B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00361

December, 2012

BIMEE-008 : MECHANICAL VIBRATION

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any seven** questions. All questions carry **equal** marks. Use of scientific calculator is **permitted**.*

1. A body oscillates with a simple harmonic motion along x-axis. Its displacement varies with time according to **10**

$$x = 8\cos\left(\pi t + \frac{\pi}{4}\right),$$

Where x is in metre, t is in seconds, and angle is in radians.

(a) Determine amplitude, frequency, and period of motion.

(b) Calculate velocity and acceleration of the body at any time 't'.

(c) Using the results of (b), determine the position, velocity and acceleration of the body at $t = 1$ second.

(d) Determine maximum speed and acceleration.

(e) Find the displacement of the body between $t=0$ to $t=1$ second.

2. A mass 0.5 kg is connected to a light spring of stiffness 20 N/m, oscillates on a horizontal frictionless track. **10**

Calculate :

(a) Total energy of the system and the maximum speed of the mass if the amplitude of motion is 3 cm.

(b) The velocity of the mass when the displacement is equal to 2 cm.

(c) Compute kinetic and potential energies of the system when the displacement is equal to 2 cm.

3. A diesel engine generator of mass 1000 kg is mounted on springs with total stiffness 400 kN/m. If the period of oscillation is 0.32 sec, determine the damping coefficient C and damping factor ρ. **10**

4. A weight attached to a spring of stiffness 530 N/m undergoes viscous damping and the weight was displaced and released as shown in figure 1. **10**

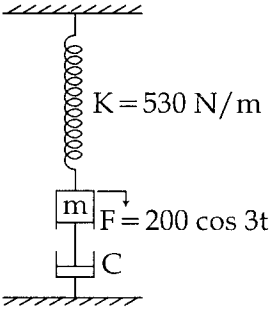

Figure - 1

The period of vibration was found to be 1.8 seconds. The ratio of consecutive amplitude was found to be 4.2.

Determine the amplitude and phase angle when a force (N) of $F = 200 \cos 3t$ acts on the system.

5. A machine part having a mass of 2.5 kg vibrates in a viscous medium. A harmonic exciting force of 30 N acts on the part and causes a resonant amplitude of 14 mm with a period of 0.22 second. Find the damping coefficient. If the frequency of the exciting force is changed to 4 Hz, also determine the increase in the amplitude of the forced vibration upon the removal of the damper. **10**

6. A vertical shaft 100 mm in diameter and 1 m in length has its upper end fixed to the ceiling. At the other end it carries a disc of weight 5000 N having a radius of gyration of 450 mm. The modulus of rigidity for the material of the shaft is 0.8×10^5 N/mm^2. Determine the frequency of torsional vibrations. **10**

7. Find the damping factor of a vibrating system which consists of a mass of 7 kg, a spring of stiffness 5 N/mm and a damper of damping co-efficient of 0.036 N/mm/s. Also find the logarithmic decrement and the ratio of any two consecutive amplitudes. **10**

8. The guns are designed so that on firing, the barrel recoils against a spring. A dashpot is engaged that allows the barrel to return to its position at the end of each recoil. A gun barrel has a mass of 500 kg and a recoil spring constant of 300 N/mm. The barrel recoils 1 m on firing. **10**

   Determine :

   (a) the initial recoil velocity of the gun barrel and

   (b) the critical damping co-efficient of the dashpot engaged at the end of the recoil stroke.

9. A vertical shaft 100 mm in diameter and 1 m in length has its upper end fixed at the top. At the other end it carries a disc of weight 20 kN. The young's modulus of the material of the shaft is 2×10^5 N/mm^2. Neglecting the weight of the shaft, determine the frequency of longitudinal vibrations and transverse vibrations. **10**

10. A shaft of length 1.5 m is 0.095 m in diameter for the first 0.6 m of its length, 0.06 m in diameter for the next 0.5 m of the length and 0.05 m in diameter for the remaining 0.4 m of its length. The shaft carries two rotors at two ends. The mass moment of inertia of the first rotor is 650 kg m^2 where as of the second is 212 kgm^2. Determine the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. **10**