

(i) Printed Pages : 3

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(ii) Questions : 7

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Exam. Code : 

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B.A./B.Sc. (General) 1<sup>st</sup> Semester

1125

PHYSICS

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

Time Allowed : Three Hours]

[Maximum Marks : 22

- Note : (i) Attempt five questions in all, selecting two questions each from Units I and II. Unit III is compulsory.
- (ii) Use of non-programmable calculator is allowed.

UNIT—I

- I. (a) Show that the total energy of a body executing S.H.M. is directly proportional to the square of the frequency.
- (b) If  $x = a \cos \omega t + b \sin \omega t$ , show that it represents S.H.M. Also find the amplitude of S.H.M. 3, 1½
- II. What are damped vibrations ? Derive expression for displacement in case of damped oscillatory motion. Discuss the case of critical damping. 4½
- III. (a) What is meant by logarithmic decrement and quality factor of a damped Simple Harmonic oscillator ? Deduce their expressions.
- (b) What is the effect of damping on the natural frequency of an oscillator ? 3, 1<sup>1</sup>

## UNIT—II

- IV. (a) Derive expression for the velocity of a forced oscillator. Discuss the variation of velocity amplitude with driving force frequency and show its behaviour graphically.
- (b) Show that the maximum displacement amplitude of a forced oscillator having damping constant  $r$  and driven by the force  $F = F_0 \cos \omega t$  is given by :

$$A_{\max} = \frac{F_0}{\omega' r} \quad \text{where } \omega' = \sqrt{\frac{s}{m} - \frac{r^2}{4m^2}} . \quad 3, 1\frac{1}{2}$$

- V. (a) Find expression for the quality factor of a forced oscillator in terms of resonance absorption band width.
- (b) Find the frequency of a circuit containing inductance of  $5 \times 10^{-2} \text{ H}$  and a capacitance of  $5 \times 10^{-10} \text{ F}$ . Find the wavelength of the radiowaves to which it will respond.  $3, 1\frac{1}{2}$
- VI. (a) Explain the transfer of energy between two electrical circuits which are inductively coupled. When the coupling is loose or tight?
- (b) Define normal mode, normal co-ordinates and degrees of freedom of an oscillatory system.  $3, 1\frac{1}{2}$

## UNIT—III

VII. Attempt any **six** parts :

- (a) The marching troops are asked to break their steps while crossing the bridge. Why ?
- (b) What are forced oscillations ?

- (c) What is stiffness controlled forced oscillator ?
- (d) What are units of damping constant ?
- (e) A mass of 1 kg is attached to a spring of stiffness constant  $16 \text{ Nm}^{-2}$ . Find its natural frequency.
- (f) What is mechanical impedance of a forced oscillator ?
- (g) What do you mean by inductive coupling ?

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