CBCS SCHEME

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15ME73

Seventh Semester B.E. Degree Examination, June/July 2019
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 requirements of an ideal Control System? With neat sketch, explain the working of an Automatic tank – level control system. **(08 Marks)**

b. With a block diagram explain : i) Propotional Controller ii) Integral Controller. **(08 Marks)**

OR

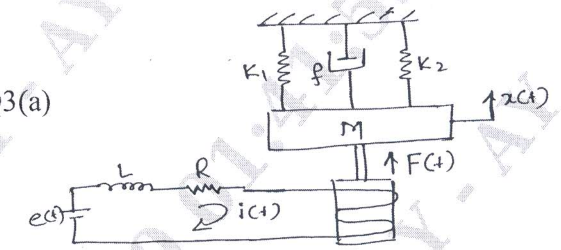
2 a. Define Control System. Compare open loop and closed loop control system with an example for each type. **(08 Marks)**

b. With a block diagram , explain : i) Propotional Plus Integral Controller (PI).
ii) Propotional Plus Integral Plus derivate controller (PID).
And also mention its characteristics. **(08 Marks)**

Module-2

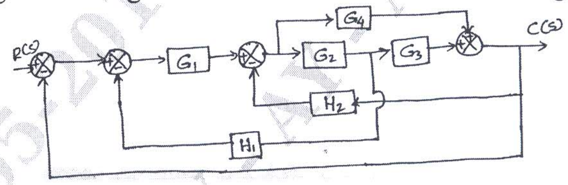
3 a. Write differential equations for the system shown in fig.Q3(a). The force (F) produced by the Solenoid, when coil is connected to voltage source is F = (t) = K i(t). and determine x(s) /e(s). **(08 Marks)**

Fig.Q3(a)



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

Fig.Q3(b)

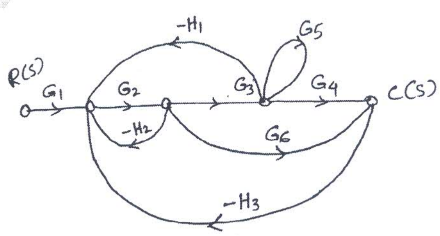


OR

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 Masons gain formula, find the gain of the following system shown in fig.Q4(b). **(08 Marks)**

Fig.Q4(b)



Module-3

5 a. Derive an expression for unit step response of first order system. **(06 Marks)**

b. The unity feedback system characterized by an open loop transfer function $G(s) = \frac{K}{S(S+10)}$. Determine the gain K, so that the system will have a damping ratio 0.5 for this value of K. Determine Settling time , Rise time , Peak overshoot and Peak time for unit step input. **(06 Marks)**

c. Using Routh Criteria, determine stability of a system its characteristic equation is $S^4 + 8S^3 + 18S^2 + 16S + 5 = 0$. **(04 Marks)**

OR

6 Sketch the root locus of the system whose open loop transfer function is

$$G(S)\ H(S) = \frac{K}{S(S+2)(S+4)}.$$ **(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 a. Explain the following : i) Lead Compensator ii) Lag compensator. **(06 Marks)**

b. If the system is described by :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u \quad ; \quad Y = [20\ \ 9\ \ 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

Check System Completely State Controllable and Completely Observable. Use Kalman's method. **(10 Marks)**

OR

10 a. Choosing suitable state variable, construct a state model for a spring , mass and damper system. **(07 Marks)**

b. Determine the state controllability and observability of the system described by

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u \quad ; \quad Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x$$ **(09 Marks)**

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