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Total Number of Pages: 2

M.TECH
MDPC103

1st Semester Regular/Back Examination – 2014
MACHINE VIBRATION
BRANCH(S): MACHINE DESIGN,MECHANICAL SYSTEM DESIGN

Time: 3 Hours
Max Marks: 70

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) What is the difference between a discrete and a continuous system? Is it possible to solve any vibration problem as a discrete one?
b) A 453-kg mass attached to a light spring elongates it 7.87 mm. Determine the natural frequency of the system.
c) Differentiate between Vibrometer and Accelerometer.
d) What is steady-state response?
e) What happens to the response of an undamped system at resonance?
f) Define the term magnification factor?
g) What is the function of a vibration isolator?
h) Write the forced harmonic vibration in matrix form?
i) What is the basic principal of Lagrange's method in vibration, Explain briefly.
j) State the Dunkerley's formula.

Q2 A disc of mass *m* rolls without slipping on an inclined surface as shown in figure-1 . (10)

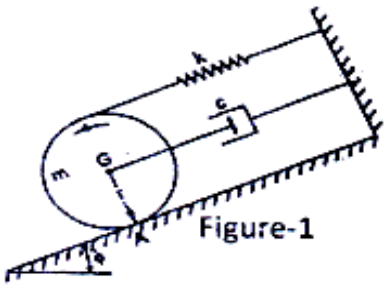

Figure-1

a) Write down the equation of motion, don't neglect gravity.
b) Assuming system to be under-damped, find the frequency of damped oscillations.
c) For what value of a damping coefficients c is the system critically damped ?

Q3 An under damped shock absorber is to be designed for an automobile. It is required that initial amplitude to be reduced to 1/16th in one cycle. The mass of the automobile is 200 kg and damped period of vibration is 1 sec. Find necessary stiffness and damping constants of shock absorbers. (10)

Q4 A machine of mass 150 kg operates at 650 rpm and has a 25 kg rotor with 5 mm eccentricity. The machine is mounted on springs having stiffness 85 kN/m and damping is negligible. If the unit is constrained to move vertically, *(i)* Detremine the dynamic amplitude of machine at the operating speed. *(ii)* Redesigned the mounting so that the dynamic amplitude is reduced to half of its original value, but keeping same natural frequency. (10)

Q5 Find the total response of a single degree of freedom system with m=12 kg, c=55 N-s/m, k=2050 N/m under the action of harmonic force $F=F_0 \sin\omega t$ with F_0 =250 N and ω=31.416 rad./s. The initial conditions may be assumed as initial displacement , x=0.01 m and initial velocity , $\dot{x}$=5 m/s at t=0. (10)

Q6 Figure-2 shows an overhead crane schematically. The cabin is at the centre of the beam of l_1.Reduce the system to an equivalent two degree of freedom system; determine the natural frequency and amplitude ration of this system. Assume EI=21x10^6 Nm^2,m_1=3050 kg, l_1=10 m EA=2.47x10^6 N, m_2=650 kg, l_2=6m. (10)

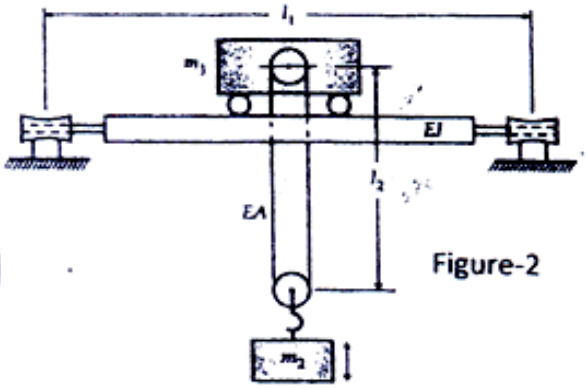

Figure-2

Q7 (10)

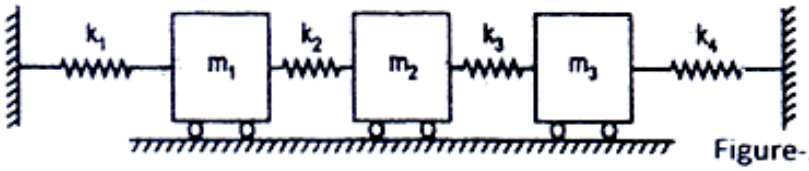

Figure-3

For the three-degrees-of-freedom system shown in Figure-3

a) Write the differential equations of motion in matrix form.

b) Find the fundamental natural frequency and corresponding mode shape of vibration for k_1 =25 N/m, k_2 =30 N/m, k_3 =20 N/m, k_4 =35 N/m,m_1=m_2=2.0 kg and m_3=0.8 kg ,by matrix iteration method.

Q8 A rectangular bar of length l and uniform cross section is fixed at one end and free at the other end. Derive the suitable expression for longitudinal vibration. (10)