328556(28)

B. E. (Fifth Semester) Examination, April-May 2018

(New Scheme)

(Branch : Et & T)

AUTOMATIC CONTROL SYSTEM

Time Allowed : Three hours

Maximum Marks : 80

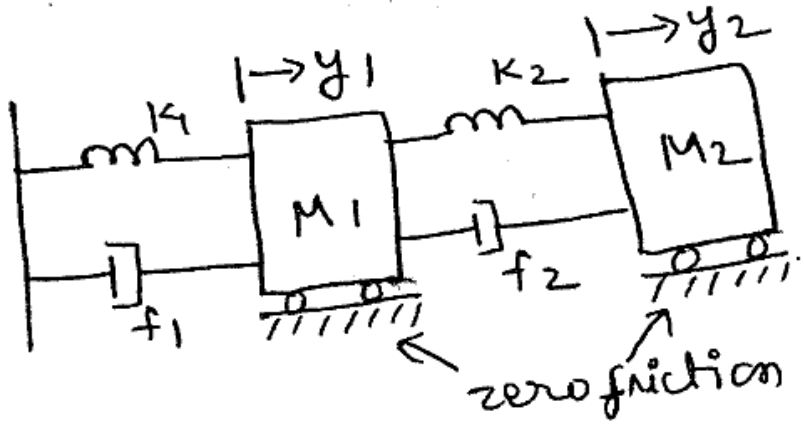
Minimum Pass Marks : 28

Note *: Part (a) of each question is compulsory. Solve any **two** from (b), (c) and (d) part of each question. All questions carry equal marks.*

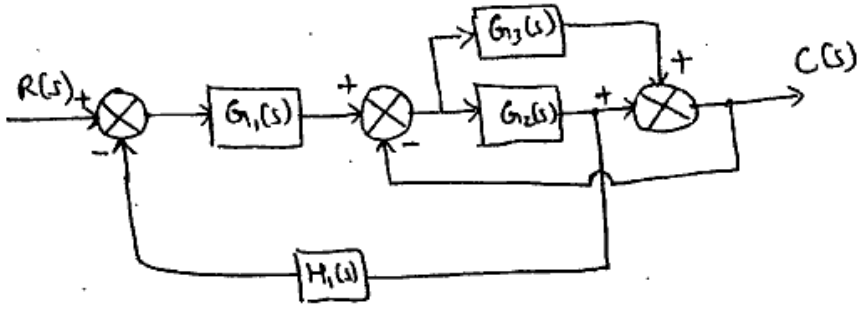
Unit - I

1. (a) Explain Mason's gain formula for signal flow graph. 2

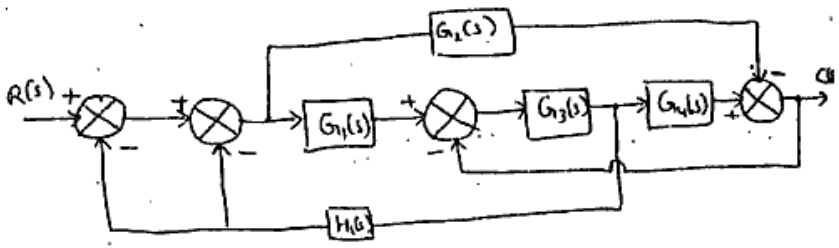
(b) Find the force-current analogy of the following system. Draw the equivalent electrical circuit. 7



(c) Find the transfer function $\frac{C(s)}{R(s)}$ for the system shown below using block diagram reduction technique. 7



(d) Draw the signal flow graph and determine the overall transfer function for the block diagram given below. 7



Unit - II

2. (a) Define type and order of the system. 2

(b) Derive the expression for the second order unity feedback control system for under damped condition. Assume unit step input. 7

(c) The overall transfer function of a control system is given by :

$$\frac{C(s)}{R(s)} = \frac{16}{S^2 + 1{\cdot}6S + 16}$$

It is desired that the damping rate be 0.8. Determine the derivative rate feedback constant K_t and

compare the rise time, peak time, maximum overshoat and steady state error for unit step ramp input with and without derivative feedback control. 7

(d) The open loop transfer function of a unity feedback control systme is given by :

$$G(s) = \frac{2}{S(S + 3)}$$

Obtain an expression for unit step response of the system. 7

Unit - III

3. (a) How will you find root locus on real axis? 2

(b) The open loop transfer function of a control system is given by :

$$G(s)\,H(s) = \frac{K}{S(S+6)\,\left(S^2 + 4S + 13\right)}$$

sketch the root locus and determine the value of "K" for the system to be stable. 7

(c) Open loop transfer function of a unity feed back system is given by :

$$G(s)\,H(s) = \frac{K}{S^4 + 20S^3 + 15S^2 + 2S}$$

Determine using Routh Huruitz criteria the maximum value of "K" for the system to be stable. 7

(d) What are the steps to plot a root locus? Explain 7

Unit - IV

4. (a) Define Gain Margin and Phase Margin. 2

(b) Draw the polar plot for the transfer function given below :

$$G(s)\,H(s) = \frac{10}{S(S+1)(S+2)}$$

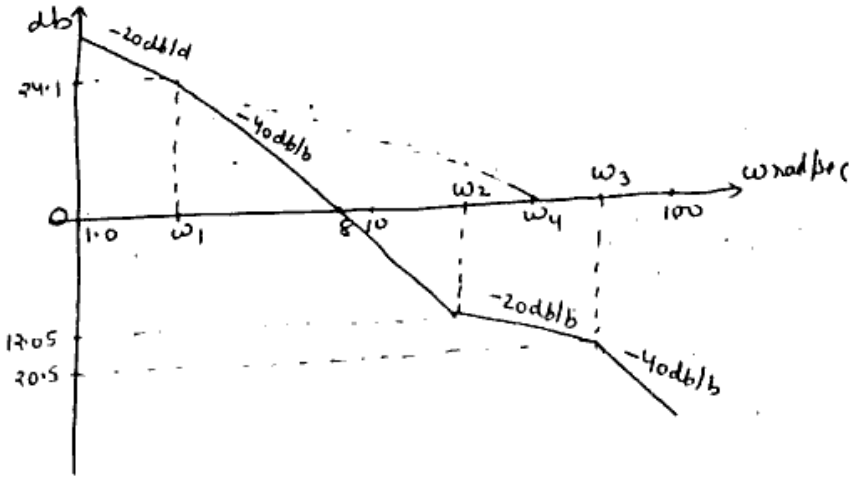
Calculate the gain margin and comment on stability. 7

(c) Sketch the nyquist plot for a system with :

$$G(s)\,H(s) = \frac{4S+1}{S^2(S+1)(2S+1)}$$

comment on stability of the system. 7

(d) Determine the open loop transfer function from the Bode plot shown below : 7



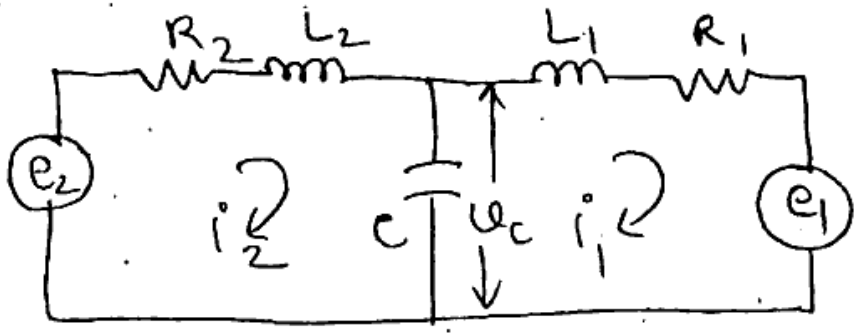
Unit - V

5. (a) Define : 2

(i) State space vector

(ii) State space variable

(b) For the electrical network shown below, determine the state model. Consider i_1, i_2 and v_c as state variables. The output variables are i_1 and i_2. 7



(c) The transfer function of a system is given by

$$\frac{Y(s)}{U(s)} = \frac{5S^2 + 4S + 2}{S^3 + 3S^2 + 7S + 9}$$

Apply direct decomposition method to obtain state space representaiton. 7

(d) Check for controllability and observability of a system having following coefficient matrices.

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \text{ and}$$

$$C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$