CBCS SCHEME

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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).

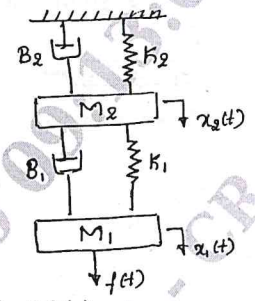

Fig.Q3(a) **(10 Marks)**

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.

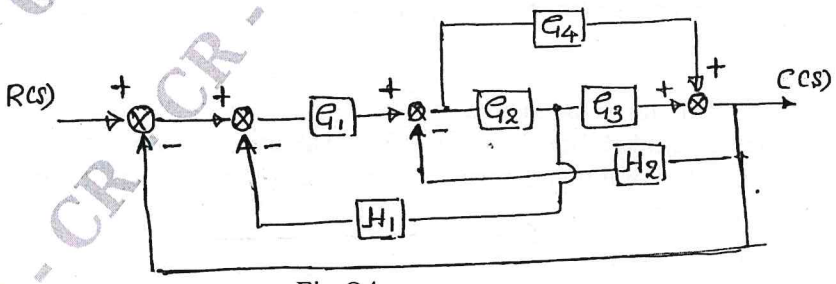

Fig.Q4 **(16 Marks)**

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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