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BIMEE-008

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00741

December, 2015

BIMEE-008 : MECHANICAL VIBRATION

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. Define any ***four*** of the following terms : $4 \times 3\frac{1}{2} = 14$

(a) Free vibration

(b) Forced vibration

(c) Periodic motion

(d) Degree of freedom

(e) Natural frequency

2. A machine of mass m = 500 kg is mounted on a simply supported steel beam of length l = 2 m having a rectangular cross-section (depth = 0·1 m, width = 1·2 m) and Young's modulus E = $2{\cdot}06 \times 10^{11}$ N/m^2. To reduce the vertical deflection of the beam, a spring of stiffness k is attached at the mid-span, as shown in Figure 1. Determine the value of k needed to reduce the deflection of the beam by (a) 25% of its original value, (b) 50% of its original value, and (c) 75% of its original value. *14*

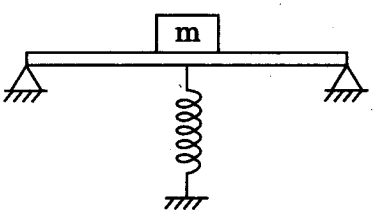

Figure 1

3. (a) Find the sum of the two harmonic motions $x_1(t) = 10 \cos(\omega t)$ and $x_2(t) = 15 \cos(\omega t + 2)$. *7*

(b) A cantilever beam carries a mass M at its free end as shown in Figure 2. A mass m falls from a height h onto the mass M and adheres to it without rebounding. Determine the resulting transverse vibrations of the beam. 7

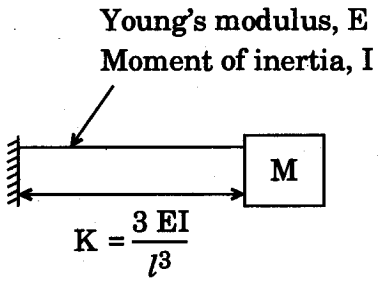

Figure 2

4. Find the equation of motion of the uniform rigid bar OA of length l and mass m shown in Figure 3. Also find its natural frequency. *14*

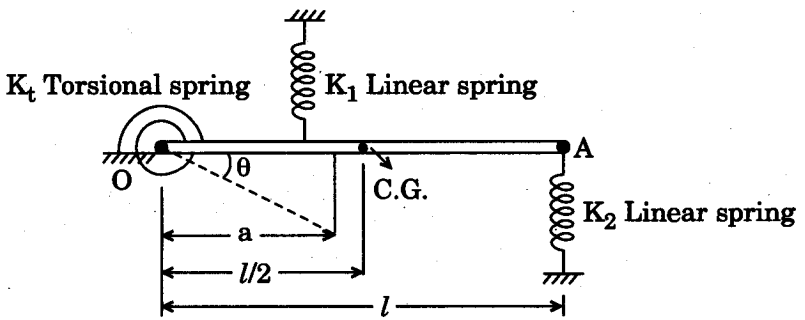

Figure 3

5. Find the total response of a single degree of freedom system with m = 10 kg, C = 20 Ns/m, K = 4000 N/m, x_0 = 0·01 m and $\dot{x}_0$ = 0 under the following conditions : *14*

(a) An external force $F(t) = F_0 \cos \omega t$ acts on the system with F_0 = 100 N and ω = 10 rad/s.

(b) Free vibration with F(t) = 0.

6. Write the equations of motion for the response of a damped system under harmonic force and derive the expression for 'Magnification factor'. Also give the main characteristics of the magnification factor. *14*

7. (a) Determine the equations of motion and the natural frequencies of the system shown in Figure 4. *10*

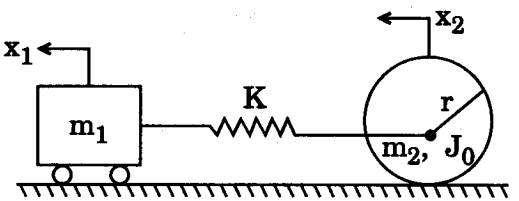

Figure 4

(b) What is critical speed of a shaft and what is its significance ? *4*

8. Find the natural frequencies of the tapered cantilever beam shown in Figure 5, using deflection shape $W(x) = \left(1 - \frac{x}{l}\right)^2$. Apply Rayleigh-Ritz method. *14*

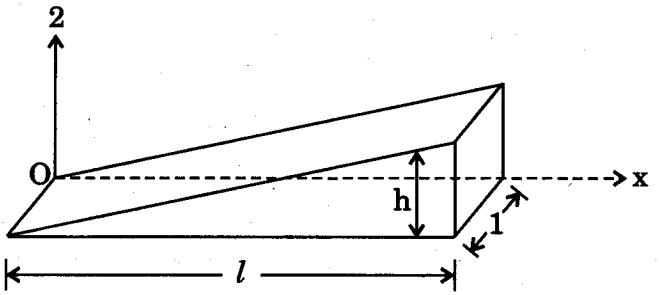

Figure 5