BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE
FIRST SEMESTER 2016-17, COMPREHENSIVE EXAM
DE G611 DYNAMICS & VIBRATIONS (Regular)
Date: 09-12-2016 Maximum Marks: 35 Time: 3 Hours

For Open Book (part-B) you can use any book, xerox material, Laptop without Internet.

Part-A (Closed Book)

Q1. The disk in the system shown in Fig. Q1 rolls without slip. Derive the Equation of motion of the system. Find the Value of 'c' such that the system has damping ratio of 0.2. **[3]**

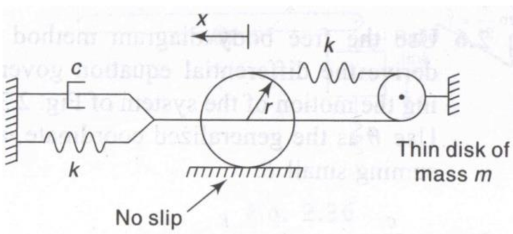

Fig. Q1

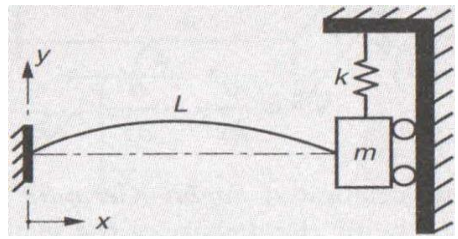

Fig. Q2

Q2. A string of length L and mass per unit length ρ is under tension T with its one end fixed and the other end being attached to a spring mass system constrained to move vertically as shown in Fig.Q2. Derive the characteristics equation of the system. **[3]**

Q3. Derive the equation of motion for a bar. Determine the natural frequencies and mode shapes of axial vibration of a fixed-free bar having uniform cross section area. **[3]**

Q4. State the orthogonality condition for modes in a continuous system. Prove the orthogonality condition for a free-free beam. **[3]**

Q5. A non-uniform cross section bar of length 'L' is shown in Fig. Q5. Use Rayleigh's method find the lowest natural frequency of longitudinal motion of the bar. Given, cross-sectional area, $A(x)= 2A(1-x/L)$ **[5]**

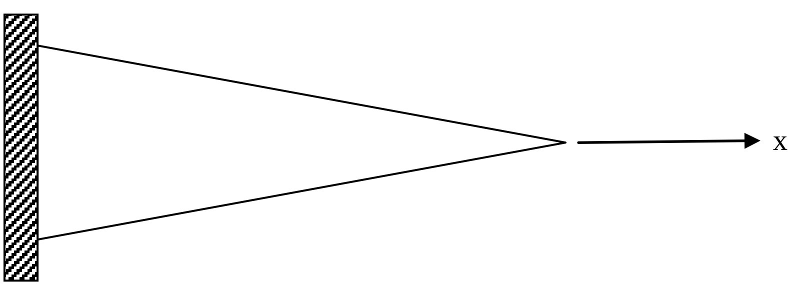

Fig. Q5

Part-B (Open Book)

Q1. A uniform bar of length 'L' and mass 'm' is suspended symmetrically by two strings as shown in Fig. Q1. Establish the differential equation of motion for small angular oscillations of the bar about the vertical axis O-O and find the time period of oscillation. **[3]**

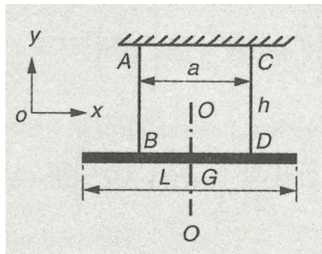

Fig. Q1

Q2 A cantilever rod of circular cross section shown in Fig. Q2.

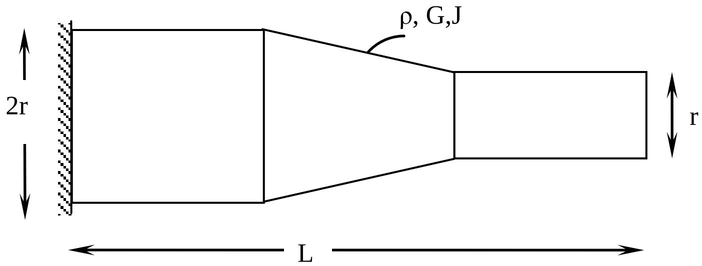

Fig. Q2

(a)Using three element finite element model find out the assemble mass matrix and stiffness matrix for the torsional motion of the rod as shown in Fig.Q2. **[6]**

(b)Determine the natural frequency and draw the mode shapes based on global matrices obtained from Q2(a). **[3]**

(c) Use Rayleigh-Ritz method to approximate two lowest natural frequency of the system as shown in Fig.Q2. **[6**]