Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PEME 5401

Seventh Semester (Speical) Examination – 2013

MECHANICAL VIBRATION

QUESTION CODE : D 419

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) What do you mean by Degree of Freedom of a Vibratory System ? Illustrate with example.

(b) A harmonic motion has a frequency of 15 cycles / second and its maximum velocity is 5 m/s. Determine its amplitude, period and maximum acceleration.

(c) What do you mean by Rayleigh's principle as applied to vibration systems ?

(d) Define viscous damping coefficient, critical damping coefficient and damping factor.

(e) What do you mean by torsional equivalent shafts ?

(f) What do you mean by normal modes ?

(g) Name a few methods for finding the fundamental natural frequency of a multi-degree freedom system.

(h) Differentiate between the vibration of a continuous system and vibration of a multi-degree of freedom system.

(i) Differentiate between vibrometer and accelerometer.

(j) What do you mean by whirling of rotating shaft and critical speed ?

2. Define natural frequency of a vibratory system. A block of mass 0.05 kg is suspended from a spring having a stiffness of 50 N/m. The block is displaced downwards from its equilibrium position through a distance of 2 cm and released with an upward velocity of 3 cm/s. Determine

   (a) the natural frequency

   (b) the period of oscillation

   (c) the maximum velocity

   (d) the maximum acceleration and

   (e) the phase angle. 10

3. Define Logarithmic decrement ? A single-degree-of-freedom viscously damped system makes six complete oscillations per second. Its amplitude diminishes to 5 percent in 30 cycles. Determine

   (a) the logarithmic decrement

   (b) the damping ratio

   (c) the damping factor. 10

4. A single-degree-of-freedom viscously damped system is composed of a mass of 10 kg, a spring having a spring constant of 2000 N/m, and a dashpot having a damping constant of 50 N-s/m. The mass of the system is acted on by a harmonic force $F = F_0 \sin \omega t$ having a maximum value of 250 N and a frequency of 5 Hz. Determine the complete solution for the motion of the mass. 10

5. A machine of 100 kg mass is supported on springs of total stiffness 700 kN/m and has an unbalanced rotating element, which results in a disturbing force of 350 N at a speed of 3000 RPM. Assuming a damping factor of $\zeta = 0.20$, determine 10

   (a) its amplitude of motion due to the unbalance

   (b) the transmissibility and

   (c) the transmitted force.

6. Using Holzer s method, find the natural frequencies and mode shapes of the system shown in Figure 1. Assume that $J_1 = 10$ kg-m^2, $J_2 = 5$ kg-m^2, $J_3 = 1$ kg-m^2, and $k_{t1} = k_{t2} = 1 \times 10^6$ N-m/rad. 10

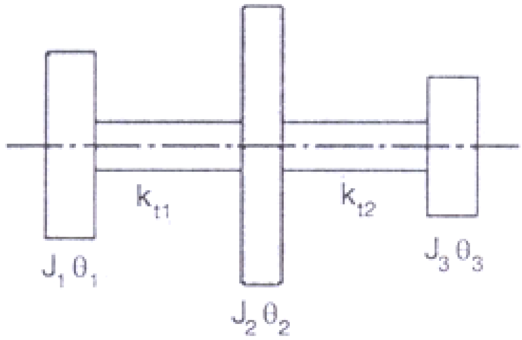

Figure 1

7. Determine the natural frequencies and mode shapes of a uniform thin slender rod having one end fixed and the other end free. Show the first three principal mode shapes. 10

8. For the 2-degree of freedom vibratory system shown in Figure 2, with $m_1 = m$, $m_2 = 3m$, $k_1 = k$, $k_2 = 3k$, $k_3 = 2k$, evaluate the equations of motion, the natural frequencies and mode shapes. 10

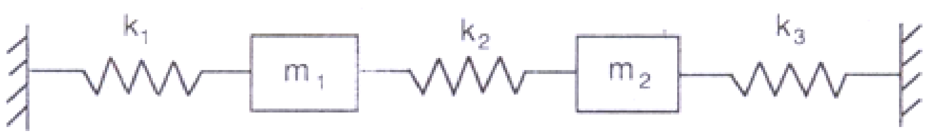

Figure 2