Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

FIFTH SEMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: SYSTEM MODELING AND SIMULATION [ICE 319]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A.	Define transfer function? State whether transfer function modeling technique is applicable to non-linear system and whether the transfer function is independent of the input of a system. List the drawbacks in the conventional transfer function model.	**4**
1B.	A common example of a two-input control system is a home shower with separate valves for hot and cold water. The objective is to obtain (1) a desired temperature of the shower water and (2) a desired flow of water. Sketch a block diagram of the closed-loop control system.	**3**
1C.	Obtain the transfer function $X_2(s)/U(s)$ for the mechanical system shown in Fig Q(1C).	**3**
2A.	Write the differential equation governing the mechanical system shown in Fig Q(2A). Draw the force-current analogous circuit and verify by writing node equation.	**5**
2B.	Derive transfer function and state space model of an armature controlled DC motor.	**5**
3A.	In the liquid-level system of Fig. Q(3A) assume that the outflow rate Q m^3/sec through the outflow valve is related to the head H m by $Q = 0.01\sqrt{H}$. Also assume that when the inflow rate Qi is 0.015 m^3/sec the head stays constant. For t < 0 the system is at steady state at (Qi=0.015 m^3/sec). At t=0 the inflow valve is closed and so there is no inflow for $t \geq 0$. Find the time necessary to empty the tank to half the original head. The capacitance C of the tank is 2 m^2.	**5**
3B.	For the hydraulic linear actuator shown in Fig Q (3B), obtain the transfer function Y(s)/X(s). List the advantages and disadvantages of hydraulic system.	**5**
4A.	Define transmissibility for force excitation and motion excitation. Explain the variation of transmissibility with $\beta(=\frac{\omega}{\omega_n})$ and damping factor.	**5**
4B.	For the mechanical system shown in Fig Q (4B), when P = 1N and ω = 2 rad/s, the steady state amplitude of x(t) is found to be 0.05 m. If the forcing frequency is changed to ω = 10 rad/s, the steady-state amplitude of x(t) is found to be 0.02 m. Determine the values of b and k.	**5**
5A.	With a schematic diagram, briefly explain about longitudinal and lateral – directional motion of an aircraft. Derive moment equations of an aircraft.	**7**
5B.	Obtain the state space model for the single axis space craft as shown in Fig Q(5B), flying near-earth or an interplanetary trajectory. Moments acting on the spacecraft are control moment $M_C(t)$ and disturbance moment $M_D(t)$.	**3**

6A. Consider the inverted – pendulum system shown in Fig Q(6A). Assume that the mass of the inverted pendulum is m. The center of gravity of the pendulum is located at the center of the rod. Assuming that θ is small, derive the differential equation describing the whole system. **5**

6B. Write about the physical setup of a ball and beam system. Considering both rotational and translational motion of the ball, derive the differential equation governing the system. **5**

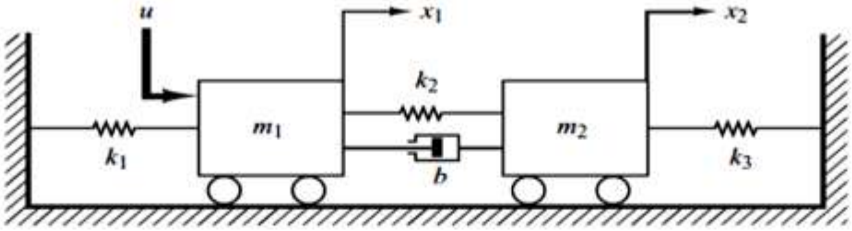

Fig. Q (1C)

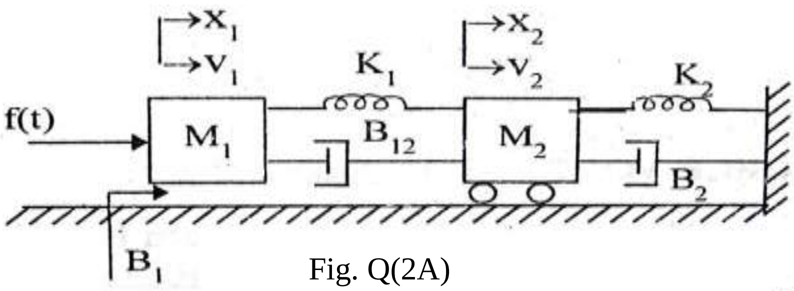

Fig. Q(2A)

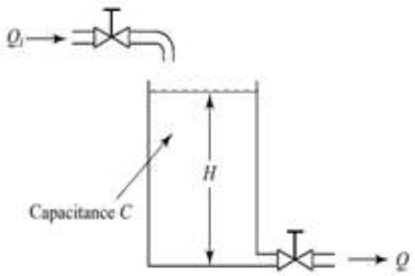

Fig Q(3A)

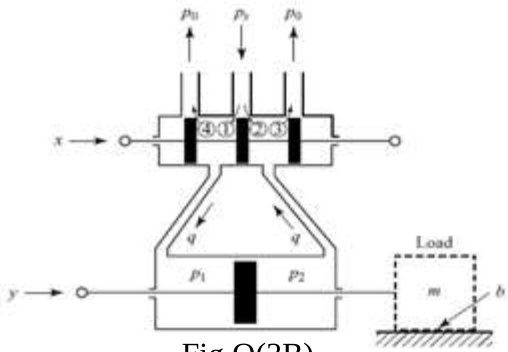

Fig Q(3B)

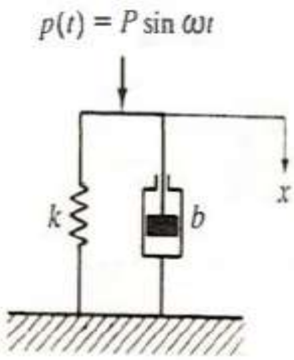

Fig Q(4B)

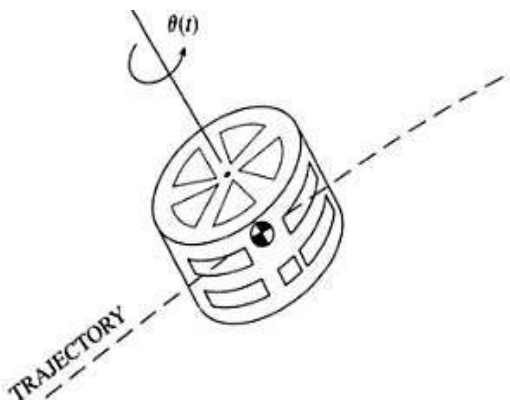

Fig Q(5B)

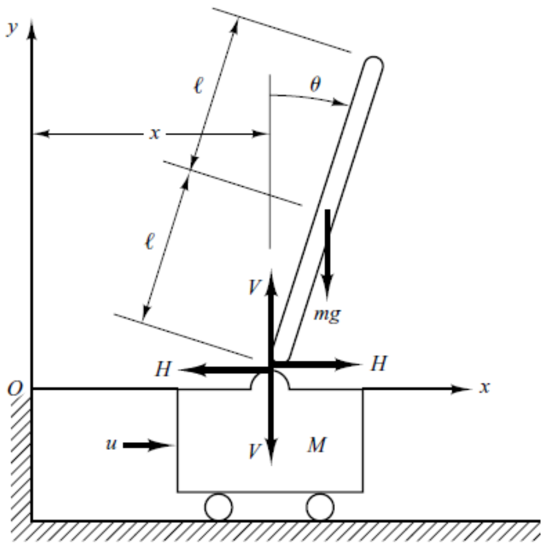

Fig Q(6A)