, the fork of the higher pitch with was, the period of cycle is raised to 10 second. If the frequency of the lower fork is 150, what is the frequency of the other fork before and after loading? 3

**OR**

- b) i) What is the principle of superposition of waves? Give the conditions for interference of sound. 2½
- ii) Show that the frequency of beats is equal to the difference in frequencies of the sounding bodies with the help of Superposition of two SHMs having slightly different frequencies along same line. 2½
- iii) Give the applications of Lissajous's figure. 2½
- iv) Calculate the velocity of sound in a gas in which the waves of wavelength 50 cm and 50.5 cm produce 6 beats per second. 2½

**Either:**

2. a) i) State the characteristics of progressive waves. 2
- ii) Derive wave equation of standing waves on a stretched string. 4
- iii) Define phase velocity and group velocity. Obtain the relationship between phase velocity and group velocity. 4

**OR**

- b) i) What is progressive wave? Derive an equation of velocity of transverse waves on stretched string. 2½

ii) A sonometer wire has a mass of 0.002 kg/meter and tension of 20 newton is applied on it. When the length of the wire is 0.125 meter between the bridges, a tuning fork produces 8 beats per sec. with it if the length of the wire be increased by a small amount, the number of beats is reduced. Compute the frequency of fork. 2½

iii) State Fourier's Theorem and give its coefficients. 2½

iv) Find out Fourier series of saw tooth wave using Fourier's Theorem. 2½

**Either:**

3. a) i) What are ultrasonic waves? 1
- ii) Explain the production of ultrasonic waves using piezo - electric crystals. 4
- iii) Explain the applications of ultrasonic waves. 3
- iv) Calculate the fundamental frequency of ultrasonics produced by quartz crystal of thickness 0.5 mm. The value of Young's modulus for quartz is  $8 \times 10^{11}$  dynes/cm<sup>2</sup> and density 2.65 gm/cm<sup>3</sup> 2

**OR**

- b) i) Distinguish between noise and music. 2½
- ii) Explain Bel and Decibel. 2½
- iii) What is reverberation and reverberation time? 2½
- iv) Give the requirements of good auditorium. 2½

**Either:**

4. a) i) Define following terms. 3
- a) Population inversion.
- b) Pumping
- c) Active system.
- ii) Explain the construction and working of Ruby laser by drawing suitable diagrams. 5
- iii) Imagine that we chop a continuous laser beam (assumed to be perfectly monochromatic  $\lambda_0 = 623.8\text{nm}$ ) into 0.1ns pulses using some sort of shutter. Compute the coherence length and band width. 2

**OR**

- b) i) Explain Temporal Coherence and Spatial Coherence. 2½
- ii) Derive Einstein's coefficient relation. 2½
- iii) Explain the construction and working of Semiconductor Laser. 2½

iv) Write applications of lasers in any three fields. 2½

5. Attempt **any ten** questions from the following.

- a) Write conditions for interference of sound. 1
- b) Define Beat. 1
- c) Calculate the number of beats heard per second if there are two sources of sound of frequencies 400 Hz and 402 Hz of equal intensity sounded together. 1
- d) What are Normal Modes of Vibration of string? 1
- e) What is wave Intensity? 1
- f) Write any two limitations of Fourier's theorem. 1
- g) Write properties of ultrasonic waves. 1
- h) Give the characteristics of musical sound 1
- i) What is Echo? 1
- j) What do you mean by LASER? 1
- k) For a source radiating at mean wavelength  $6000 \text{ \AA}$ , the coherence time is  $2 \times 10^{-10} \text{ sec}$ . Determine coherence length L. 1
- l) What is stimulated emission? 1

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