Roll No. ..... Total Pages : 3

BT-6/M-13 **8641**

MECHANICAL VIBRATION

Paper : ME-306(E)

Opt. (i)

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *five* questions in all, selecting at least *one* question from each unit.

UNIT–I

1. (a) A body is subjected to two harmonic motions as given below :

$x_1 = 15 \sin(\omega t + \pi/6)$ and $x_2 = 8 \cos(\omega t + \pi/3)$.

What harmonic motion should be given to the body to bring it to equilibrium ? (12)

(b) If there is a non-zero number y such that $\phi(t + y) = \phi(t)$, what is the type of motion $\phi(t)$? State its most important characteristics. (8)

2. (a) A force $P_0 \sin \omega t$ acts on a displacement $x_0 \sin(\omega t - \pi/6)$ where $P_0 = 25$ N, $x_0 = 0.05$ m and $\omega = 20\pi$ rad/sec. What is the work done during the first second ? 12

(b) Explain the following terms :
Forced vibration, Resonance, Damping, and Fundamental mode of vibration. 8

UNIT–II

3. For measuring the frequency of vibration of a system, a Frahm's Reed tachometer is to be designed. A mass of 0.01 kg is to be placed at the end of one of the reeds so that the reed is in resonance at 15 Hz. The steel reed is 40 mm long and 3 mm wide. Determine the thickness of the reed. Take $E = 2 \times 10^{11}$ N/m^2.

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4. An aircraft radio weighing 118 N is to be isolated from engine vibrations ranging in frequencies from 1600 to 2200 cpm. What static deflection must the isolator have for 85% isolation ?

UNIT–III

5. Using Holzer method, find the natural frequencies of the system shown in Fig. 1.

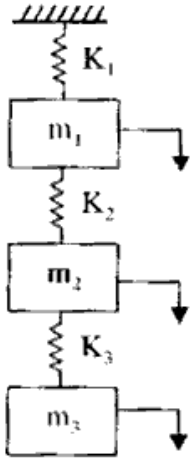

Fig. 1.

Take $m_1 = m_2 = m_3 = 1$ kg.

$K_1 = K_2 = K_3 = 1$ N/m.

6. The vibrations of a cantilever are given by

$$y = y_L \left[1 - \frac{\cos \pi x}{2L}\right],$$

where y_L = amplitude of vibration at free end.

Calculate frequency by Rayleigh's method.

Take $E = 2 \times 10^{11}$ N/m^2, $I = 0.02$ m^4, mass $= 6 \times 10^4$ kg, and length $L = 30$ m.

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UNIT–IV

7. Find frequency equation of a uniform beam fixed at one end and free at the other for transverse vibrations.

8. The rotor of a turbo super charger of mass 9 kg is keyed to the centre of a 25 mm diameter steel shaft 40 cm between bearings. Determine

   (a) The critical speed of the shaft.

   (b) The amplitude of vibration of the rotor at a speed of 3200 r.p.m., if the eccentricity is 0.015 mm.

   (c) The force transmitted to the bearings at this speed.

   Assume the shaft to be simply supported and that the shaft material has a density of 8×10^3 kg/m^3. Take $E = 2.1 \times 10^{11}$ N/m^2.
