Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, JULY 2016

SUBJECT: LINEAR CONTROL THEORY [MTE 2203]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Construct the root locus diagram of a negative unity feedback system with OLTF, $G(s) = \frac{K}{(s+1)(s+3)}$ **5**

1B. Design a proportional controller to yield a closed-loop step response with 17.8% overshoot for the system described in question 1A. **2**

1C. Design a compensator with 17.8% overshoot to reduce the steady state error to zero for a unit step input without appreciably affecting transient response. Also comment on the steady state error of the system for a unit step input **3**

2A. Determine the transfer function, $G(s) = V_o(s)/V_i(s)$, for the operational amplifier circuit shown in the Figure 1. **4**

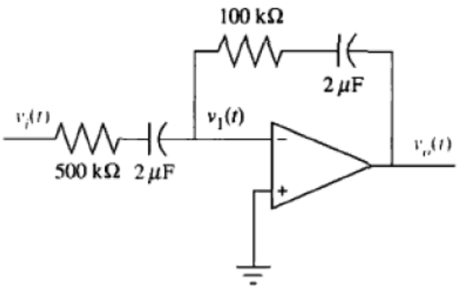

Figure 1

2B. For the system shown in Figure 2, find natural frequency, damped frequency, damping ratio, percent overshoot, settling time and peak time. **5**

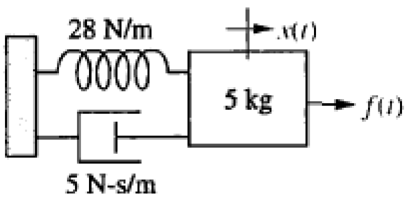

Figure 2

2C. Also determine the order of the system shown in figure 2. **1**

3A. Design a passive compensator for a level controller of nuclear power plant with OLTF as **4**

$G(s) = \frac{K\,(s+2)}{(s+1)(s+3)(s+4)}$ to improve the steady-state error by a factor of 10 if the system is operating with 17.8%overshoot. (The root locus of the plant is given in the Figure 3).

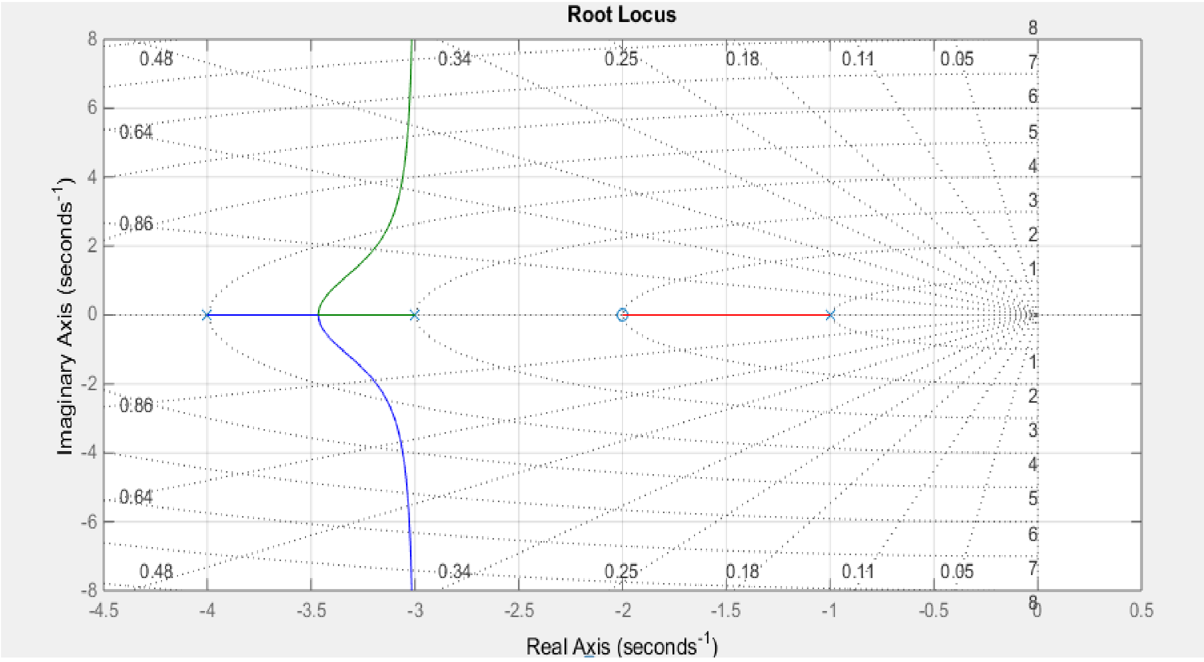

Figure 3

3B. Verify the design in question 3A **2**

3C. For the rotational system shown in Figure 4, Identify the transfer function, $G(s) = \theta_2(s)/T(s)$. **4**

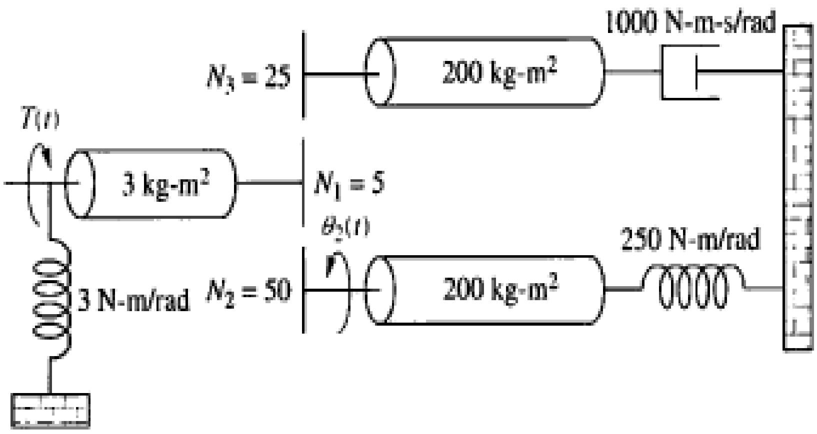

Figure 4

4A. Find the transfer function Y_7/Y_1 of the system shown in the Figure 5 using Mason's gain formula **6**

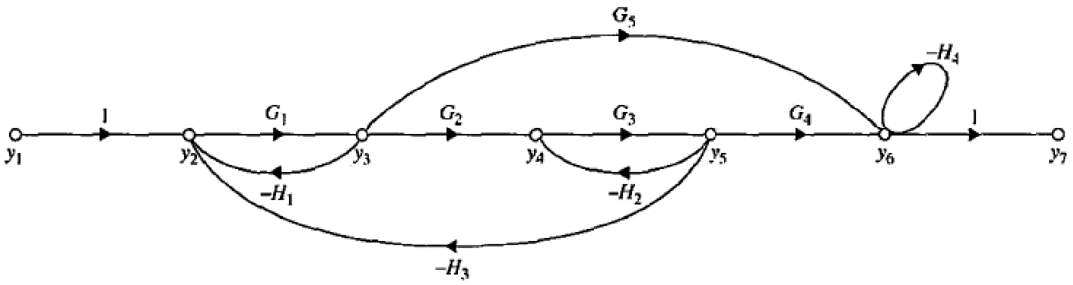

Figure 5

4B. The unit-step response of a linear control system is shown in figure 6. Find the transfer function of a second-order prototype system to model the system. **4**

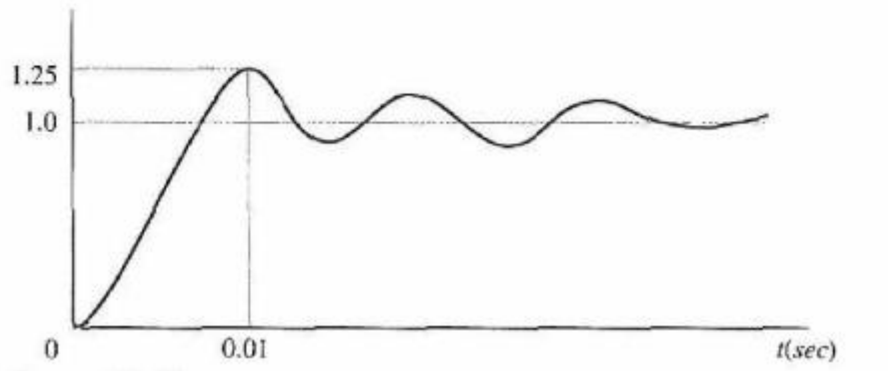

Figure 6

5A. Write, but do not solve, the equations of motion for the translational mechanical system shown in Figure 7. **4**

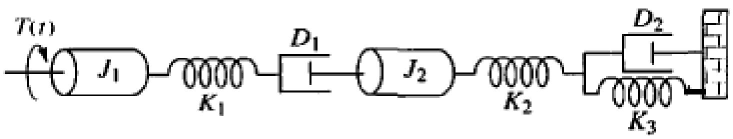

Figure 7

5B. For the system shown in Figure 8, determine the following **5**

- The system type
- The appropriate static error constant
- The input waveform to yield a constant error and the steady-state error for a unit input of the waveform found
- Final value of the system response

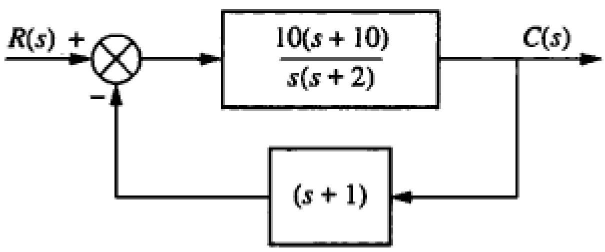

Figure 8

5C. Describe the necessity of closed loop control systems. **1**