USN | | | | | | | | | | |

10ES43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Control Systems

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define and compare open loop control system with closed loop control system with an example. **(06 Marks)**

b. Obtain the differential equation for the Fig. Q1 (b) shown in Fig. Q1 (b). **(04 Marks)**

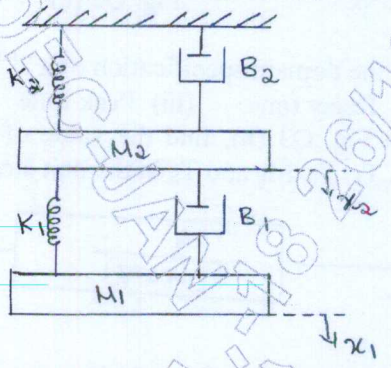

Fig. Q1 (b)

c. Obtain the differential equation describing the system shown in the Fig. Q1 (c) and also sketch the electrical circuit based on, (i) Torque voltage analogy (ii) Torque current analogy. **(10 Marks)**

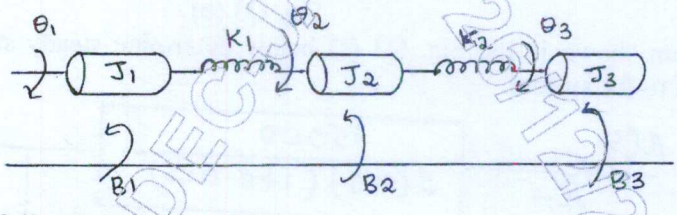

Fig. Q1 (c)

2 a. Define the following terms:
(i) Self loop (ii) Node (iii) Branch (iv) Feedback loop. **(04 Marks)**

b. Simplify the block diagram shown in the Fig. Q2 (b) below, also obtain he closed loop transfer function $C(s)/R(s)$. **(08 Marks)**

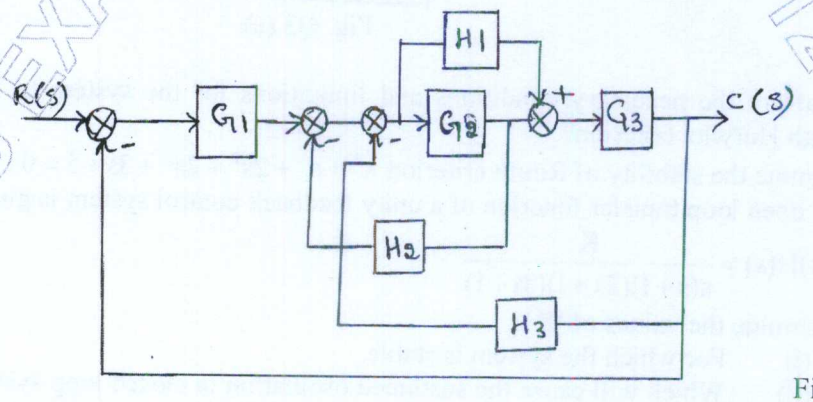

Fig. Q2 (b)

c. Find the overall transfer function by using Mason's gain formula for Fig. Q2 (c) shown below. **(08 Marks)**

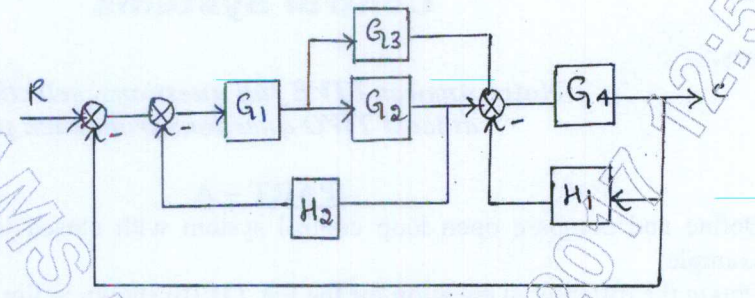

Fig. Q2 (c)

3 a. Explain the following time domain specification of a 2nd order system,
(i) Rise time (ii) Delay time (iii) Peak time (iv) Peak overshoot. **(06 Marks)**

b. For a system shown in Fig. Q3 (b), find the value of 'A' such that damping ratio is 0.5, determine the values of Tr, T_P, M_P and T_S in the unit step response. **(08 Marks)**

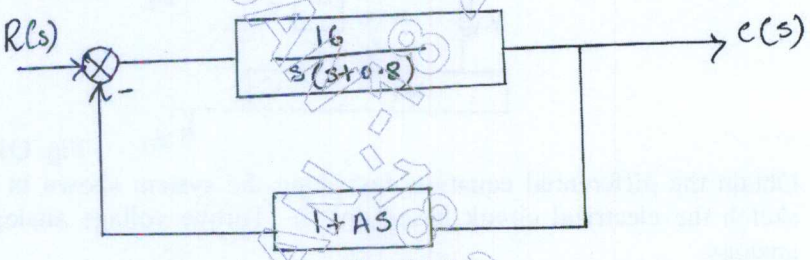

Fig. Q3 (b)

c. For a system shown in the Fig. Q3 (c) below determine steady state error for a unit step input given to the system. **(06 Marks)**

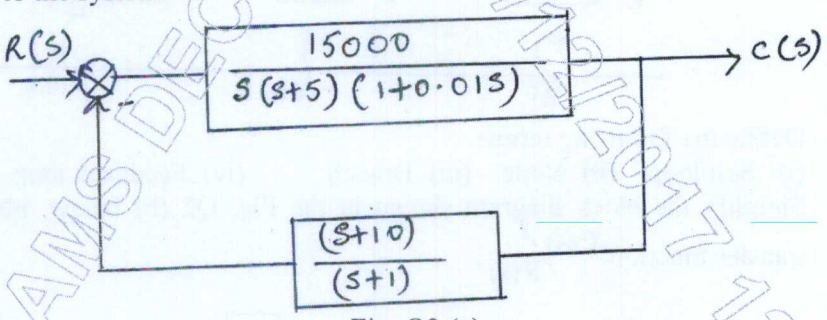

Fig. Q3 (c)

4 a. What are the necessary conditions and limitations for the system to be stable in case of Routh Hurwitz criterion? **(06 Marks)**

b. Examine the stability of Routh criterion $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. **(06 Marks)**

c. The open loop transfer function of a unity feedback control system is given by,

$$G(s)H(s) = \frac{K}{s(s+1)(2s+1)(3s+1)}$$

Determine the values of 'K'.
(i) For which the system is stable.
(ii) Which will cause the sustained oscillation in closed loop system and frequency of sustained oscillations? **(08 Marks)**

PART – B

5 a. What is Root locus? State the different rules for construction of root loci? **(08 Marks)**

b. For a unity feedback system $G(s) = \frac{K}{s(s+4)(s+2)}$. Sketch the root locus showing all the details on it. **(12 Marks)**

6 a. State and explain Nyquist stability criterion. **(08 Marks)**

b. Sketch the Nyquist plot and comment on closed loop stability of a system whose open loop transfer function is,

$$G(s)H(s) = \frac{10}{s(s+2)(s+1)}$$ **(12 Marks)**

7 a. Define the following terms:

(i) Gain cross over frequency (ii) Gain margin

(iii) Phase cross over frequency (iv) Phase margin **(08 Marks)**

b. A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine GM, PM, ω_{gc} and ω_{pc}. Comment on the stability. **(12 Marks)**

8 a. Define the following terms:

(i) State

(ii) State variable

(iii) State space **(06 Marks)**

b. Obtain the state space representation of the following system given by,

$$\frac{Y(s)}{U(s)} = \frac{2(s+3)}{(s+1)(s+2)}$$

Find the partial fraction of it. **(07 Marks)**

c. Obtain phase variable representation for a system whose transfer function is given by,

$$\frac{Y(s)}{u(s)} = \frac{6s^3 + 4s^2 + 3s + 10}{s^3 + 8s^2 + 4s + 20}$$. **(07 Marks)**

* * * * *