Roll No .....

MMPD-104

M.E./M.Tech. I Semester

Examination, June-2013

Theory of Vibration

Time : Three Hours

Maximum Marks : 70

Note: *Attempt any five questions.*
All question carry equal marks.

1. a) The displacement of the slider ice the slider crank mechanism is given by

   $x = 24 \cos 8\,zt + 3/2 \cos 16\,zt$

   Plot a displacement versus time diagram. What is the acceleration of the piston at $t = 1/8$ sec.

   b) A harmonic displacement is given by

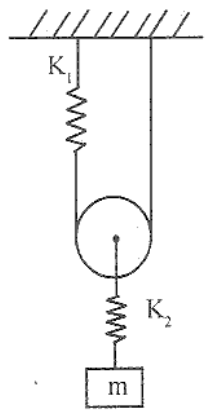
   $x\,(t) = 6 \sin (20t + z/3)$ mm. Where + is in second and phase angle in radians. Find :

   i) Frequency and period of motion

   ii) The maximum displacement velocity and acceleration.

2. a) A spring mass system has spring constant of KN/m and the mass W Kg. It has natural frequency of vibration as 12 c.p.s. An extra 2 kg mass is coupled to W and natural frequency reduces by 2 c.p.s. Find K and W.

   b) Determine the natural frequency of the mass M = 15 kg as shown in figure assuming that the cords do not sketch and slide over the pulley rim. Assume that the pulley has no mass.



3. a) A steel shaft 6 cm diameter and 50 cm long fixed at one end carries a flywheel at weight 1000 kgs and radius of gyration 30 cm at its free end. Find the frequency at free longitudinal transverse, and torsional vibrations.

   $E = 2 \times 10^6$ kgf/cm^2, $C = 3.8 \times 10^6$ kgf/cm^2

   b) A shaft supported freely at the ends has a mass of 100kg placed 25cm from one end. Find the frequency of the natural transverse vibration if the length of the shaft is 75cm $E = 200$ GN/m^2 and shaft diameter is 4cm.

4. a) A door 200cm high, 75cm wide and 4 cm thick and weighing 35 kg is fitted with an automobile door closer. The door opens against a spring with a modules of 1 kg-cm/ radians. 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 critically damped.

b) The damped vibration record of a spring mass dashpot system shows the following data :

Amplitude on second cycle = 1.2 cm

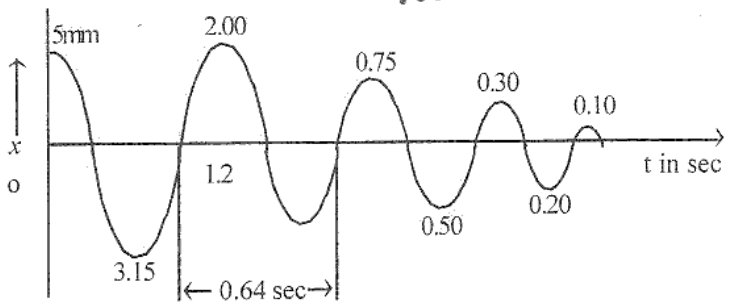
Amplitude on third cycle =1.05 cm

Spring constant K = 8 x10^3 N/m

Mass on the spring W = 2 kg

Determine the damping constant, assuming the viscous damping.

5. a) Free vibration records of 1 tonne machine mounted on an isolator is shown in figure identify the type of isolator and its characteristics i.e., the spring.



b) A shock absorber is to be designed so that its overshoot is 10% of the initial displacement when released. Determine the damping factor. If the damping factor is reduced to one half this value, what will be the overshoot?

6. a) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 KN/m has a rotating unbalance force of 525N at a speed of 6000 rpm. If the damping factor is 0.3 determine.

i) The amplitude caused by the unbalance and its phase angle

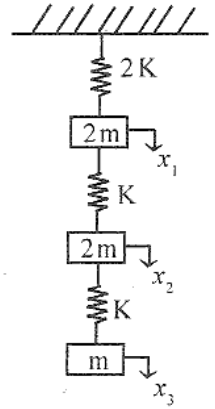
ii) The transmissibility

iii) The actual free transmitted and its phase angle

b) What will be the frequency ratio when the amplitude in forced vibration is maximum. Determine the peak amplitude and the corresponding phase angle.

7. a) Calculate the natural frequency of a shaft of diameter 10cm and length 300cm carrying two discs of diameters 125cm and 200cm respectively at its ends and weighing 480N and 900N respectively. Modulus of rigidity of the shaft may be taken as 1.96 x 10^{11} N/m^2

b) By using matrix method determine the natural frequency of the system as shown in figure.



8. Short notes on (any two)

a) Duhamel's Integral method

b) Phase plane method

c) Perturbation method

d) Jump phenomenon

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