(i) Printed Pages: 3 Roll No. .....

(ii) Questions : 7 Sub. Code : 0047

Exam. Code : 0001

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

1128

PHYSICS

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

Time Allowed : Three Hours] [Maximum Marks : 22

Note :— (1) Attempt **five** questions in all, selecting **two** questions each from Section-A and B. Section-C is compulsory.

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

SECTION—A

I. (a) Discuss composition of two SHM perpendicular to each other and periods are in the ratio 1 : 2.

(b) A body stands on a platform which vibrates simple harmonically in a vertical direction at a frequency of 5 Hz. Show that the body loses contact with the platform when displacement exceeds 10^{-2} meters. 3,1.5

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

(b) Find the frequency and quality factor of a circuit having L = 2 mH, C = 5 μF and R = 0.2 ohm. 3,1.5

III. What is a compound pendulum ? Derive an expression for its time period. What is the condition for time period to be a minimum ? 4.5

SECTION—B

IV. (a) Find expression for the quality factor of a forced oscillator in terms of resonance absorption band width.

(b) What is mechanical impedance of a forced oscillator ? Write expression for it, explaining the meaning of each term. 3.5,1

V. (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 in a resonant LCR circuit, the maximum potential drop occurs across the capacitor at a frequency :

$$w = w_0\sqrt{1-\frac{1}{2Q^2}}$$

where $w_0 = \frac{1}{\sqrt{LC}}$ and $Q = \frac{w_0 L}{R}$. 2.5,2

VI. Write down the equation of motion of a forced oscillator being driven by an alternating force F_0 cos wt. Explain its steady state behaviour and hence describe the behaviour of displacement versus driving force frequency. 4.5

SECTION—C

VII. Attempt any **eight** parts :

(a) Explain the role of restoring force and inertia in SHM.

(b) A mass of 1 kg is attached to a spring of stiffness constant 25 Nm^{-1}. Find the natural frequency.

(c) How the logarithmic decrement is related to quality factor ?

(d) Is energy stored in a forced oscillator ? Explain.

(e) What is meant by transient state of a forced harmonic oscillator ?

(f) What is the effect of damping on the natural frequency of an oscillator ?

(g) Why does an LC circuit usually produce damped oscillations ?

(h) Why the glass windows may be broken by the far away explosion ?

(i) Is the transformer loose or tight coupled, whose mutual inductance is 0.3 H and self inductance of primary and secondary are 0.25 H and 4.0 H respectively ?

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

$\frac{1}{2} \times 8 = 4$