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

1 a. What are the ideal requirements of a control system? Explain. **(08 Marks)**

b. 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

2 a. How control systems are broadly classified? Explain with the help of block diagrams and examples. **(08 Marks)**

b. Compare and contrast proportional, integral and differential controllers. **(08 Marks)**

Module-2

3 a. 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)**

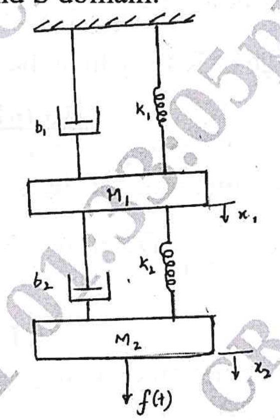

Fig. Q3 (a)

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

OR

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

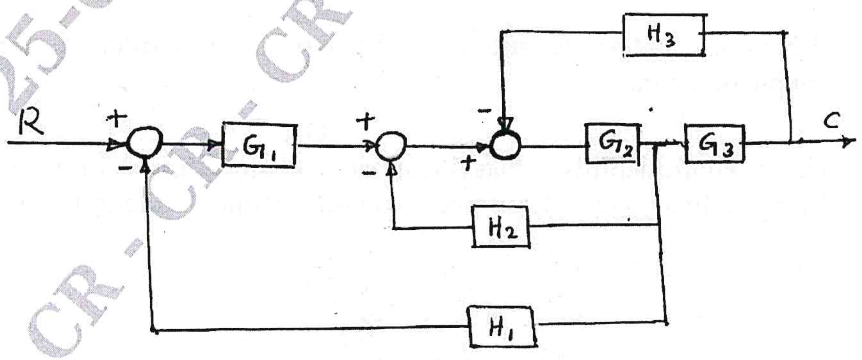

Fig. Q4 (a)

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

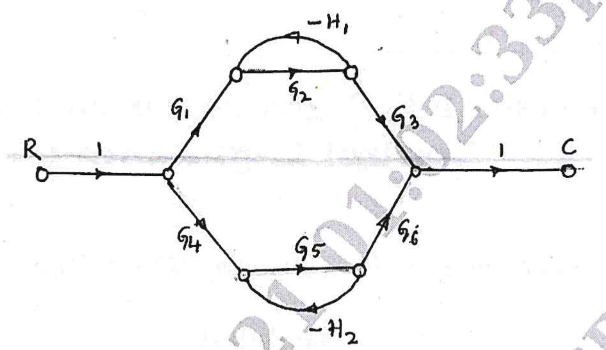

Fig. Q4 (b)

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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