

2125

B.A./B.Sc. (General) First Semester  
Physics

Paper – B: Vibrations, Waves and E.M. Theory - I

Time allowed: 3 Hours

Max. Marks: 44

**NOTE:** Attempt five questions in all, including Question No. 7 (Unit-III) which is compulsory and selecting two questions each from Unit I - II. Use of non-programmable calculator is allowed.

x-x-x

UNIT -I

1. What are damped vibrations? Derive expression for displacement in case of damped oscillatory motion. Discuss the case of critical damping. 9
2. (a) Show that total energy of a body executing SHM is directly proportional to square of the frequency.  
(b) At what distance from mean position, the kinetic energy is equal to potential energy of SHM. 6,3
3. (a) Explain the formation of Lissajous figures for two SHM of different amplitudes having periods in the ratio 1:2, when phase difference of vibrations are 0 and  $\pi/2$   
(b) What is relaxation time? How is it related to damping coefficient? 6,3

UNIT -II

4. (a) Discuss the oscillations of two pendulums coupled through a spring of stiffness  $S$  and write the equations of motion of the system in different cases.  
(b) Show that the maximum displacement amplitude of a forced oscillator having damping constant  $r$  driven by the force  $F = F_0 \cos \omega t$  is given by

$$A_{\max} = \frac{F_0}{\omega' r} \quad \text{where} \quad \omega' = \sqrt{\frac{S}{m} - \frac{r^2}{4m^2}} \quad 6,3$$

5. What is a forced oscillator? Derive an expression for velocity of a forced oscillator. Discuss variation of velocity amplitude with driving force frequency and show its behavior graphically. 9

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6. (a) Find expression for the quality factor of a forced oscillator in terms of resonance absorption band width.  
(b) Show that the total energy dissipated over one cycle in a forced oscillator is proportional to the square of amplitude. 6,3

### UNIT -III

7. Attempt any eight parts:

- (a) What are the equivalents of stiffness and mass in electrical oscillators?
- (b) What is logarithmic decrement?
- (c) What is the difference between free and forced vibrations?
- (d) Give example of inductive coupling?
- (e) What is restoring force?
- (f) Define torsional pendulum?
- (g) Define mechanical impedance of a forced oscillator?
- (h) Explain the cause of damping?
- (i) Can there exist a circuit of zero quality? Explain.
- (j) The marching troops are asked to break their steps while crossing the bridge. Why?

1\*8=8

x-x-x