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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Electronics and Communication Engineering
Semester End Examination; Dec. - 2019
Control Systems

Time: 3 hrs Max. Marks: 100

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

UNIT - I

1 a. List the characteristics of good control systems. 6

b. Explain open loop and closed loop control system with an example. 6

c. For the two port network shown in Fig. (1c) obtain the transfer functions;

i) $\frac{V_2(s)}{V_1(s)}$ ii) $\frac{V_1(s)}{I_1(s)}$

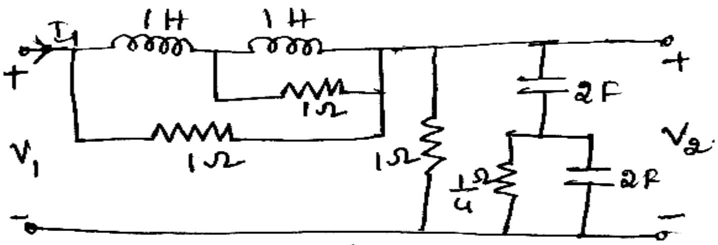


fig (1.c) 8

2 a. Write the differential equations for the mechanical system shown in Fig. (2.a) and obtain the analogous electrical network based on F-V and F-I analogy.

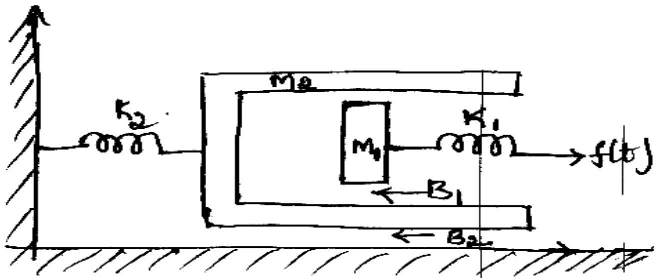


fig (2.a) 12

b. For a given rotational system shown in Fig. (2.b) obtain the electrical analogous system based on T-I analogy.

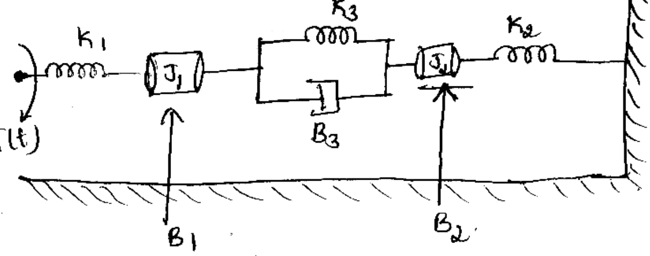


fig (2.b) 8

UNIT - II

3 a. Explain the following block diagram reduction rules: 6

i) Blocks in parallel

ii) Shifting a summing point behind the block

iii) Shifting a takeoff point after the block

b. Obtain the Transfer Function C(s) / R(s) for the block diagram of Fig. (3.b) using block diagram reduction technique. 7

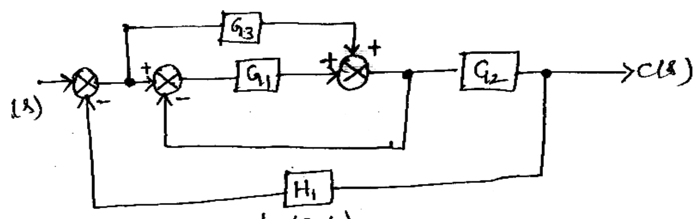


fig (3.b)

c. Find the overall Transfer function by using Mason's Gain formula for the signal flow graph given in the Fig (3.c). 7

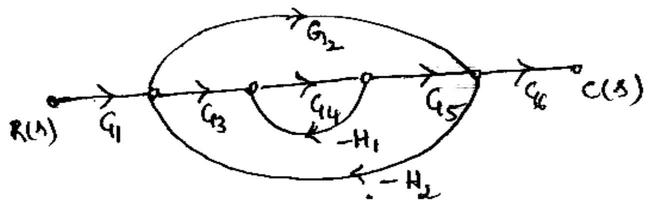


fig (3.c)

4 a. Derive an expression for unit step response of second order system for under damped system. 8

b. For a system with open loop transfer function has

$G(S)=\frac{100}{S^2(S+2)(S+5)}$, H(S) = 1, where the input is $r(t)=1+t+2t^2$. Compute K_p, K_v, K_a and steady state error. 8

c. Define the following: 4

i) Delay Time (T_d) ii) Peak Time (T_p)

iii) Peak Overshoot (M_p) iv) Settling time (T_S)

UNIT - III

5 a. Use R-H criterion to determine the stability of the system having characteristic equation; 8

$S^6 + 2S^5 + 9S^4 + 16S^3 + 24S^2 + 16 = 0.$

b. Determine the ranges of k such that the characteristic equation; 8

$S^3 + 3(k+1)\,S^2 + (7k+5)S + (4k+7) = 0$ has roots more negative than $S = -1$.

c. Write a note on R-H criterion. 4

6 a. Explain the procedure to plot root locus for a given transfer function. 8

b. Sketch the complete Root Locus for open loop transfer function; 12

$G(S)H(S)=\frac{k}{S(S+1)(S+2)(S+3)}$. Comment on the stability.

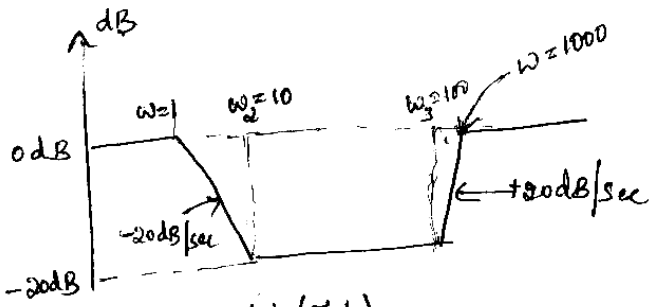
UNIT - IV

7 a. Sketch the Bode plot for the transfer function;

$$G(S)=\frac{kS^2}{(1+0.2S)(1+0.02S)}$$ 14

Determine the value of 'k' for the gain cross over frequency to be 5 rad/s.

b. For the plot shown in Fig. (7.b) determine the transfer function. 6



fig(7.b)

8 a. Sketch the polar plot for the system with transfer function;

$$G(S)H(S)=\frac{1}{(1+T_1S)(1+T_2S)}$$ 6

b. Sketch the Nyquist plot for the system with transfer function;

$$G(S)H(S)=\frac{10(S+3)}{S(S-1)}$$ Comment on the stability. 14

UNIT - V

9 a. Find the state transition matrix for;

$$A=\begin{bmatrix}1 & -2\\ 1 & -4\end{bmatrix}$$ 8

b. List the properties of state Transition matrix. 6

c. Construct the state model using phase variable for the given differential equation;

$$\frac{d^3y(t)}{dt^3}+\frac{4d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+2y(t)=u(t)$$ 6

10 a. Define the following: 4

i) State ii) State variables

iii) State vector iv) State space

b. Find the Transfer function of the system having state model

$$\dot{X}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}X+\begin{bmatrix}1\\ 0\end{bmatrix}U \text{ and } Y=\begin{bmatrix}1 & 0\end{bmatrix}X$$ 6

c. Obtain the time response of the following system:

$$A=\begin{bmatrix}1 & -1\\ 2 & -4\end{bmatrix},\ B=\begin{bmatrix}1\\ 0\end{bmatrix} \text{ and } X(0)=\begin{bmatrix}1\\ 0\end{bmatrix}$$ 10

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