Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER III–EXAMINATION (Remedial)– WINTER 2015

Subject code: 734703 **Date: 07/12/2015**

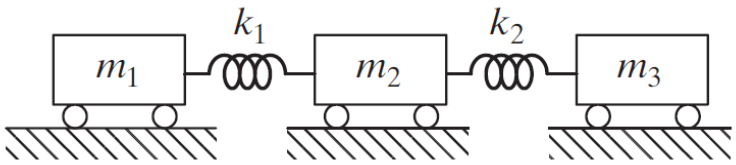
Subject Name: Dynamics of Machines

Time: 2:30 PM to 5:00 PM **Total Marks: 70**

Instructions:

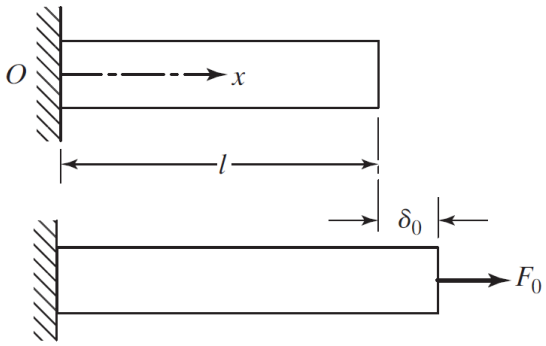
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q:1 Explain the concept of modal analysis to determine the vibration response of multi degree of freedom system. Three freight cars are coupled by two springs, as shown in following figure. Find the natural frequencies and mode shapes of the system for $m_1 = m_2 = m_3 = m$ and $k_1 = k_2 = k$. **14**



Q:2 **(a)** Derive the Equation of motion for the lateral vibration of the beams. **07**

(b) A bar of uniform cross section area A, densityρ, modulus of elasticity E, and length l is fixed at one end and free at other end. It is subjected to an axial force F0 at the free end as shown in following figure. **07**



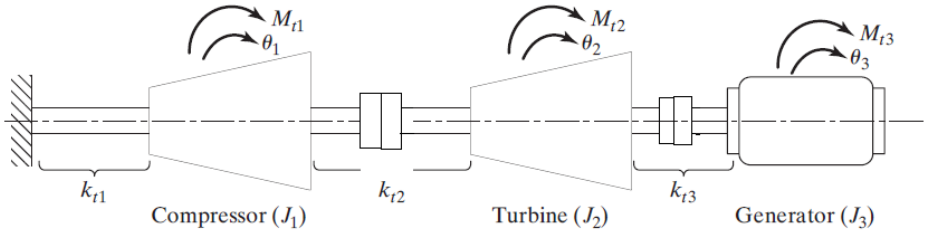
OR

(b) Derive the equations of motion for the transverse vibration of a string. **07**

Q:3 **(a)** Explain the approximate methods to determine the fundamental frequency of multi degree of freedom system. **07**

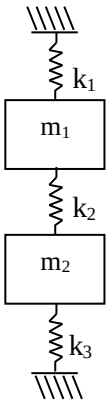
(b) The arrangement of the compressor, turbine, and generator in a thermal power plant is shown in the following figure. This arrangement can be considered as a torsional system where Ji denote the mass moments of inertia of the three components (compressor, turbine, and generator), M_{ti} indicate the external moments acting on the components, and k_{ti} represent **07**

the torsional spring constants of the shaft between the components, as indicated in the figure. Derive the equations of motion of the system using Lagrange s equations by treating the angular displacements of the components θ_i as generalized coordinates.



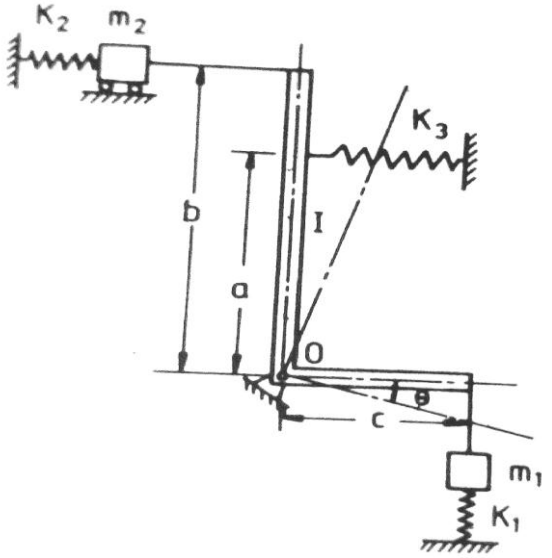
OR

Q:3 **(a)** Find the natural frequency and mode shape for the following system. Assume that $k_1 = k_3 = k$; $k_2 = 2k$ and $m_1 = m_2 = m$. **07**

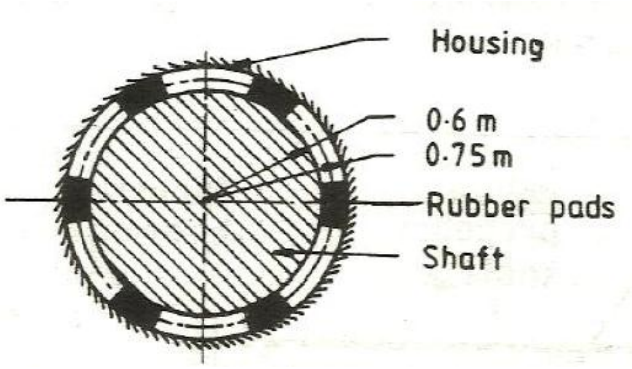


(b) Derive the equation of motion for two degree of freedom mass coupled system and find out the natural frequency of the system. **07**

Q:4 **(a)** An indicator mechanism is shown in the following figure. The arm pivoted at point O has a mass moment of inertia I and is constrained to move about O by two spring mass system K_1, m_1, K_2, m_2 and another spring K_3. Using maximum energy determined the natural frequency. **07**



(b) Six equally spaced rubber pads are used for mounting a machinery as shown in the following Fig. The pad subtends an angle of 25° at the centre and its length in the axial direction is 0.1 m. If the shear modulus of the rubber is 6×10^5 N/m^2 . What is the total torsional stiffness of the pads? Determine the natural frequency of the system if the mass moment of inertia of machinery is 800 kgm^2. **07**



OR

Q:4 **(a)** Explain the Frahm's dynamic vibration absorber. **07**

(b) An instrumental panel of natural period 0.1 s, is excited by a step function ½ cm magnitude of period τ = 0.075 s. Determine the response of the system by phase plane method. **07**

Q:5 **(a)** Explain the vibration isolation and force transmissibility. **07**

(b) Explain the different types of instruments that are used in conducting the vibration tests. **07**

OR

Q:5 **(a)** Derive the equations for viscous damping factor in following cases: **07**

1. Viscous damper based on friction in pipe
2. Torsional viscous damper based on two parallel circular plates

(b) Determine the response to an initial disturbance of single degree of freedom undamped system **07**

****