Registration no: | | | | | | | | | | |

Total Number of Pages: 03 **M.TECH**

MDPC103

1st Semester Back Examination – 2016-17

MACHINE VIBRATION

BRANCH(S): MECHANICAL SYSTEM DESIGN

Time: 3 Hours

Max marks: 70

Q.CODE:Y926

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 are the three elementary parts of a vibrating system?

b) What are half-range expansions?

c) How many degrees-of-freedom the cylinder has when descending an inclined plane?

d) Why does the amplitude of free vibration gradually diminish in practical system?

e) What is complex stiffness?

f) Explain why constant force on the vibrating mass has no effect on the steady state vibration.

g) What is self-excited vibration?

h) What are principal co-ordinates? What is their use?

i) State Lagrange's equation.

j) What is the difference between a transducer and a pickup?

Q2 a) A body is subjected to two motion as given by $x_1 = 15\ \sin(\omega t + 30^0)$ and $x_2 = 8\ \cos(\omega t + 60^0)$, What harmonic motion should act upon the body so as to bring it to equilibrium? (5)

b) A simply supported beam of square cross-section 5mmX5mm and length 1m, carrying a mass of 2.3 kg at the middle is found to have a natural frequency of transverse vibration of 30 rad/s. Determine the Young's modulus of elastic beam. (5)

Q3 a) Find the natural frequency of vibration of the system as shown in figure-1. The rod may be assumed to rigid and weightless. (6)

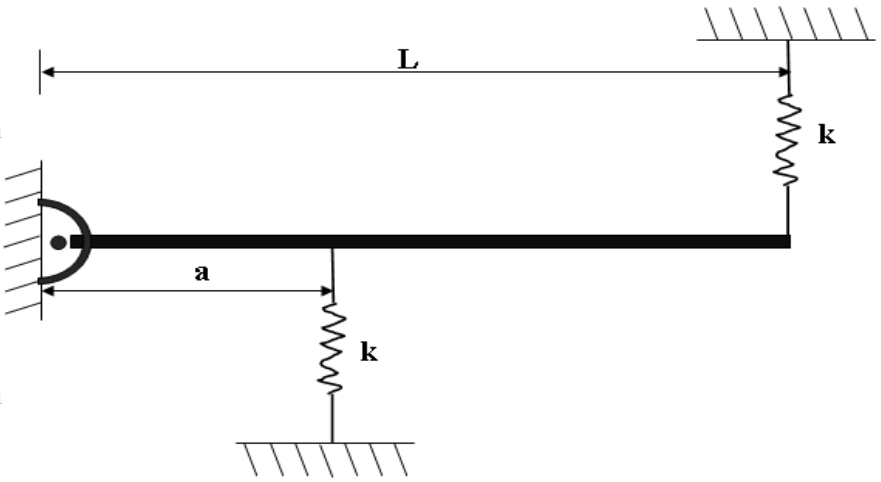

Figure-1

b) Design a velometer if the maximum error is to be limited to 1 percent of the true velocity. The natural frequency of the velometer is to be 80Hz and the suspended mass is to be 0.05kg. (4)

Q4 a) Find the total response of a single degree of freedom system with following conditions: (6)

$m = 10kg,\ c = 20\ Ns/m, k = 4000N/m,\ \dot{x_0} = 0\ and\ x_0 = 0.01m$

An external force $F(t) = F_0 \cos \omega t$ acts on the system with

$F_0 = 100N, and\ \omega = 10\ rad/s$

Free vibration with $F(t) = 0$

b) Find the equivalent viscous damping coefficient corresponding to quadratic or velocity squared damping that is present when a body moves in a turbulent fluid flow. (4)

Q5 a) The anvil of forging hammer weigh 5000N and is mounted on a foundation that has a stiffness of $5X10^6$ N/m and a viscous damping constant of 10,000 N-s/m. during a particular forging operation , the top falling weight 1000N is made to fall from height 2m on the anvil as shown in figure-2. If the anvil is at rest before impact of falling weight, determine the response of the anvil after impact. Assume coefficient of restitutions between the anvil and top falling weight is 0.4. (5)

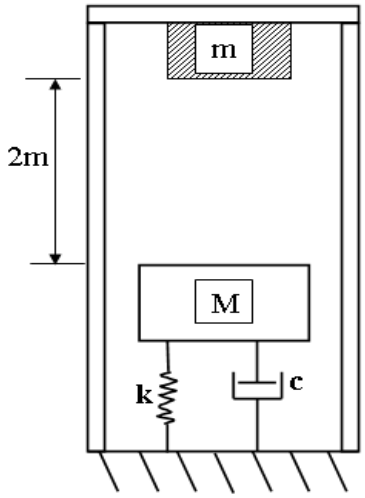

Figure-2

b) Explain in details the working principle of an accelerometer. Investigate the output of an accelerometer with damping ζ = 0.70 when used to measure a periodic motion with displacement given by equation $y = Y_1 \sin \omega_1 t + Y_2 \sin \omega_2 t$. (5)

Q6 a) For system shown in figure-3, write the matrix equation based on the flexibility and determine the lowest natural frequency by iteration. (5)

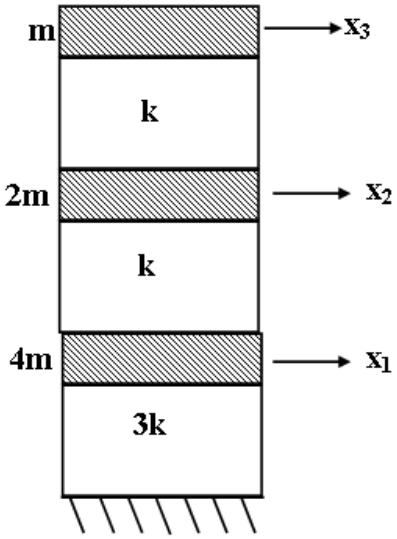

Figure-3

b) Determine the equation of motion and natural frequencies and normal mode of a fixed-free uniform rod of the system as shown in figure-4, using modes:- (5)

$\varphi_1(x) = \frac{x}{l}$ *and* $\varphi_2(x) = \left(\frac{x}{l}\right)^2$.

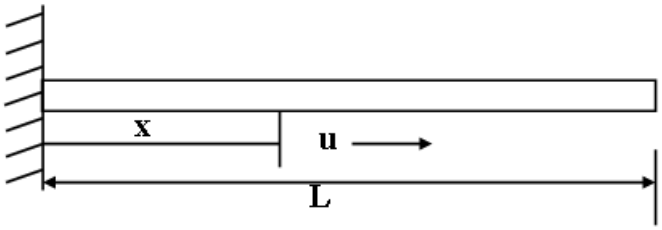

Figure-4

Q7 Using Lagrange's method, set up the equations of motion for the system shown in figure-5. (10)

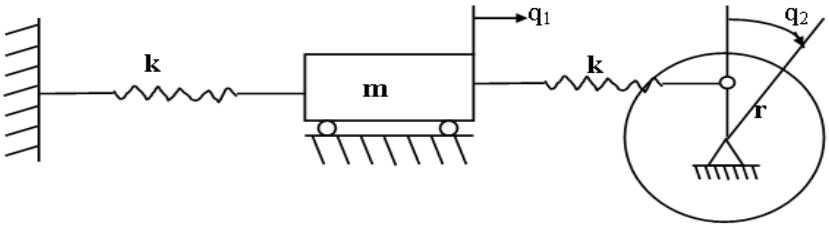

Figure-5

Q8 Write short notes on any four (4 x 2.5)

a) State three methods of representing the frequency response data.
b) Explain the difference between passive and active isolation.
c) Explain in details, under what circumstances dose the frequency of vibration of a beam subjected to an axial load become zero.
d) What is expansion theorem and what is its importance?
e) What is meant by static and dynamic coupling? How can you eliminate coupling of the equations of motion?