

# CBCS SCHEME

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15ME73

## Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024 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. Explain open and closed loop control systems with examples. (08 Marks)
- b. With block diagram, explain:
  - i) Proportional controller
  - ii) Integral controller
  - iii) Proportional plus differential controller. (08 Marks)

OR

- 2 a. List the advantages and disadvantages of open loop and closed loop control system. (08 Marks)
- b. Explain requirements of automatic control system. (08 Marks)

### Module-2

- 3 a. Write differential equations for the system shown in fig.Q3(a). The force (F) produced by the Solenoid, when coil is connected to voltage source is  $F = (t) = K i(t)$ . and determine  $x(s) / e(s)$ . (08 Marks)

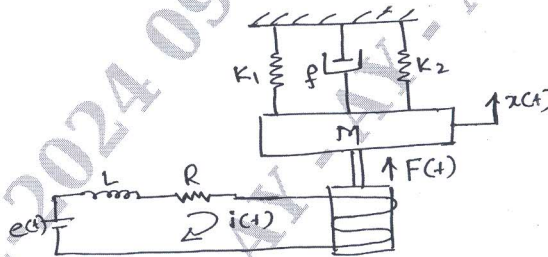


Fig.Q3(a)

- b. Reduce the following block diagram and determine control ratio fig.Q3(b). (08 Marks)

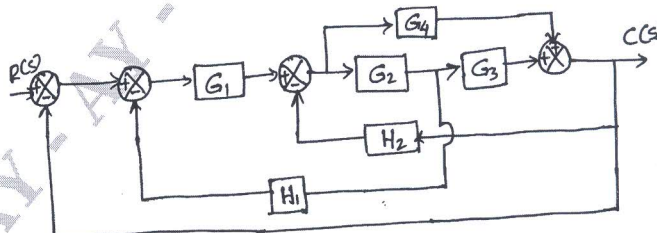


Fig.Q3(b)

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

- 4 a. Derive the transfer function of an armature controlled DC motor, where output parameter is the angle turned by motor shaft and input is the applied voltage to the armature circuit. (08 Marks)
- b. Using Mason's gain formula, find the gain of the following system shown in Fig.Q4(b). (08 Marks)

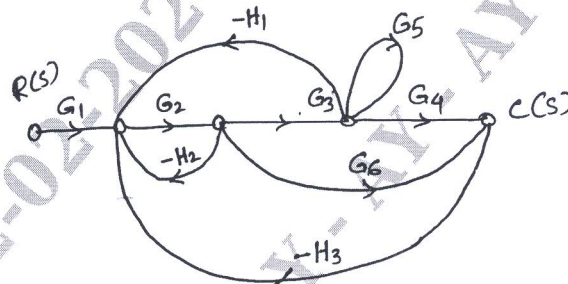


Fig.Q4(b)

**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 a. Sketch Polar plot for the transfer function :

$$G(S) = \frac{1}{S^2(S+1)(2S+1)}$$

(06 Marks)

- b. Apply Nyquist stability criteria to the system with transfer function :

$$G(S) H(S) = \frac{(4S+1)}{S^2(S+1)(2S+1)}$$

(10 Marks)

OR

- 8 Sketch Bode plot for

$$G(S) H(S) = \frac{10}{S(1+0.4S)(1+0.1S)}$$

and obtain Gain and Phase cross over frequency. (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  
b. Determine the controllability and observability of the systems represented by

(06 Marks)

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

(10 Marks)

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