Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, JULY 2017

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 suitable assumed.
- Graph sheets will be provided

1A. Apply Mason's gain formula to the signal flow graph shown in Figure 1A and find the transfer function C/R. **04**

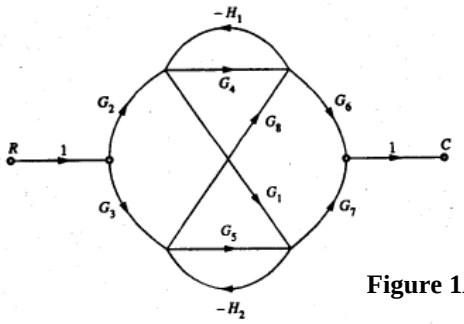

Figure 1A

1B. If $V_i(t)$ is a unit step voltage in the network shown in figure 1B, find the value of the resistor such that a 20% overshoot in voltage will be seen across the capacitor if C = 1μ F and L = 1H. **03**

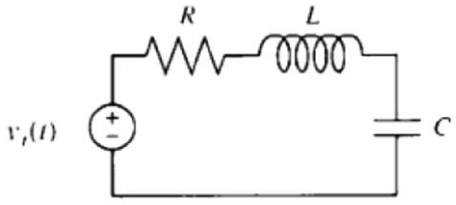

Figure 1B

1C. Write but do not solve the equations of motion for the mechanical system shown below **03**

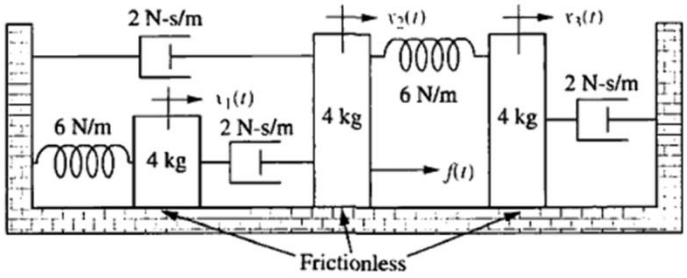

Figure 1C

2A. Find the values of n, K and a in order to meet 12% overshoot and K_v= 110 for a unity feedback system with OLTF given as follows **03**

$$G(s) = \frac{K}{(s^n + a)}$$

2B. The OLTF of a unity feedback system is represented as follows **04**

$$G(s) = \frac{10}{s^5 + 7s^4 + 6s^3 + 42s^2 + 8s + 56}$$

Using the Routh Hurwitz Criterion, find the stability of the closed loop system. Comment on the location of poles

2C. For the system shown in figure 2C, find the ratio N1/N2 such that the settling time for a step torque input is 16s. **03**

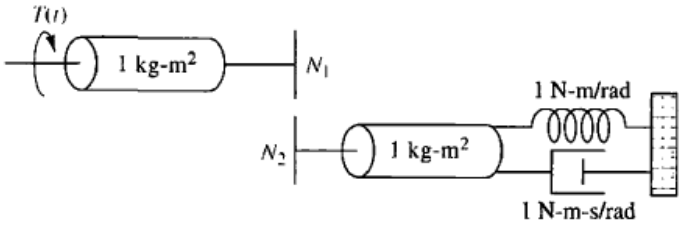

Figure 2C

3A. Sketch the root locus for the system that has OLTF **06**

$$\frac{K}{s(s+2)(s^2+s+1)}$$

3B. For the system in question 3A calculate the gain at breakaway point and imaginary axis crossing **02**

3C Comment on the stability of the system in question 3A and find the frequency of critically damped oscillations **02**

4A. Find the transfer function $\theta_L(s)/E_a(s)$ for system shown in figure 4A1 given Torque Speed curve as shown in figure 4A2 **04**

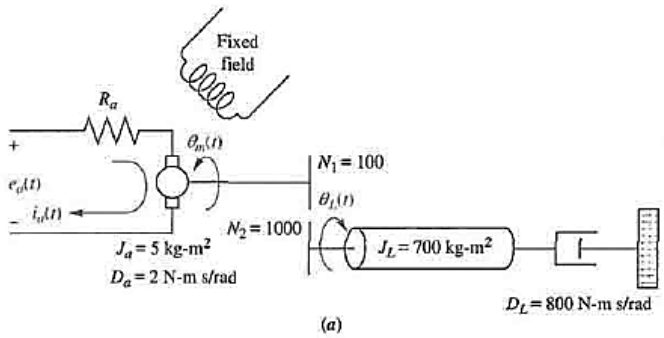

Figure 4A1

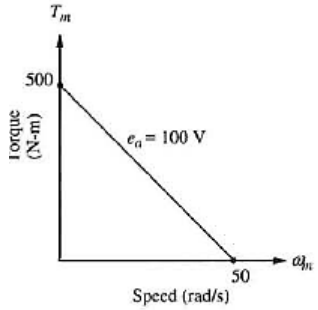

Figure 4A2

4B. Define the term asymptotic stability **01**

4C. For the unity feedback system with OLTF given as follows **05**

$$G(s) = \frac{K}{s(s+2)}$$

Design a compensator to decrease steady state error by a factor of 10 while operating at an overshoot of 0.501%. Root locus of the uncompensated system is shown.

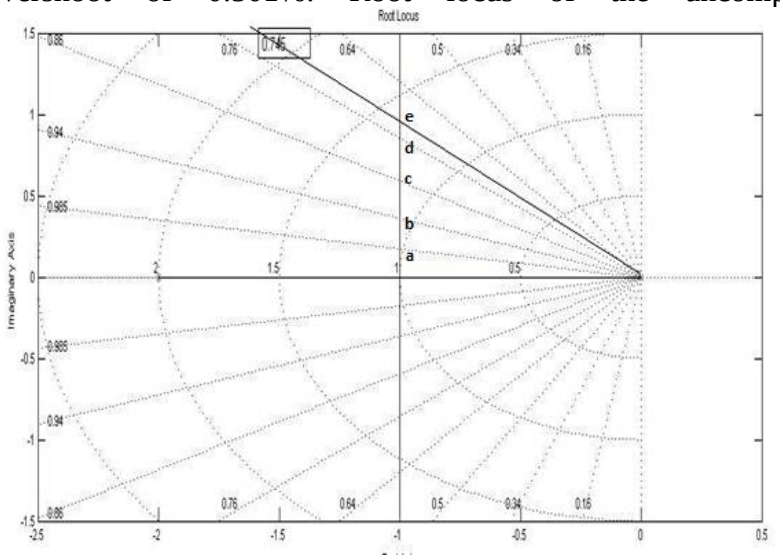

Figure 4C

a = -1+0.1i
b = -1+0.4i
c = -1+0.6i
d = -1+ 0.7i
e = -1+0.85i

5A. For the system shown in figure 5A, determine the following **05**

(i) System Type

(ii) Appropriate static error constant

(iii) Input waveform to yield a constant error. Also calculate the steady state error for the suggested waveform of magnitude unity.

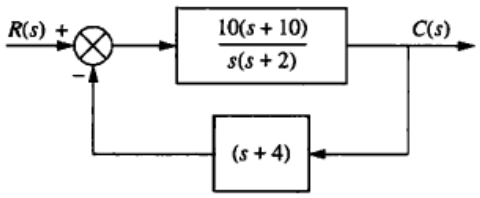

Figure 5A

5B. Using block diagram reduction technique, reduce the following system shown in figure 5B into a single transfer function. **03**

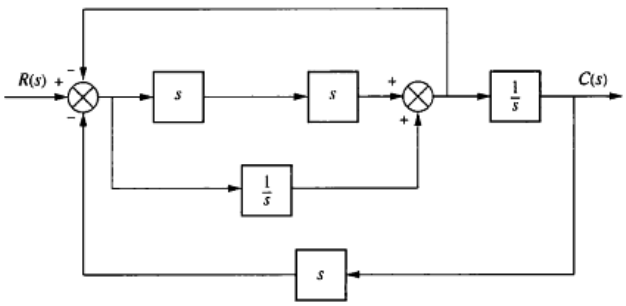

Figure 5B

5C. For the given transfer function, find damping ratio and natural frequency of oscillation **02**

$$G(s) = \frac{36}{s^2 + 4.2s + 36}$$