Total No. of printed pages = 4

ME 181701

Roll No. of candidate | | | | | | | | | | |

1572/22 2021

B.Tech. 7th Semester End-Term Examination

VIBRATION OF MECHANICAL SYSTEM

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *three* from the rest.

1. (a) A harmonic motion has an amplitude of 0.05 m and a frequency of 25 Hz. Find the time period, maximum velocity and maximum amplitude. (5)

   (b) A body perform simultaneously the motions

   $x_1 = 1.90 \sin 9.5t$

   $x_2 = 2.00 \sin 10.0t$ (5)

   The units being mm, radium and seconds. Find the maximum and minimum amplitude of the combined motion and time period of the resulting motion.

2. (a) Find the natural frequency of the following free undamped vibration. (10)

Mass of the spring is 'm'

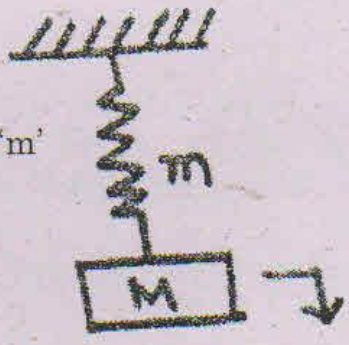

Figure 1

[Turn over

(b) A manometer used in a fluid mechanics laboratory has a uniform bore of cross-section area A. If a column of liquid of length L and density f is set into motion as shown in Figure. 2, find the natural frequency of the resulting motion. (10)

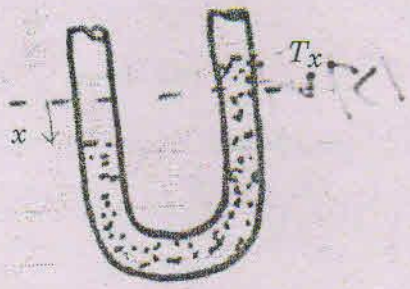

Figure 2

3. (a) A semicircular homogeneous disk of radius r and mass m is pivoted freely about its centre as shown in Figure. 3. Determine the natural frequency of vibration. (10)

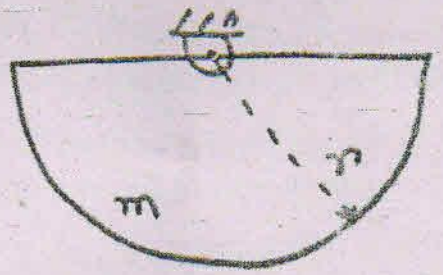

Figure 3

(b) A circular cylinder of mass m and radius r is connected by a spring of modulus k (spring constant) as shown in figure 4 rolls on a rough surface without slipping. Find the natural frequency of vibration of the mechanical system. (10)

Figure 4

4. (a) A gun barrel mass 600 kg has a recoil spring at stiffness 294 × kN/m. If the barrel recoils 1.3 meters on fixing, determine

(i) the initial recoil velocity of the barrel

(ii) the critical damping dashpot attached

(iii) the time required for the barrel to return to a position 50 mm from the initial position. (3 + 3 + 4 = 10)

(b) What is logarithmic decrement? Derive the mathematical formula for the logarithmic decrement? Mention various types of dampers used in mechanical system. (2 + 4 + 4 = 10)

5. (a) A system of beam supports a motor of mass 1200 kg. The motor has an unbalanced mass of 1 kg located at 60 mm radius. It is observed that resonance occurs at 2210 rpm. What amplitude of vibration can be expected as the motor's operating speed of 1440 rpm. If the damping factor is assumed to be less than 0.1. (10)

(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 0.08 m and wave length of 14 meter. What will be the amplitude of vibration at 60 km/hour. (10)

6. Write short notes on the following.: (any *four*) (4 × 5 = 20)

(a) Semi-definite system

(b) Critical damping

(c) Motion transmissibility

(d) Vibration isolator

(e) Seismic instruments

(f) Orthogonality principle

(g) Influence coefficient

(h) Rayleigh's method

(i) Principal mode

7. Determine the natural frequencies and mode shapes of the mechanical system as shown in figure 5. (20)

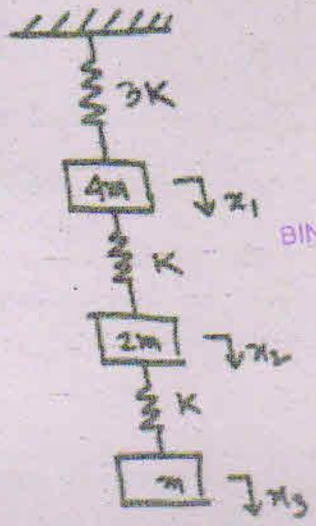

Figure 5