Code: **17MEMD1T3**

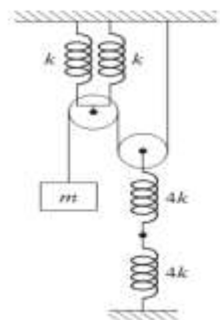
I M.Tech - I Semester – Regular / Supplementary Examinations December 2018

MECHANICAL VIBRATIONS
(MACHINE DESIGN)

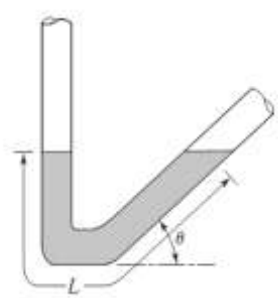
Duration: 3 hours | Max. Marks: 60

Answer the following questions.

1. a) Find the natural frequency of the pulley system shown in Fig. by neglecting the friction and the masses of the pulleys. 8 M

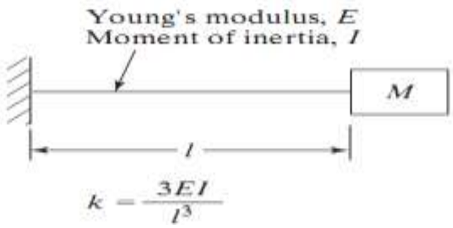


b) The inclined manometer as shown in Fig. is used to measure pressure. If the total length of mercury in the tube is L, find an expression for the natural frequency of oscillation of the mercury 7 M



(OR)

2. a) A cantilever beam carries a mass M at the free end as shown in Fig. A mass m falls from a height h on to the mass M and adheres to it without rebounding. Determine the resulting transverse vibration of the beam. 6 M



b) A helical spring of stiffness, k is cut into two halves and a mass m is connected to the two halves as shown in Fig. 1. The natural time period of this system is found to be 0.5 s. If an identical spring is cut so that one part is one-fourth and the other part three-fourths of the original length, and the mass m is connected to the two parts as shown in Fig. 2. what would be the natural period of the system? 9 M

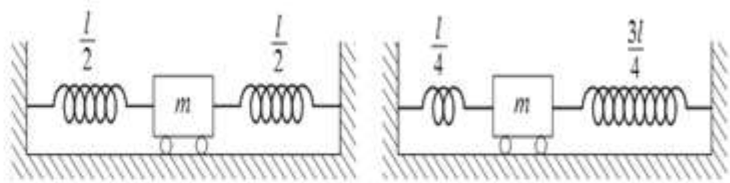
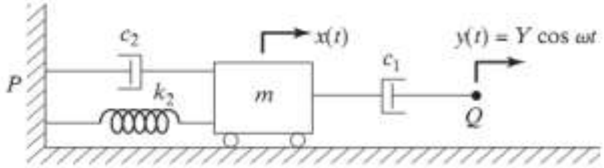


Fig. 1 Fig. 2

3. a) A spring-mass system consists of a mass weighing 100 N and a spring with a stiffness of 2000 N/m. The mass is subjected to resonance by a harmonic force $F(t)=25\cos\omega t$ N. Find the amplitude of the forced motion at the end of (i) $\frac{1}{4}$ cycle, (ii) $2\frac{1}{2}$ cycles, and (iii) $5\frac{3}{4}$ cycles. 6 M

b) For the system shown in Fig. x and y denote, respectively, the absolute displacements of the mass m and the end Q of the dashpot c_1 (i) Derive the equation of motion of the mass m, (ii) find the steady-state displacement of the mass m, and (iii) find the force trans-mitted to the support at P, when the end Q is subjected to the harmonic motion $y(t)=Y\cos\omega t$. 9 M



(OR)

4. a) Find the frequency ratio $r = \frac{\omega}{\omega_n}$ at which the amplitude of a single-degree-of-freedom under damped system attains the maximum value. Also find the value of the maximum amplitude. 6 M

b) Derive the transfer function of a viscously damped system under rotating unbalance, with the equation of motion:

$$M\ddot{x} + c\dot{x} + kx = me\omega^2 \sin \omega t$$

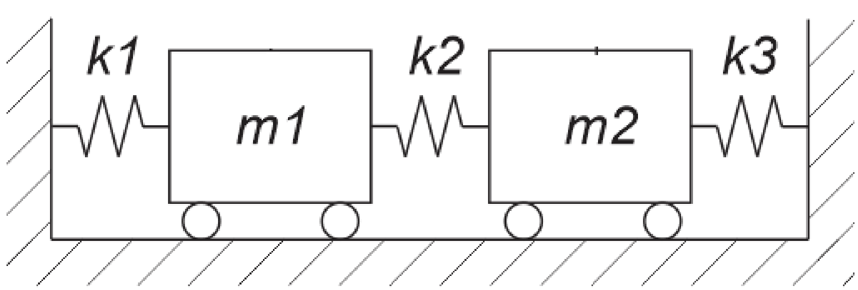
9 M

5. a) Find the response of an under damped single-degree-of-freedom system to a unit impulse. 7 M

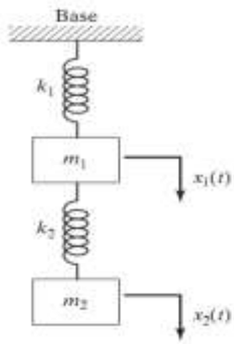
b) Find the response of an under damped single-degree-of-freedom system to a unit step function. 8 M

(OR)

6. a) Determine the natural modes of vibration for the system shown in Fig. when $k_1=k_2=k_3=k$. 7 M

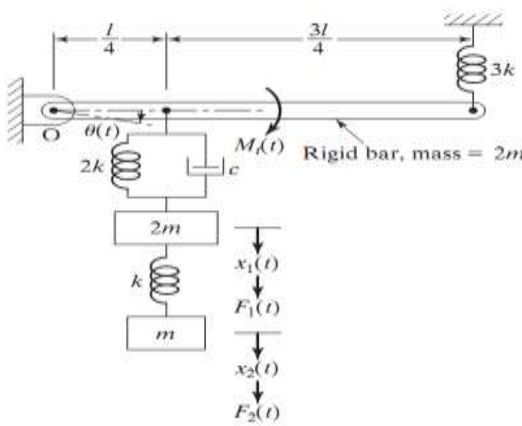


b) Determine the initial conditions of the system shown in Fig. for which the system vibrates only at its lowest natural frequency for the following data: k_1=k, k_2=2k and m_1=m, m_2=2m. 8 M



7. a) Find the first two natural frequencies and mode shapes of a rod with both ends free. 7 M

b) Derive the equations of motion, for the system shown in Fig. 8 M



(OR)

8. Find the flexibility and stiffness influence coefficients of the system shown in Fig. Also, derive the equations of motion of the system. 15 M