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**BIMEE-008**

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

00043 **Term-End Examination**

**December, 2016**

## 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.** (a) What is vibration ? Discuss the main causes of vibration. How do you reduce (or) eliminate the undesirable vibrations ? 7

(b) A force $P_0 \sin(\omega t)$ acts on a displacement

$x_0 \sin(\omega t - \frac{\pi}{6})$,

where

$P_0 = 25$ N

$x_0 = 0{\cdot}05$ m and $\omega = 20\,\pi$ rad/sec.

What is the work done during

(i) the first second ?

(ii) the first 1/40 second ? 7

2. (a) Derive the differential equation of a spring-mass system. 7

(b) Find the mass m such that the system has a natural frequency of 10 Hz for the given spring-mass system as shown in Figure 1. Given : $K_1$ = 2000 N/m, $K_2$ = 1500 N/m, $K_3$ = 3000 N/m, $K_4 = K_5$ = 500 N/m 7

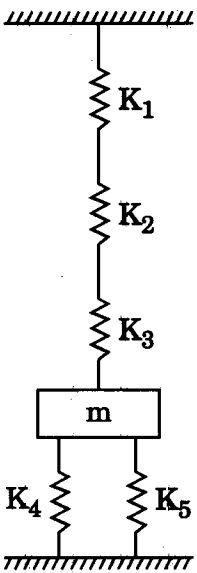



*Figure 1*

3. (a) What are the different types of damping ? Explain any one with neat sketch. 7

(b) The springs of an automobile trailer are compressed 0·1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude of 0·08 m and wavelength of 14 m. What will be the amplitude of vibration at 60 km/hr ? 7

4. (a) Briefly explain the vibration isolation and transmissibility with suitable sketch. 7

(b) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0·3, determine

(i) the amplitude caused by the unbalance and its phase angle,

(ii) the transmissibility, and

(iii) the actual force transmitted. 7

5. (a) Derive an expression for the natural frequency and amplitude ratios for the system as shown in Figure 2. 7

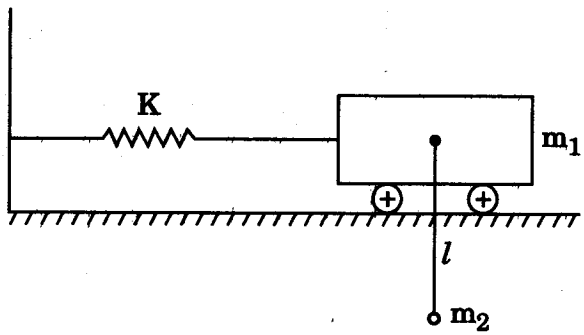
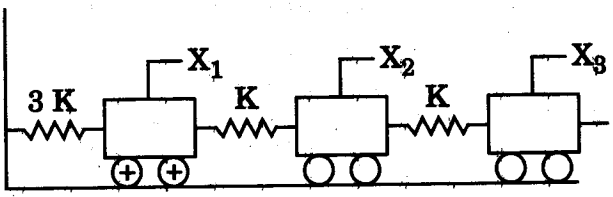



*Figure 2*

(b) Determine the natural frequency of torsional vibrations of a shaft with two circular discs of uniform thickness at the ends. The masses of the discs are $M_1$ = 500 kg and $M_2$ = 1000 kg. The outer diameters are $D_1$ = 125 cm and $D_2$ = 190 cm. The length of the shaft is $l$ = 300 cm and its diameter d = 10 cm. Modulus of rigidity for the material of the shaft G = $0{\cdot}83 \times 10^{11}$ N/m$^2$. 7

6. (a) A three degrees of freedom system is schematically shown in Figure 3. Write down its differential equation of motion by Newton's second law. Put the equation in matrix form. 7




Three degrees of freedom system

*Figure 3*

(b) Use Dunkerley's method to find the fundamental natural frequency of transverse vibration for the system as shown in Figure 4. 7

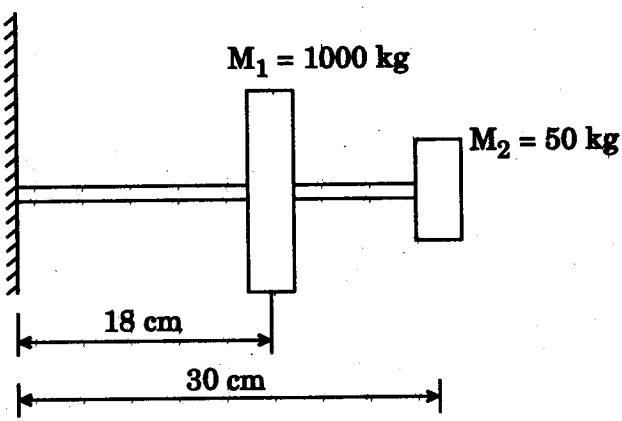



*Figure 4*

7. Write short notes on the following : $4 \times 3\frac{1}{2} = 14$

(a) Multi-disc Shafts

(b) Stodola Method

(c) Dry Friction Damper

(d) Vibration Measuring Instruments