Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2017

SUBJECT: ROBOT DYNAMICS AND CONTROL [MTE 4007]

REVISED CREDIT SYSTEM

(25/11/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

1A. Write down the forward kinematics equation and Jacobian matrix for two link planar manipulator. Write down the singularity location for the same employing rank of the Jacobian matrix. **05**

1B. Deduce the equation of motion for two link planar manipulator (Q1B) **05**

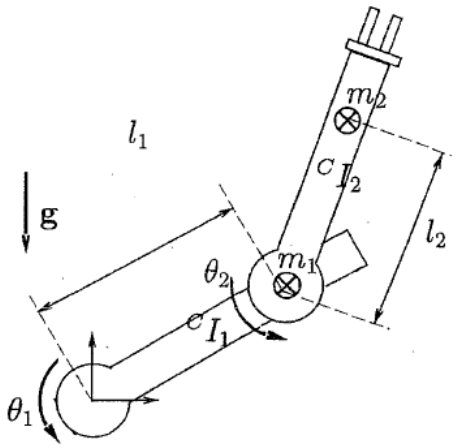

Figure. Q1B.

2A. Write down the general form of EoF (equation of motion) for multi body system. What does each of the component represents? Deduce the same using Lagrangian Formulation. **06**

2B. Write down the expression for the individual force components (in the EoF). **04**

3A. Determine the Equation of Motion (EoF) fr the system shown in Figure Q3A, if parameter values are in = 1, b = 5, and k = 6 and the block (initially at rest) is released from the position x = —1. **04**

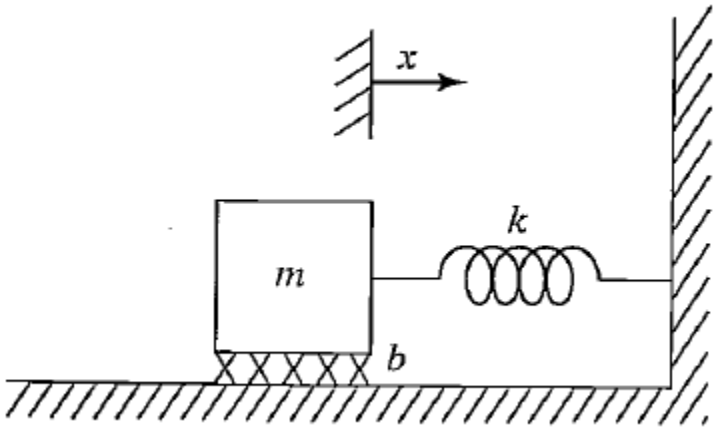

Figure Q3A

3B. If the parameters of the system in Figure Q3A are in m = 1, b = 1, and k = 1, find the gains k_p, k_v for a position-regulation control law that results in the system's being critically damped with a closed-loop stiffness of 16.0. **04**

3C. Draw a block diagram for a position regulator system **02**

4A. Draw the basic block diagram of partitioned control method and derive the close loop equation for the same. **04**

4B. If the parameters of the system in Figure Q3A are in m = 1, b = 1, and k = 1, find α, β and the gains k_p, k_v for a position-regulation control law that results in the system's being critically damped with a closed-loop stiffness of 16.0. **04**

4C. What are the two conditions which needs to be satisfied for stability detection by Lyapunov's method. **02**

5A. Draw the block diagram for Hybrid position/force controller for a general manipulator. **04**

5B. Illustrate the concept of Model Based control for general manipulator with servo control law. **04**

5C. With the help of energy analysis demonstrate that spring-mass-friction system will eventually come to rest even when it starts with an arbitrary initial condition **02**