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

Total number of printed pages – 2

B. Tech

PEME 5401

Seventh Semester Examination – 2011

MECHANICAL VIBRATION

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 degrees of freedom of a vibrating system ? Give an example.

   (b) What do you mean by an over damped system ? Draw the time response curve of the same.

   (c) Define magnification factor.

   (d) Define resonance and sharpness of resonance.

   (e) Explain static and dynamic coupling of a multi degree vibrating system.

   (f) Explain material damping mechanism.

   (g) What do you mean by base excitation and vibration isolation ?

   (h) Explain static and dynamic balancing of rotors.

   (i) Differentiate between vibrometer and accelerometer.

   (j) State and explain Dunkerley's method for fundamental frequency estimation.

2. Define the terms damping coefficient, damping factor and logarithmic decrement. A vibrating system has the following constants : m = 17.5 kg, k = 70.0 N/cm and c = 0.70 N/cm/s. Determine

   (a) the damping factor, the natural frequency of damped oscillation,

   (b) the logarithmic decrement, and

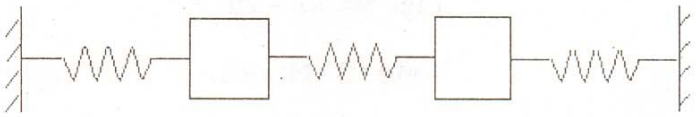
   (c) the ratio of any two consecutive amplitudes. 10

3. A single degree of freedom viscously damped system has a spring stiffness of 6000 N/m, critical damping constant of 0.3 Ns/mm and a damping ratio of 0.3. If the system is given an initial velocity of 1 m/sec, determine the maximum displacement of the system. 10

P.T.O.

4. A machine of mass 20 Kg is acted upon by a harmonic force having a maximum value of 25 N at a frequency of 120 cycle/min. Design the machine mounts consisting of a linear spring and a viscous damping device with damping factor of 0.2, so that only 20% of the dynamic force is transmitted to the base of the support. 10

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



6. An electric motor rotating at 1500 r.p.m drives a centrifugal pump at 500 r.p.m through a single reduction gearing. The moments of inertia of the electric motor and the pump impeller are 400 Kg-m^2 and 1400 Kg-m^2 respectively. The motor shaft is 45 mm in diameter and 180 mm long. The pump shaft is 90 mm in diameter and 450 mm long.

   Determine the frequency of torsional oscillation of the system, neglecting the inertia of the gears. The modulus of rigidity for both the shaft material is 84 GN/m^2. 10

7. Mention the conditions of Euler beam. Derive Euler's equation of motion for beam vibration. Determine the natural frequencies and mode shapes for simply supported end conditions. 10

8. A single rotor of mass 7 Kg is mounted midway between bearings on steel shaft 10 mm in diameter. The bearing span is 0.4 m. It is known that center of gravity of the rotor is 0.025 mm from the geometric axis. If the system rotates at 1000 r.p.m, find out the amplitude of vibration , the dynamic load transmitted to the bearings and the maximum stress in the shaft, when

   (a) the shaft is vertically supported

   (b) the shaft is horizontally supported.

   Neglect the weight of the shaft and the damping in the system. Assume the shaft to be simply supported. 10