

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

P. Pages : 3

Time : Three Hours



GUG/S/25/12016

Max. Marks : 50

- Notes :
1. All questions are compulsory.
 2. Draw neat and well labeled diagrams wherever necessary.
 3. Scientific calculator is allowed.

Either:

1. A) i) Derive an expression for the resultant displacement due to superposition of two S.H. Ms. of the same frequency, acting at right angles to each other with different amplitude and having a phase difference of ϕ . Discuss the special cases, when phase angle is 0 and $\pi/4$. **6**
- ii) Discuss the method to determine unknown frequency of an a.c. source with the method of Lissajous' figures by using C.R.O. **2**
- iii) In an electrical experiment on Lissajous' figures, if the frequency of known a.c. source is 200 Hz and the Lissajous' figures obtained has a shape of three horizontal loops. Find the frequency of unknown source. **2**

OR

- B) a) Explain the formation of Lissajous' figures in laboratory by optical method. **2½**
- b) Show that the resultant of two S. H. Ms. at right angles to each other having equal period and equal amplitude but phase difference of 90° is a circle. **2½**
- c) A particle is subjected simultaneously to two S.H. Ms. of different amplitudes and period in the ratio 1:2 acting right angles to each other. Find the expression for the resultant motion when the phase difference between them is 0° . **2½**
- d) A tuning fork A produces 3 beats per second with a tuning fork B of frequency 512Hz. When a small quantity of wax is applied to the prongs of fork A, the number of beats per second becomes 2. What is the natural frequency of tuning fork A? **2½**

Either:

2. A) i) State Fourier's Theorem. Write the Fourier's series for a complex periodic function. Evaluate the constants A_0 and coefficients A_n and B_n . **6**
- ii) Obtain the Fourier's series for square wave in which the displacement y varies according to the conditions:
 $y = f(t) = a$ from $t = 0$ to $t = T/2$
 $y = f(t) = 0$ from $t = T/2$ to $t = T$ **4**

OR

- B) a) Distinguish between progressive waves and standing waves. 2½
- b) Obtain a relation between phase velocity and group velocity. 2½
- c) Deduce an expression for the velocity of transverse wave in a string. 2½
- d) Find the amplitude, frequency, velocity and wavelength of the transverse wave in a string represented by:
 $y = 5 \sin 2\pi(t - 0.04x)$ in SI units 2½

Either:

3. A) i) What are ultrasonic waves? Explain with diagram the Piezoelectric method to produce ultrasonic waves. 5
- ii) What is SONAR system? Explain its working with neat diagram. 5

OR

- B) a) Describe the different characteristics of musical sound. 2½
- b) Explain the important requirements of good acoustics of a hall. 2½
- c) Derive Sabine's formula for the reverberation time. 2½
- d) A class room of size $5 \times 6 \times 10$ meters and has a reverberation time of 1.6 seconds. Find the total sound absorption of the class room. 2½

Either:

4. A) i) Explain the terms: 6
- 1) Absorption
- 2) Spontaneous emission
- 3) Stimulated emission
- ii) Discuss with suitable diagram the principle of construction and working of Ruby laser. 4

OR

- B) a) Discuss in detail the terms (1) temporal coherence and (2) spatial coherence. 2½
- b) What is the need of population inversion in laser? 2½
- c) State and explain important characteristics of a laser beam. 2½
- d) Coherence length of sodium D_2 line is 2.5cm and its wavelength is 5892 \AA . Calculate the coherence time and purity of spectral line. 2½

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

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| a) Give any two applications of Beats. | 1 |
| b) What is SHM? | 1 |
| c) What is the principle of superposition of wave? | 1 |
| d) What are normal modes of vibration of string? | 1 |
| e) What is Intensity of an acoustic wave? | 1 |
| f) State the limitations of Fourier's Theorem. | 1 |
| g) Distinguish between noise and musical sound. | 1 |
| h) What is bel and decibel? | 1 |
| i) What is an echo? | 1 |
| j) State the different types of lasers on the basis of material used. | 1 |
| k) Define 'purity of a spectral line'. | 1 |
| l) Write any two applications of lasers in medicine. | 1 |
