Or

A linear time invariant system is described by $\dot{X} = Ax$.

where $A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$ with initial conditions $X(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

Find the solution of this equation.

a) Given $G(s) = \dfrac{5s+10}{s^2+4s+5}$

write a computer program using Matlab to determine Step response of this system.

b) What will be the output of the following Matlab command: rlocus (A, B, C, D, K).

c) Write a Matlab based computer program to plot Bode plot of the following unity feedback control system

$$G(s) = \frac{1}{s(1+0.2s)(1+0.5s)}$$

d) By assuming suitable value for the parameter of a dc motor, construct a state space model of dc motor using Matlab programming.

Or

Write the equation showing dynamics of dc motor and design a simulink model for this (Make suitable assumptions).

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EI - 605

B.E. VI Semester

Examination, December 2015

Control Systems

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

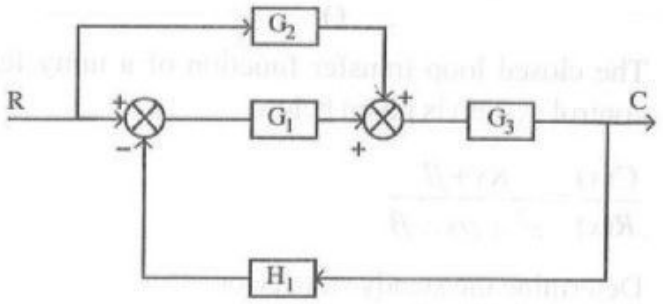
iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Differentiate between open loop and closed loop control system.

b) Define the transfer function of a control system.

c) Draw a neat diagram of Pneumatic actuating valve. Also mention its force balance equation.

d) Reduce the block diagram shown in figure 1 into a form having one block in the forward path and one in feedback path.



Determine the transfer function $\frac{C}{R}$ of the system shown in figure 1 using Mason's gain formula.

2. a) What is the effect of transfer function parameter variation on the open loop control system.

   b) After applying excitation at the input terminals an output response is produced at the output terminals which varies with time. Sketch the output response and show rise time and settling time on it.

   c) A second order system is shown in figure 2.

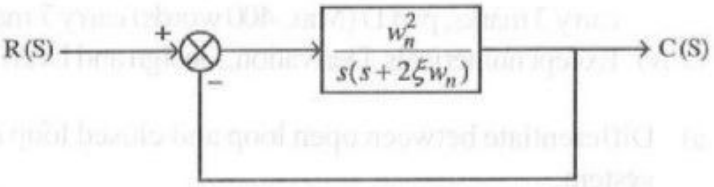


Figure 2

What is the condition when poles are real and equal.

   d) If the transfer function of a system is

$$\frac{C(s)}{R(s)}=\frac{81}{s^2+6s+81}.$$

find (i) W_n (ii) ξ (iii) W_d (iv) T_P

Or

The closed loop transfer function of a unity feedback control system is given below

$$\frac{C(s)}{R(s)}=\frac{Ks+\beta}{s^2+\alpha s+\beta}$$

Determine the steady state error.

3. a) Define stability of a linear control system.

   b) What is co-relation between the closed loop poles and stability.

   c) How will you determine number of branches of root loci and behaviour of the root loci at $|S| = \infty$

   d) A single-loop feedback control system has the loop transfer function

$$L(s)=G(s)H(s)=\frac{K}{s(s+2)(s+10)}$$

sketch the Nyquist plot and comment on stability of this system.

Or

The open-loop transfer function of a unity feed back control system is given by

$$G(s)=\frac{K}{s(0.5s+1)(0.25s+1)}$$

assuming K = 1 sketch the gain phase plot. Determine the value of K such that Gain Margin = 8 db.

4. a) Define the properties of state transition matrix.

   b) What is relation between characteristics equation, Eigenvalues and Eigen vectors of a control system.

   c) Define the problem of pole-placement through state feedback

   d) A system is defined by

$\dot{X}=Ax+Bu$ where

$$A=\begin{bmatrix}1 & 2 & 1\\ 0 & 1 & 3\\ 1 & 1 & 1\end{bmatrix},\ B=\begin{bmatrix}1\\ 0\\ 1\end{bmatrix}$$

find its Controllability Canonical Form (CCF) model.