Printed Pages: 02 **Sub Code: MME253**

Paper Id: 240253 **Roll No.** | | | | | | | | | | |

M. TECH.
(SEM VI) THEORY EXAMINATION, 2017-2018
ADVANCED MECHANICAL VIBRATION

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION-A

1. Attempt *all* questions in brief. 2 x10 = 20

a. Explain principle mode of vibration.
b. What is a far coupled system?
c. What is the purpose of vibration isolation?
d. Define orthogonality of mode shapes.
e. What is the purpose of modal analysis?
f. What is the role of vibration absorber?
g. What is a shock spectrum?
h. How free body diagram is used in modelling mechanical systems?
i. What does the equation $x(t) = X \sin(vt + f)$ represent?
j. The acceleration of a particle traveling in a circular path has two components. What are they?

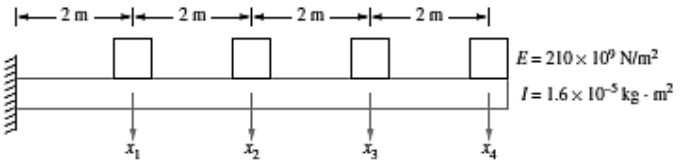
SECTION-B

2. Attempt any *three* of the following: 10x3 = 30

(a) What is principle modes of vibrations? Define spring coupled and mass coupled systems.

(b) Why can't the concept of logarithmic decrement be used to measure viscous damping ration greater than or equal to one. Discuss.

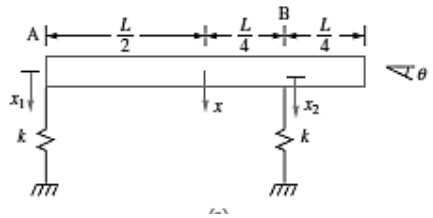
(c) Four machines are equally spaced along the length of an 8 m fixed free beam of elastic modulus 210 GPa and cross section moment of inertia of 1.6 x 10^{-5} mm^4 as shown in figure. Determine the flexibility matrix of a four degree of freedom model of the system with the locations of the machines as the generalized coordinates.



(d) Discuss forced vibration of systems governed by wave equation.

(e) Consider the system shown in figure in which the slender bar of mass m and moment of inertia $1/12(mL^2)$ is attached to springs of stiffness k at its left end and three-quarters of the way across the bar. Derive the differential equations for the system of figure using the following.

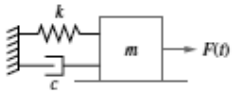
(a) x is as generalized coordinates: the displacement of the mass center of the bar from equilibrium, and _ is the clockwise angular displacement of the bar.
(b) x1 and x2 are the vertical displacements of particles where the springs are attached and measured from equilibrium. Assume small θ.



SECTION-C

3. Attempt any *one* part of the following: **10x1 =10**

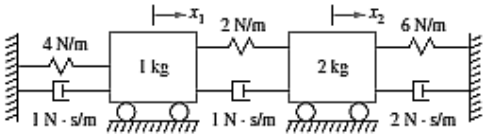
(a) The block of figure slides on a frictionless surface. Derive the differential equation governing the motion of the system using x as the displacement of the system from its equilibrium position and as the generalized coordinate.



(b) Explain free, damped and forced vibrations and differentiate between them.

4. Attempt any *one* part of the following: **10x1 =10**

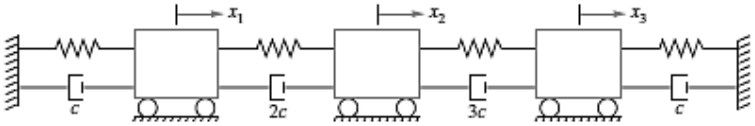
(a) Determine the response of the system shown in figure when using x_1 and x_2 as generalized coordinates when and all other initial conditions are zero.



(b) Discuss the principle of vibration isolator with a suitable example.

5. Attempt any *one* part of the following: **10x1 =10**

(a) Determine the damping matrix for the three degree-of-freedom system shown in figure



(b) Explain eigen value problems. What is the condition for orthogonality of mode shapes in eigen value problems.

6. Attempt any *one* part of the following: **10x1 =10**

(a) Discus the finite element-based modeling of close coupled and far coupled systems.

(b) Describe the forced vibration of continuous systems using wave equation methodology.

7. Attempt any *one* part of the following: **10x1 =10**

(a) Explain the transient response of a two degree of freedom system under step input.

(b) What are the causes of non-linearity in systems? Explain undamped and forced vibration with nonlinear spring forces.