TE-Sem-V - Old - Mech - MV

20/5/16

Q.P. Code : 560902

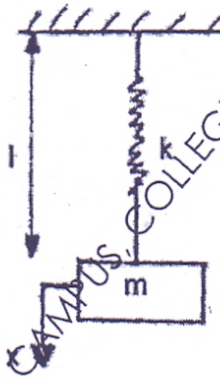
(OLD COURSE)

(3 Hours) **[Total Marks : 100**

N.B. 1) **Q. No. 1 is compulsory.**
2) Attempt **Any Four** questions out of the remaining.
3) Assume suitable data, if required with justification.
4) Draw neat sketches to illustrate your answers.
5) Answers to questions should be grouped and written together. For example, answer to sub question a) and b) of question no 3 should be written one below.

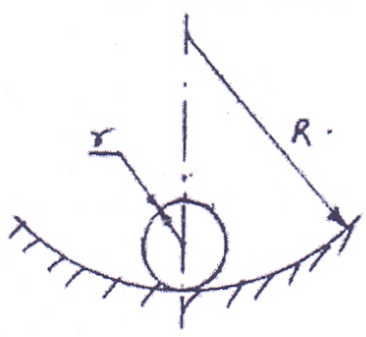
1. a) Answer the following (any three) **(12)**
   i) Explain why Mechanical Vibration is an important area of study for engineers. List out any two applications each where Vibration is desirable and undesirable.
   ii) Differentiate between Coulomb Damping and Viscous Damping.
   iii) Explain why only a part of the primary unbalanced force due to the reciprocating masses is balanced by revolving masses.
   iv) Write short note on critical speed of the shaft.

   b) Determine the effect of mass of the spring on the natural frequency of the system shown in figure. The length of spring is 'l', mass is 'm_s' and stiffness is 'k'. **(08)**



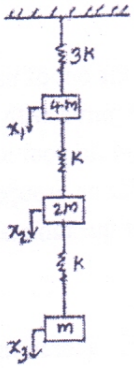
2. a) A door 200 cm high, 75 cm wide and 4 cm thick and weighing 35 kg is fitted with an automatic door closer. The door opens against a spring with a modulus of 9.81 x 10^{-2} N-m/rad. If the door is opened 90° and released, how long will it take the door to be within 1° of closing? Assume the return spring of the door to be critically damped. **(10)**

   b) A roller of mass 'm' & radius 'r' rolls without slipping on a concave path of radius 'R' as shown. Determine the natural frequency of small oscillations. **(10)**



TURN OVER

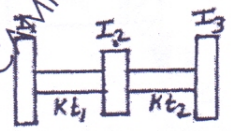
3. a) Find the Eign values and Eign vectors of the system shown in figure. (12)



b) A flywheel of mass 20 kg and radius of gyration 0.3 m makes torsional vibrations under a torsion spring of stiffness 5 N-m/rad. A viscous damper is fitted to reduce the amplitude by a factor 100 over two complete cycles find i) Damping Factor ii) damping coefficient iii) periodic time of damped oscillations. (08)

4. a) A spring mass damper system, having an undamped natural frequency of 100 Hz and a damping constant of 20 N-s/m is used as an accelerometer to measure the vibration of a machine operating at a speed of 3000 r.p.m. If the actual acceleration is 10 m/s^2 and the recorded acceleration is 9 m/s^2, find the mass and the spring constant of the accelerometer. (08)

b) Determine the natural frequency of the system shown in figure by Holzer's method in the range of 0 to 2 rad/s. (12)
Take $I_1=I_2=I_3=1$ kg.m^2 and $K_{t1}=K_{t2}=1$ N-m/rad



5. a) A vertical shaft of 20 mm in diameter and 600 mm long is held in short bearings at the ends. A 5 kg disc is mounted on the shaft midway between the bearings. CG of the disc is 0.5 mm away from the axis of the shaft. If the allowable tensile stress for the shaft is 70 N/mm^2. Determine, (10)
i) the critical speed of the shaft
ii) the range of the speed which is not safe
take E = 200 GPa
It may be assumed that the shaft is simply supported as shaft is supported in short bearings.
$M=(W_d.l)/4$
Where, M = Bending Moment, W_d = Dynamic load, l = length of shaft

b) A machine having a mass of 100 kg is supported on springs of total stiffness 7.84×10^5 N/m. The machine has an unbalanced rotating element which results in a disturbing force of 392 N at a speed of 3000 rpm. Assuming a damping factor of $\varepsilon = 0.2$, Find **(10)**
i) The amplitude of motion due to unbalance,
ii) The transmissibility, and
iii) The force transmitted.

6. a) The suspension system of a vehicle has a spring constant of 500 KN/m and a damping ratio of 0.5. The vehicle has a speed of 80 km/hr. The road surface varies sinusoidally with amplitude of 10 cm and a wavelength of 5 m. If the mass of vehicle is 1000 kg, determine its amplitude of oscillations. **(08)**
b) Explain the balancing of V Engines. **(08)**
c) Write short note on Accelerometer. **(04)**

7. a) The firing order of a six cylinder vertical four stroke inline engine is 1,4,2,6,3,5. The piston stroke is 80 mm and the length of each connecting rod is 180 mm. The pitch distances between the cylinder center lines are 80, 80, 120, 80 and 80 mm respectively. The reciprocating mass per cylinder is 1.2 kg and the engine speed is 2400 rpm. Determine the out of balance primary and secondary forces and couples on the engine taking a plane midway between the cylinder 3 and 4 as the reference plane. **(12)**
b) Write short note on **(08)**
i) Static and Dynamic Balancing.
ii) Follower Jump phenomenon.