(i) Printed Pages : 4] Roll No. .....

(ii) Questions : 7] **Sub. Code : 0047**

Exam. Code : 0001

B.A./B.Sc. (General) 1st Semester Examination

1127

PHYSICS

(Vibrations, Waves and E. M. Theory–I)

Paper : B

Time : 3 Hours] **[Max. Marks : 44**

Note :– (i) Attempt *five* questions in all, selecting *two* questions each from Unit I, II and Unit III is compulsory.

(ii) Use of non-programmable calculator is allowed.

Unit–I

1. (a) What is a compound pendulum ? Derive an expression for its time period. What is the condition for time period to be minimum ?

(b) At what displacement will the kinetic energy and potential energy be equal in a simple harmonic oscillator ? 7,2

2. What are damped vibrations ? Derive expression for displacement in case of damped oscillatory motion. Discuss the case of critical damping. 9

3. (a) Write and solve the differential equation for damped electrical LCR circuit and discuss the case of oscillatory discharge of capacitor.

   (b) The mass of 1 kg is suspended from a spring of stiffness constant $25 Nm^{-1}$. If the frequency of natural oscillations be $2/\sqrt{3}$ times the frequency of damped oscillations, find the damping constant. 6,3

Unit–II

4. (a) Discuss the driving force frequency behaviour with velocity and displacement.

   (b) Show that in the rasonant LCR circuit, the maximum potential drop across an inductor occurs at a frequency :

$$\omega = \frac{\omega_0}{\left[1 - \frac{1}{2Q^2}\right]^{1/2}}$$

6,3

5. (a) Distinguish between transient and steady state in a forced oscillator. Explain the transient and steady state behaviour of a mechanical oscillator driven by a force $F = Fo e^{i\omega t}$.

(b) A damped oscillator consisting of mass 0.2 kg, damping constant 4 $Nm^{-1}s$, spring constant 80 Nm^{-1} is driven by force $F = 6 \cos 30t$ Newton. Calculate the average power dissipated. 6,3

6. (a) Two LC circuits are coupled by mutual inductance. Discuss the behaviour of the coupled system and find the frequency of oscillation of the system. What is the effect if the coupling is loose or tight ?

(b) Show that the total energy dissipated over one cycle in a forced oscillator is proportional to the square of the amplitude. 6,3

Unit–III

7. Attempt any *eight* parts :

(a) What is dampling ? On what factors the damping depends ?

(b) The amplitude of simiple harmonic oscillator is doubled. How does this affect the total energy of the oscillator ?

(c) An inductor, capacitor and resistor of values 0.2 H, 1μF and 800Ω are connected in series. Calculate the frequency of oscillations.

(d) Are all periodic motion SHM ? Explain.

(e) What is importance of normal modes of vibration ?

(f) Is the transformer loose or tight coupled if it has mutual inductance of two coils as 0.3 H, self-inductance of primary and secondary as 0.28 H and 0.36 H respectively.

(g) What are free oscillations and rasonant oscillations ?

(h) Is energy stored in the forced oscillator ? Explain.

(i) What is meant by inertia controlled and stiffness controlled oscillator ?

(j) What determines the natural frequency of an oscillator ? 8