Registration No: | | | | | | | | | | |

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

P2MYCC01

2nd Semester Regular Examination 2016-17
Vibration of Structure
BRANCH: Mechanical System Design and Dynamics, Design and Dynamics
Time: 3 Hours
Max Marks: 100
Q.CODE: Z388

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

Q1 Answer the following questions: ***Short answer type*** **(2 x 10)**

- **a)** Explain D'Alembert's Principle for dynamic systems
- **b)** Differentiate between Euler Bernoulli beam and Timoshenko beam
- **c)** Explain self-adjoint property of a vibrating structure.
- **d)** What are the different types of Boundary conditions of a vibrating structure.
- **e)** Differentiate between admissible function, comparison function and eigenfunction as applied to vibrating structures.
- **f)** Write the expression for the Frequency response of a harmonically excited SDOF spring-mass-damper vibrating system and Draw the corresponding frequency response plot.
- **g)** Explain Hamilton's Principle.
- **h)** Mention the basis of the Rayleigh-Ritz method
- **i)** Differentiate between the terms eigenvectors and eigenfunctions in vibrating systems.
- **j)** What is the difference between lumped parameter vibration system and distributed parameter vibration system.

Q2 **a)** Explain the terms flexibility influence coefficient and stiffness influence coefficient. For the vibrating system shown in Figure 1, calculate the matrix of flexibility influence coefficients. **(10)**

b) Develop the equation of motion for the transverse vibration of a string with mass per unit length $m(x)$, tension T, externally applied distributed load of $p(x)$ per unit length. Evaluate its natural frequencies and mode shapes. **(10)**

Q3 **a)** Develop the equations of motion and specify the boundary conditions of a simply supported Euler-Bernoulli beam in transverse vibration using either Hamilton's Principle or Equilibrium method. **(10)**

b) Using Matrix Iteration Method, evaluate the first two natural frequencies of the vibrating system shown in Figure 1. **(10)**

Q4 **a)** Explain the orthogonality property of eigenfunctions of a continuous vibrating system. Illustrate this property for the case of longitudinal vibration of a uniform fixed free bar. **(10)**

b) What is the use of Holzer Method in vibrating systems. Explain all the steps of the method for a typical torsional vibration system. **(10)**

Q5	**a)**	In case of a uniform clamped-free bar in longitudinal vibration, evaluate the fundamental natural frequency through Rayleigh's method using the trial function as $u(x) = c[(x / l)^3 - 3(x / l)]$, l is the length of the bar, E is Young's modulus and A is the area of cross section.	**(10)**
	b)	Explain the Myklestad Thomson Method for vibrating systems, mentioning the steps adopted and using a simply supported beam in transverse vibration as example.	**(10)**
Q6	**a)**	Develop the expressions for the natural frequencies and mode shapes of a slender clamped free beam in transverse vibration.	**(10)**
	b)	Write the expression for Lagrange's equations for non-conservative vibrating systems explaining the terms used. Find out the equation of motion of the damped forced vibratory system by Lagrange's method (Fig. 2). The intermediate bar is rigid and massless.	**(10)**
Q7	**a)**	Outline the broad steps involved in the Finite Element Technique as applied to vibration of structures. Derive the expression for the stiffness matrix of an axially loaded rod element of length 'L', Area of cross section 'A' and Young's modulus 'E' using linear interpolation function.	**(10)**
	b)	Explain the Transfer Matrix Method as applied to vibrating structures, outlining the steps involved and taking the example of a torsional vibration system with Free-Fixed boundary conditions.	**(10)**

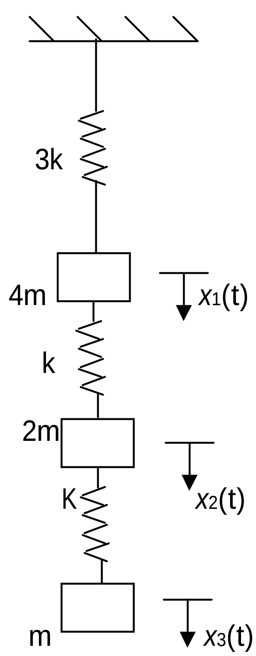

Figure 1

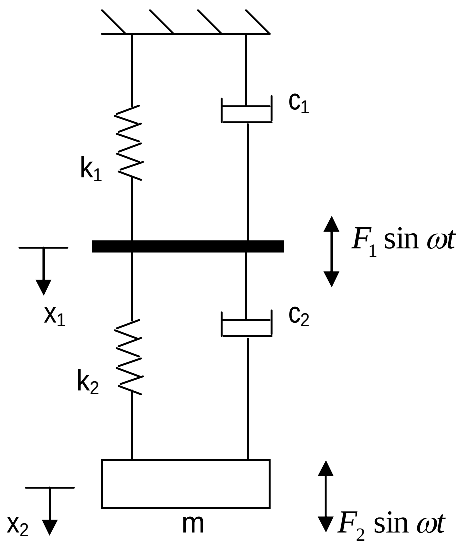

Figure 2