d) For a unity feedback system having open loop transfer function

$$G(s)=\frac{K(s+2)}{s(s^3+7s^2+12s)}$$

Determine:

i) Error constants

ii) Steady state error for parabolic input.

OR

Open loop transfer function of a system is given by $G(s)=\frac{K}{s(1+Ts)}$ by what factor K should be reduced so that the peak overshoot for a unit step input response is reduced from 75% to 30%.

5. a) Design a phase lag-lead compensator for a unity feedback system with transfer function

$$G(s)=\frac{K}{s(s+2)(s+4)}$$

To meet the following specification:

i) Velocity error constant = 80 and

ii) Phase margin $\geq 35°$

b) What is compensation? Discuss its need. Explain the various types of electrical network along with their Bode plots for implementation of compensation.

c) Write the procedure to design a phase-lead compensator.

d) State the limitations of a single stage phase lead control.

OR

What is a lag compensator? Obtain the transfer function of a lag compensator and draw the pole zero plot.

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Roll No .....

EX-602

B.E. VI Semester

Examination, June 2016

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 questions 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.

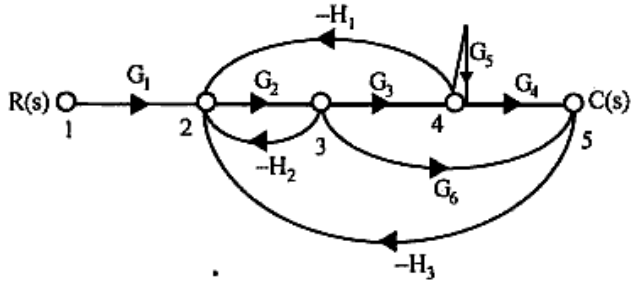
iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Explain with neat sketches, the construction, working principle and application of tacho-generator.

b) Discuss the scientific approach of developing mathematical model of a system.

c) How differential equations are simulated in analog Computer? Explain by taking suitable example.

d) Determine the transfer function C(s) / R(s) using Mason's Gain formula.



OR

Construct the Nyquist plot for a unity feedback system whose open loop transfer function is given by

$$G(s)H(s)=\frac{K}{s\left(s^2+2s+2\right)}$$

Find the maximum value of k for which the system is stable.

2. a) The characteristic equation of a closed loop system is given by $s^3 + 3Ks^2 + (K + 2)s + 4 = 0$. Determine the value of 'K' for which the system will stable.

   b) Determine position, velocity and acceleration error for (i) unit step, (ii) unit ramp and (iii) unit parabolic input, for the unity feedback control system with the open loop transfer function admissible

$$G(s)=\frac{K\left(1+0.5s\right)}{s^2\left(s^2+4s+5\right)}$$

   c) Discuss various types of control actions along with their characteristic features.

   d) What is state transition matrix? Determine state transition matrix for the system.

$$\dot{x}=Ax+Bu \text{ with } A=\begin{bmatrix}0 & -1\\ 2 & -3\end{bmatrix} \text{ and } B=\begin{bmatrix}0\\ 1\end{bmatrix}$$

OR

Explain the different steps to design a phase lag compensator using Root locus.

3. a) A unity feedback system has an open loop transfer function $G(s)=\frac{10}{s^2(s+2)}$, by sketching root locus plot, comment on the stability of the system. Now add a zero at $s = -b$ $(0 \le b \le 2)$ and show the effect of adding zero on the stability of the system.

Contd...

   b) What is root locus? Mention rules for construction of root locus. Sketch the root locus of unity feedback system with open loop function $G(s)=\frac{K\left(s^2+1\right)}{s(s+2)}$. Explain all the steps clearly and marks all salient points on root locus.

   c) State the effects of adding poles to G(s) H(s) on the root locus.

   d) Sketch the root locus of a unity feedback system with forward path transfer function given below. k is varied from zero to infinity.

$$G(s)=\frac{K}{s(s+2)(s+4)}$$

OR

For the unity feedback system, the open loop transfer function is given by

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

Sketch the root locus for the system when k is varied from zero to infinity.

4. a) For a unity feedback system having open loop transfer function $G(s)=\frac{10}{s(0.25s+1)(0.1s+1)}$

Draw the Bode plots and determine the gain margin and phase margin.

   b) Sketch the polar plot for the open loop transfer function G(s) of an unity feedback system and find gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin

$$G(s)=\frac{400}{s(s+2)(s+10)}$$

   c) What is meant by PID controller? What are the advantages of PID controller?

PTO