CBCS SCHEME

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15ME73

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.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. With a block diagram differentiate open loop and closed loop system. **(08 Marks)**

b. Discuss the main requirements of an ideal control system. **(08 Marks)**

OR

2 Explain following types of controller with block diagram and state its characteristics.
(i) Proportional
(ii) Proportional plus derivative
(iii) Integral
(iv) Proportional plus integral **(16 Marks)**

Module-2

3 a. Obtain the transfer function for an armature controlled D.C motor, which relates output angular displacement (Q) with input voltage (e). **(08 Marks)**

b. A thermometer is dipped in a vessel containing liquid at a constant temperature of θ_1. thermometer has a thermal capacitance for storing heat as C and thermal resistance to limit heat flow as R. If the temperature indicated by thermometer is θ_r, obtain the transfer function of the system. **(08 Marks)**

OR

4 a. Obtain the overall transfer function of the block diagram shown in Fig.Q4(a) by reduction technique. **(10 Marks)**

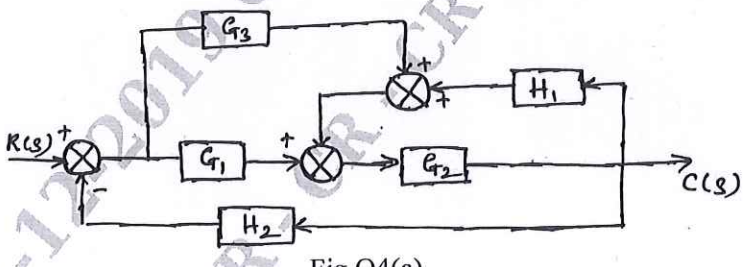

Fig.Q4(a)

b. Discuss Mason's gain formula and define the following terms used in signal flow graphs.
(i) Node (ii) Branch gain (iii) Forward path (iv) Path gain (v) Feedback loop
(vi) Self loop **(06 Marks)**

Module-3

5 Obtain the expressions for Peak time, Rise time, Maximum overshoot and settling time for a second order control system in terms of damping factor and nature frequency. **(16 Marks)**

OR

6 Sketch the root locus of unity feedback system whose forward path transfer function is

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

Determine the range of k for the system to be stable. **(16 Marks)**

Module-4

7 Draw the Bode plot for the following transfer function and determine gain margin and phase margin.

$$G(s)H(s) = \frac{10.5}{(s + 0.2)(s + 0.8)(s + 10)}$$ **(16 Marks)**

OR

8 Using Nyquist criterion, investigate the stability of a system whose open loop transfer function is $G(s)H(s) = \frac{k}{(s+1)(s+2)(s+3)}$ **(16 Marks)**

Module-5

9 Obtain the transfer functions of the following types of compensators:
(i) Lag compensator
(ii) Lead compensator **(16 Marks)**

OR

10 a. Explain the following :
(i) Kalman's test of controllability
(ii) Kalman's test of observability **(06 Marks)**

b. Determine the controllability and observability of the systems represented by

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$ **(10 Marks)**

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