CBCS SCHEME

USN

15ME73

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
Control Engineering

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Control System. With block diagram and examples, explain open loop control system and closed loop control system. (10 Marks)

b. What are the requirements of an Ideal Control System? (06 Marks)

OR

2 Explain the following controllers with block diagrams:

(i) Proportional Controller

(ii) Integral Controller

(iii) Proportional plus Integral Controller

(iv) Proportional plus integral plus differential controller (16 Marks)

Module-2

3 a. Write the Force Voltage and Force current analogous circuit for the mechanical system shown in Fig.Q3(a).

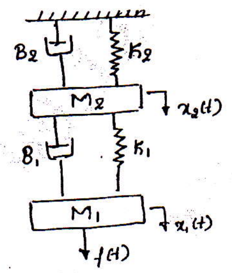

Fig.Q3(a) (10 Marks)

b. Derive an expression for the transfer function of armature controlled D.C motor. (06 Marks)

OR

4 Reduce the block diagram shown in Fig.Q4. Also verify the answer using signal flow graph and Mason's gain formula.

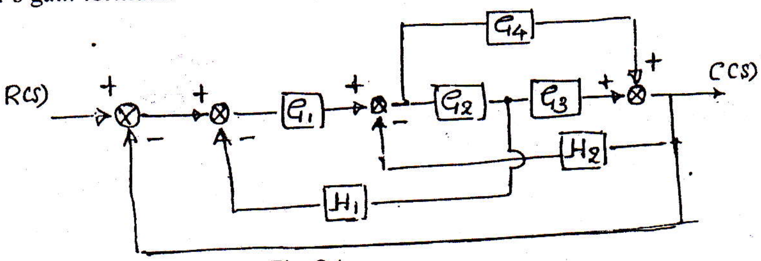

Fig.Q4 (16 Marks)

Module-3

5 a. Using RH criterion investigate the stability of the control system with characteristic equation
$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ (05 Marks)

b. Obtain an expression for time response of a first order control system subject to unit step input. (05 Marks)

c. A unity feedback control system is characterized by an OLTF

$$G(s) = \frac{10}{s^2 + 5s + 6}$$

Determine the following when system is subjected to an unit step input
(i) Undamped Natural Frequency
(ii) Damping ratio
(iii) Peak overshoot
(iv) Peak time
(v) Settling time (06 Marks)

OR

6 Draw root locus plot for the system with OLTF

$$G(s)H(s) = \frac{k}{s(s+3)(s^2 + 3s + 4.5)}$$

Also comment on stability of the control system. (16 Marks)

Module-4

7 Sketch the Bode plot for the system whose OLTF is given by

$$G(s)H(s) = \frac{ke^{-0.2s}}{s(s+1)(1+0.1s)}$$

Determine the value of System Gain k for a gain crossover frequency of 5 rad/s. (16 Marks)

OR

8 a. Explain Nyquist stability criteria. (04 Marks)

b. For a control system

$$G(s)H(s) = \frac{k}{s(s+2)(s+10)}$$

draw the Nyquist plot and hence calculate the range of values of 'k' for stability. (12 Marks)

Module-5

9 a. What is System Compensation? Explain (i) Series compensation (ii) Feedback compensation. (07 Marks)

b. Explain phase lag, phase lead and lag lead compensation circuits with sketches. (09 Marks)

OR

10 a. Explain the following terms :
(i) Controllability (ii) Observability (06 Marks)

b. Find the controllability and observability of the system described by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$y = [1 \quad 0]x$ (10 Marks)

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