

CBCS SCHEME

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)

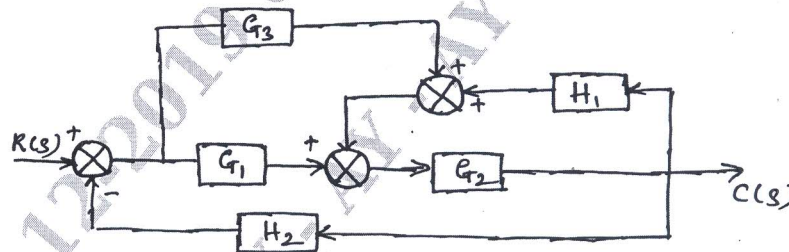


Fig.Q4(a)

- 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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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

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

$$y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x$$

(10 Marks)

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