

ME Dept., IIT Delhi
MEL832: Multibody Systems & Vibration Design
Major (Apr. 28, 2008)

Duration: 2 hours

Total Marks: 30

1. Answer the following: [7]
 - a) Write the principles of at least three dynamic modeling techniques. (3)
 - b) What are the ways of solving DAEs? Write different sources of numerical errors. (2)
 - c) What are the ways of representing the rotation of a rigid body? What is homogeneous transformation matrix in a rigid-body motion? (2)
2. For the system in Fig. 1, write its dynamic equations of motion using the concept of Natural Orthogonal Complement (NOC) matrix. [8]

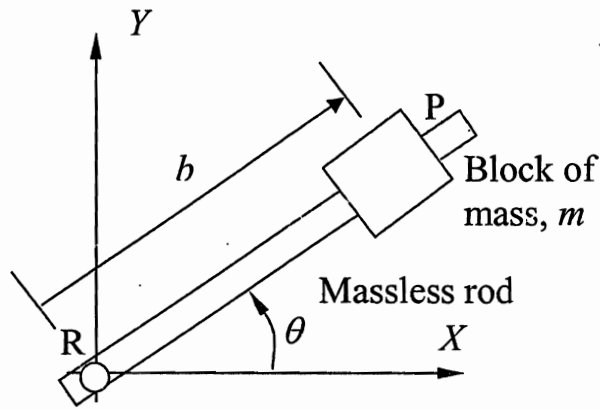


Fig. 1 A block sliding on rotating mass-less rod

3. The dynamics of a two-dimensional flexible beam is modelled using two elastic coordinates. The shape function of the beam is assumed to be

$$\mathbf{S} = \begin{bmatrix} \sin(\pi\xi) & 0 \\ 0 & \sin(\pi\xi) \end{bmatrix}$$

where the generalized coordinates are given by

$$\mathbf{q} = [R_1 \quad R_2 \quad \theta \quad q_{f1} \quad q_{f2}]^T$$

R_1 , R_2 , θ , and q_{f1} , and q_{f2} being to the position of the beam, its orientation, and the flexible time-dependent variables. Determine the expression of mass matrix of the beam.

$$[\text{If required, } \int \sin^2 x dx = \frac{x}{2} - \frac{\sin(2x)}{4}]$$

[15]

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