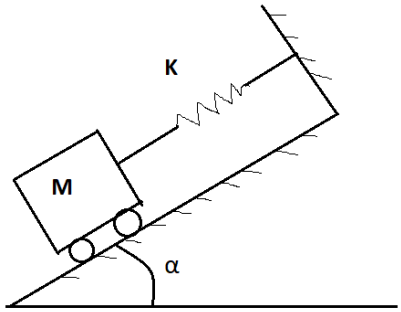
[Time: Three Hours] **[Marks: 80]**

N.B: **1. Attempt all Questions.**
2. All Questions carry equal marks.

Q. 1. Write short notes on **any FOUR** questions. **20**

a. A mass of 4.5 kg hangs from a spring and makes damped vibrations. The time taken to complete 50 oscillations is found to be 20 sec and the ratio of first downword displacement to the sixth is found to be 2.25. find stiffness of spring and damping coefficient. **5**

b. For a given system determine natural frequency of the system **5**

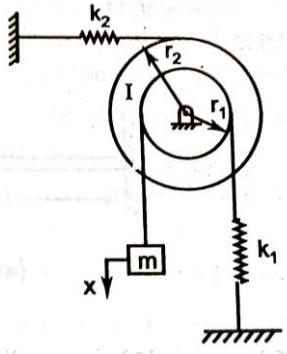


c. A spring mass system has natural frequency of 12 Hz. When the spring constant is reduced by 800 N/m, the frequency is changed by 50%. Determine the mass and spring constant of original system **5**

d. What is the Force transmissibility? Draw frequency response curve and write implications from the same. **5**

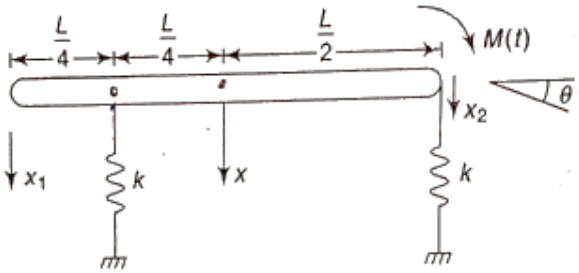
e. Explain concept of soft and hard spring in case of non-linear vibrations **5**

Q. 2. a. Derive the differential equation governing the of motion of the system using θ as generalized coordinate **10**



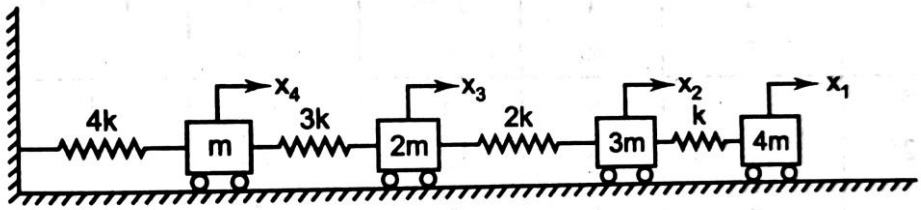
b. A vehicle of mass 490 Kg and the total spring constant of its suspension system is 58800 N/m. The profile of road may be approximated to a sine curve of amplitude 40 mm and wave length of 4 m. Determine **10**
i) critical speed of vehicle.
ii) The amplitude of steady state motion of mass when vehicle is driven at 57 km/hr and damping factor of 0.5

Q. 3. a. Derive the differential equation of motion of the system using x and θ as generalized coordinates. Let m is the mass of the system and L is total length of slender bar. **10**



b. Illustrate with an example, how the perturbation is used to solve non-linear vibration problem. **10**

Q. 4. a. Using Holzer method find the natural frequency of the system. Assume K= 1N/m and m= 1 kg **10**



b. Write a short note on condition and vibration monitoring techniques **10**

Q. 5. a. A seismic instrument is mounted on a machine running at 1000 rpm. The natural frequency of the seismic instrument is 20 Rad/Sec. The instrument records a relative amplitude of o.5 mm compute displacement, velocity and acceleration of the machine. Damping of the instrument is neglected **10**

b. A machine of mass 1000 Kg is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effect of vibration, isolator of rubber having static deflection of 2 mm under the machine load and an estimated damping is ζ =0.2 are used. Determine **10**
a) The force transmitted to the foundation.
b) The amplitude of vibration of machine.

Q. 6. a. Body of mass 1 Kg lies on a dry horizontal plane and is connected by spring to a rigid support. The body is displaced from mean position by an amount of 0.255m, how long the body will vibrate and at what distance from mean position will it stop. assume coefficient of friction as 0.25. **10**

b. Draw frequency response curve for vibration measuring instruments and show the location of vibrometer and accelerometer **5**

c. Note on eigen values and eigen vector method for multi degree of freedom system **5**
