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BIMEE-008

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

Term-End Examination

00973 **June, 2018**

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) Simple harmonic motion

(b) Free and forced vibrations

(c) Resonance

(d) Damping

(e) Natural frequency

(f) Phase difference

2. (a) Explain the energy method for determining natural frequency in single degree of freedom system. 7

(b) Calculate the natural frequency of vibration of a torsional pendulum as shown in figure 1 with the following dimensions :

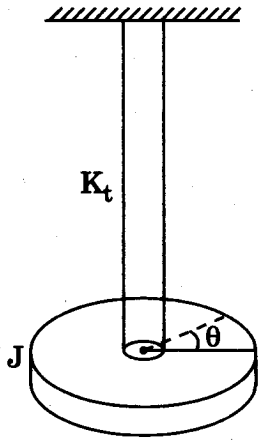

Figure 1

Length of rod l = 1 m

Diameter of the rod d = 5 mm

Diameter of rotor D = 0·2 m

Mass of rotor M = 2 kg

The modulus of rigidity for the material of the rod may be assumed to be $0{\cdot}88 \times 10^{11}$ N/m^2. 7

3. (a) Write down the differential equation of motion of the inclined spring-mass system as shown in figure 2. 7

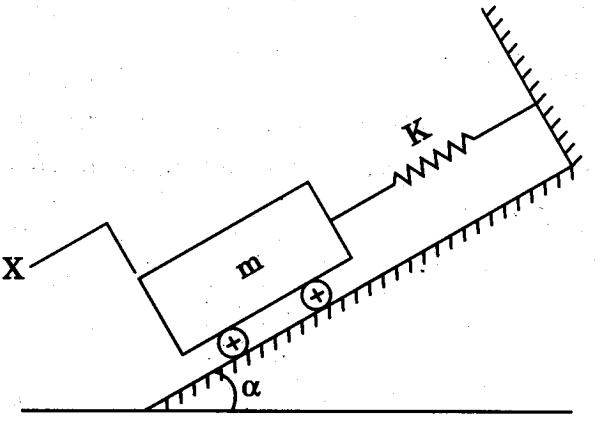

Figure 2

(b) How do you classify vibration measuring instruments ? Explain any one type with the help of neat sketch. 7

4. (a) Name different types of damping. Explain any one type with neat sketch. 7

(b) A horizontal spring-mass system with coulomb damping has a mass of 5 kg attached to a spring of stiffness 980 N/m. If the coefficient of friction is 0·025, calculate

(i) the frequency of free oscillations,

(ii) the number of cycles corresponding to 50% reduction in amplitude if the initial amplitude is 5·0 cm, and

(iii) the time taken to achieve this 50% reduction. 7

5. (a) Describe the function of centrifugal pendulum absorber with neat 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

6. (a) Describe the torsional vibration of a multi-degree rotor system with the help of suitable sketch. 7

(b) A horizontal spring-mass system subjected to dry friction damping has the following data :

Mass = 8·7 kg

Spring constant of the spring = 7550 N/m

Coefficient of friction between mass and the horizontal plane on which it slides = 0·22. The mass is subjected to sinusoidal forcing function of amplitude 19·6 N and frequency 5 Hz. Find the amplitude of vibration of the mass. Also calculate the equivalent viscous damping. 7

7. (a) A three-rotor system has the following data as shown in figure 3 :

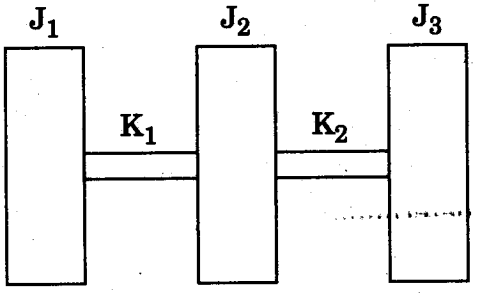

Figure 3

$J_1 = 4{\cdot}90$ kg-m^2

$J_2 = 9{\cdot}80$ kg-m^2

$J_3 = 6{\cdot}86$ kg-m^2

$K_1 = 2{\cdot}16 \times 10^5$ N-m/rad

$K_2 = 0{\cdot}78 \times 10^5$ N-m/rad

Find the natural frequency of the system. 7

(b) Describe the primary and secondary critical speed of the shaft with suitable sketch. 7