U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec. - 2019

Automatic Control Engineering

Time: 3 hrs Max. Marks: 100

Note: *i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

ii) Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Differentiate between Open loop and Closed loop control systems. 6

b. With example and necessary sketch, explain Regulator control systems. 6

c. With the help of block diagram, explain; 8

i) Traffic control system ii) Temperature control system

2 a. Sketch field controlled DC motor and derive an expression for its transfer function. 10

b. Obtain differential equation for the mechanical system shown in Fig. 2(b) and draw an analogous electrical circuit based on F-V analogy. 10

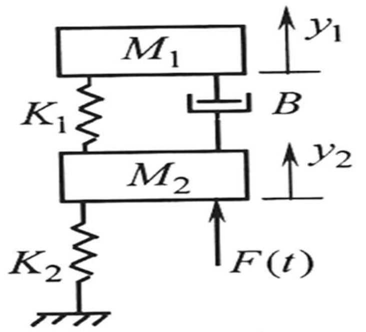

Fig. Q 2(b)

UNIT - II

3 a. Discuss the advantages and disadvantages of block diagram in control engineering. 4

b. Reduce the block diagram shown in Fig. Q3(b) and obtain its overall transfer function. 16

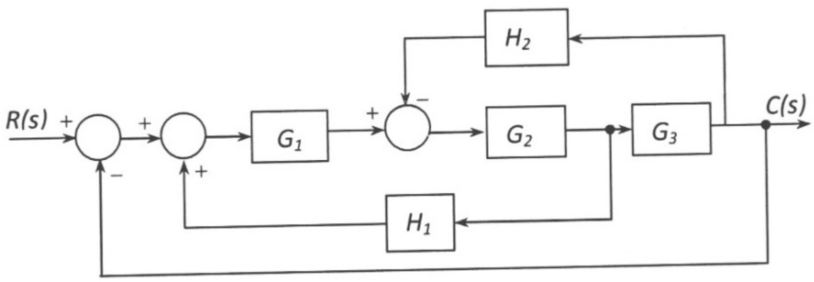

Fig. Q 3(b)

4 a. With sketch, explain the following terms related to signal flow graphs: 6

i) Forward path and path gain ii) Closed path and loop gain

b. Obtain the overall transfer function of a signal flow graph shown in Fig. Q4(b) using Mason's gain formula. 14

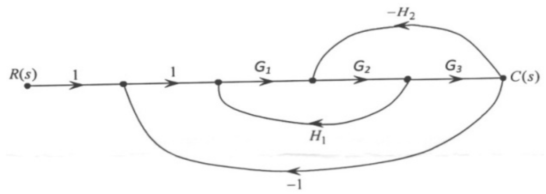

Fig. Q 4(b)

UNIT - III

5 a. Derive an expression for the response of a first order system subjected to a unit step input. 12

b. A second order system has a natural frequency of 10 rad/sec and the damping is critical. It is given a step input of magnitude 5. Determine; 8

i) Response equation ii) Time for complete response

iii) % response when time spends is 0.4 sec

6 a. How many roots of the polynomial $S^4 + 6S^3 + 11S^2 + 6S + 20 = 0$ have roots with positive real parts? 8

b. For the unity feedback system having open loop transfer function,

$G(s)=\frac{K(s+2)}{s(s^3+7s^2+12s)}$. Determine; i) Type of system ii) Error constants iii) Steady-state error for, 12

A) Unit set input and B) Unit ramp input

UNIT - IV

7 a. Draw the polar plot of, $G(s)H(s)=\frac{10s}{(s+2)}$ at frequencies of 0, 1, 2, 3, 5, 10 and 100 rad/sec. 6

b. Sketch the Nyquist plot for the system with $G(s)H(s)=\frac{40}{(s+4)(s^2+2s+2)}$ and ascertain the stability of system. 14

8. For an unity feedback control system having $G(s)=\frac{40(0.5s+1)}{s(2s+1)(0.125s^2+0.05s+1)}$.

Draw Bode plot and find phase cross over frequency, gain cross over frequency, gain margin and phase margin. Comment on system stability. 20

UNIT - V

9. Using the required step by step procedures, draw root locus for OLTF,

$G(s)H(s)=\frac{K}{(s+1)(s^2+4s+5)}$. Also determine the values of K for which the system is stable. 20

10 a. The equations of motion of two degrees of freedom spring mass system is given by,

$m_1\ddot{y}_1 + K_1y_1 + K_2(y_1-y_2) = F(t);\quad m_2\ddot{y}_2 + K_3y_2 + K_2(y_1-y_2) = 0$. Obtain its state- space model. 10

b. The state equations for a system are described by, $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-3 & 0\\ 0 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}2\\ 5\end{bmatrix}u(t); y(t)=[1\quad 1]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$ 10

Determine the controllability and Observability of the system.

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