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328556(28)

B. E. (Fifth Semester) Examination, April-May/Nov.-Dec. 2020

(New Scheme)

(Et & T Branch)

AUTOMATIC CONTROL SYSTEM

Time Allowed : Three hours

Maximum Marks : 80

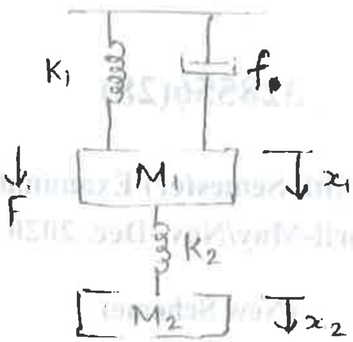
Minimum Pass Marks : 28

Note : Part (a) of each question is compulsory. Attempt any two parts from (b), (c) and (d) from each question.

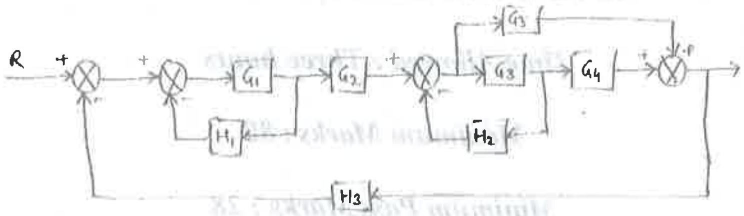
Unit-I

1. (a) Mention the difference between open loop & closed loop system. 2

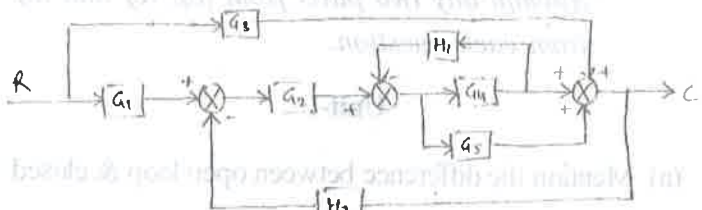
(b) Write the differential equations for the system shown below and also draw equivalent electrical network using force-voltage analogy. 7



(c) Derive the transfer function for the system shown below, using block diagram reduction technique. 7



(d) A system is shown below, determine the overall transfer function using Mason's gain formula 7



Unit-II

2. (a) Define rise time. 2

(b) Derive the expression for critical damped response of a second order control system for a unit step input. 7

(c) Explain the derivative control action in detail. Also show how it reduces max. Overshoot and effect on steady state error. 7

(d) The open loop transfer function of a unity feedback control system is $G(s) = \frac{2S}{S(S+5)}$. If the damping ratio is to be made 0·75 using tachometer feedback, Calculate the tachometer constant and max. overshoot. 7

Unit-III

3. (a) Define Stability. 2

(b) Using Routh criterion, determine the relation between K and T so that the unity feedback control system having $G(S) = \frac{K}{S[S(S+10)+T]}$ is stable.

(c) Sketch the root locus for the open loop transfer function given below. Determine the value of K to have 40% of max. overshoot for a unit step input

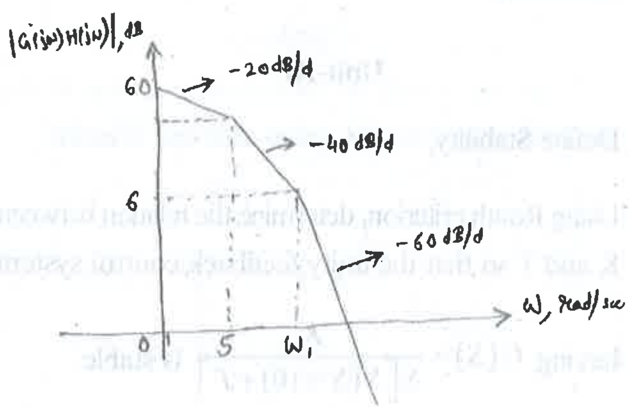
$$G(S)H(S)=\frac{K}{S(S+2)(S+4)}$$ 7

(d) Explain the procedure for plotting root locus. 7

Unit-IV

4. (a) Define gain margin & phase margin. 2

(b) Figure shows the Bode magnitude plot for the open loop transfer functions $G(S)H(S)$ of a negative feedback system. Determine the transfer function : 7



(c) A unity feedback control system has $G(S)=\frac{20}{S(S+1)(S+2)}$. Draw Nyquist plot and comment on stability. 7

(d) Sketch the polar plot for the system having $G(S)H(S)=\frac{10}{S(S+1)(S+2)}$. Calculate its gain margin in dB and comment on stability. 7

Unit-V

5. (a) Define State and state variables. 2

(b) The transfer function of a system is given by $\frac{Y(s)}{U(s)}=\frac{S^2+3S+2}{S^3+9S^2+26S+24}$. Determine the state model. Use direct decomposition method. 7

(c) A system is represented by : 7

$$\dot{X}(t)=\begin{bmatrix}-1 & 0 & 0\\ 0 & -2 & 0\\ 0 & 0 & -3\end{bmatrix}X(t)+\begin{bmatrix}1\\1\\0\end{bmatrix}u$$

Test for controllability & observability if $C = [1\ 0\ 2]$.

(d) For the electrical network shown, determine the state model. Consider i_1, i_2 and V_c state variables. The output variables are i_1 & i_2 7