

# CBCS SCHEME

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15ME73

Seventh Semester B.E. Degree Examination, Jan./Feb.2021

## Control Engineering

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- What are the ideal requirements of a control system? Explain. (08 Marks)
  - Explain the following controllers with the help of block diagrams and response curves:  
(i) Proportional plus integral. (ii) Proportional plus integral plus derivative. (08 Marks)

OR

- How control systems are broadly classified? Explain with the help of block diagrams and examples. (08 Marks)
  - Compare and contrast proportional, integral and differential controllers. (08 Marks)

### Module-2

- For the physical system shown in Fig. Q3 (a), draw the Free Body diagram and write the system equations in time domain and S domain. (10 Marks)

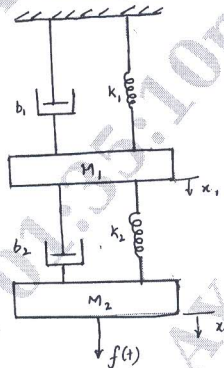


Fig. Q3 (a)

- With usual notations, obtain the transfer function of a field controlled D.C. motor. (06 Marks)

OR

- Obtain the control ratio C/R for the block diagram shown in Fig. Q4 (a). (08 Marks)

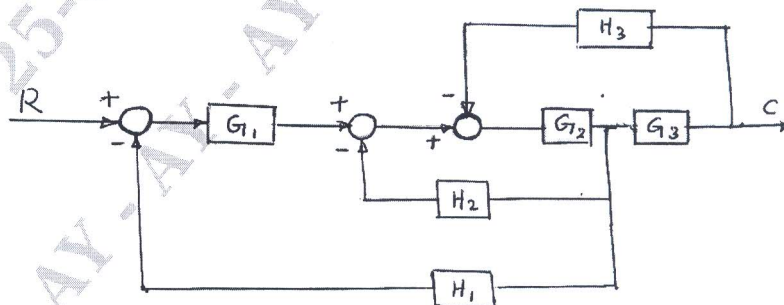


Fig. Q4 (a)

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.

- b. Find the transfer for the signal flow graph shown in Fig. Q4 (b) by using Mason's gain formula. (08 Marks)

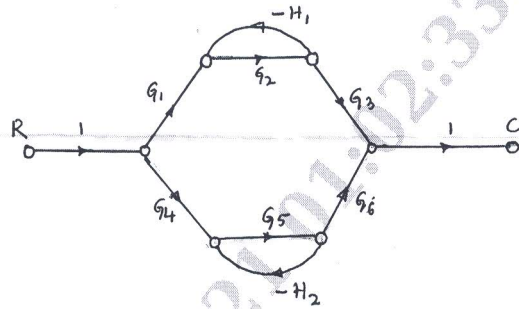


Fig. Q4 (b)

**Module-3**

- 5 a. With the help of a time response curve of a second order system, explain the following:  
 (i) Delay time (ii) Rise time (iii) Peak time (iv) Settling time  
 (v) Maximum over shoot (08 Marks)
- b. The open loop transfer function of a unity feedback system is  $G(s) = \frac{4}{s(s+1)}$ . Determine natural frequency, damped natural frequency, rise time, peak time, peak overshoot and settling time. (08 Marks)

OR

- 6 Sketch the root locus plot for the given system,  $GH = \frac{K}{s(s+4)(s+2+2j)(s+2-2j)}$  and determine the range of K for which the system remains stable. (16 Marks)

**Module-4**

- 7 a. State and explain Nyquist stability criteria. (04 Marks)  
 b. Draw the complete Nyquist plot for the system whose open loop transfer function is given by,  $GH = \frac{K}{s(1+0.1s)(1+0.5s)}$ . Determine the range 'K' for which the system is stable. (12 Marks)

OR

- 8 The open loop transfer function of a unity feedback control system is:  
 $G(s) = \frac{90(1+0.5s)}{(1+0.1s)(1+2s)(1+0.02s)}$   
 Draw Bode plot and determine phase margin and gain margin. (16 Marks)

**Module-5**

- 9 a. What are the types of compensation? Explain with the help of simple block diagrams. (08 Marks)  
 b. What are the characteristics of lead compensator? Explain a simple lead compensator with simple diagram. (08 Marks)

OR

- 10 a. Define controllability. What is Kalman's test for controllability and observability? (06 Marks)  
 b. Using Kalman's test, determine the controllability of the following system:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 2 \\ 4 & 0 & 3 \\ 1 & -1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 & 4 \\ -5 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

(10 Marks)

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