

VIBRATION AND WAVES - I (A)

(Syllabus May, 2014)

Time : Three Hours]

[Maximum Marks : 40

Note : Attempt two question each from Section A and B carrying 8 marks each, and the entire Section C consisting of 8 short answer type questions carrying 1 mark each.

Section - A

1. What are Damped oscillations ? Discuss the case of lightly damped oscillations in an electrical oscillator. 8
2. What is compound pendulum ? Derive an expression for its time period, What is the condition for time period to be minimum ? 8
3. Define Quality factor of a damped oscillator. Derive its expression for an electrical oscillator. Establish a relation between quality factor and logarithmic decrement. 8
4. (a) Prove that average kinetic energy of a harmonic oscillator is equal to its average potential energy, and each is equal to half the total energy. 5
(b) An inductor, capacitor and resistor of value 0.2 H , $1 \mu\text{F}$ and 800Ω are connected in series. Show that the circuit is oscillatory, and calculate the frequency of oscillations. 3

Section - B

5. Derive an expression for velocity of a forced oscillator. Explain its behaviour in magnitude and phase *versus* driving force frequency. 8
6. Explain the behaviour of displacement *versus* driving force frequency, and show that displacement resonance occurs at a frequency slightly less than the frequency of velocity resonance. 8
7. (a) Show that the bandwidth of resonance absorption curve defines the phase angle range $\tan \phi = \pm 1$. 6
(b) What is meant by Inertia controlled and Stiffness controlled oscillator ? 2
8. Find an expression for the average power supplied by the driving force and the average power dissipated by the damping force of a forced oscillator. Show that both are equal. 3

Section - C

9. Answer all the following :
 - (a) What is the difference between Forced and Resonant vibrations ?
 - (b) The amplitude of a simple harmonic oscillator is doubled. How does this affect the total energy ?
 - (c) What is the effect of damping on the natural frequency of an oscillator ?
 - (d) How is the restoring force of a spring related to its potential energy ?
 - (e) What is the relation between Bandwidth and Quality factor of a forced oscillator ?
 - (f) Is energy stored in a forced oscillator ?
 - (g) What is meant by Mechanical impedance of a forced oscillator ? What are its units ?
 - (h) What is Resonance absorption curve. (8×1=8)