[Total No. of Questions - 9] [Total No. of Printed Pages - 4] (2125)

15220

B. Tech 6th Semester Examination

Control Engineering (OS)

EE-6005

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all selecting one question from each of the sections A, B, C, & D. Section E is compulsory. Use of non-programmable calculators is allowed. Use semi-log paper and graph paper, if required.

SECTION - A

1. (a) Draw analogy between mechanical translational system and electrical voltage system. Also draw the corresponding elements of both the systems.

   (b) What are the advantages of negative feedback in control systems? Explain.

   (c) Compare open loop control with closed loop control. Give suitable examples. (6+6+8=20)

2. (a) Derive state variable model for series R-L-C circuit while taking output across capacitance C. Assume input applied to the circuit be V(t).

   (b) Determine the transfer function of the system represented by signal flow graph shown in figure (1) using Mason's gain formula (Assume input to be U(s) and output to be Y(s)).

[P.T.O.]

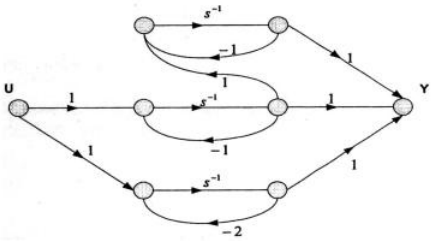

Figure 1 (8+12=20)

SECTION - B

3. (a) Determine the time domain specifications (delay time, rise time, peak time, maximum percentage overshoot & settling time) for a unit step input to a unity feedback system having $G(s) = \frac{144}{s(s+12)}$.

   (b) Explain absolute and relative stability in case of control systems. (14+6=20)

4. (a) A unity feedback control system has open loop transfer function $G(s) = \frac{K}{s(s+5)(1+0.3s)}$. Determine the steady state error for r(t) = 7t & K = 10. Also calculate the value of K for e_{ss} = 0.25.

   (b) For a unity feedback control system $G(s) = \frac{100(s+5)}{s^2(s+2)(s+6)}$, determine (i) the type of the system, (ii) error coefficients & (iii) steady state error for input $1 + 7t + \frac{t^2}{2}$. (10+10=20)

SECTION - C

5. (a) Draw the polar plot of system with open loop transfer function $G(s)=\frac{5(1+7s)}{(1+3s)}$.

   (b) Draw the Nyquist plot and determine the stability for unity feedback control system with open loop transfer function $G(s)=\frac{1}{s^2(s+3)}$. (10+10=20)

6. Explain the terms gain margin, phase margin, gain cross-over frequency and phase cross-over frequency. Draw the Bode plot for a unity feedback control system with open loop transfer function $G(s)=\frac{2000}{s(s+1)\,(s+100)}$ and determine gain margin, phase margin, gain cross-over frequency and phase cross-over frequency. Comment on stability. (20)

SECTION - D

7. (a) Explain the principle, construction and applications of stepper motor.

   (b) The open loop transfer function of a unity feedback control system is given as $G(s)H(s)=\frac{K}{s(s+1)(s+2)}$. It is required that static velocity error constant be K_v=10sec^{-1} and the phase margin be 50° and the gain margin be 10 db or more. Design lead-lag network to satisfy the required specifications. (8+12=20)

8. (a) What are compensating networks? Discuss various schemes of compensation used for control system design.

   (b) Explain the principle of operation of 2-phase ac servomotor. Explain its torque-speed characteristics and compare it with three phase induction motor. (8+12=20)

SECTION - E

9. Give short answers:

   (a) What is parallel or feedback compensation? Explain

   (b) What are single valued and analytic functions? Explain.

   (c) What is damping ratio? How does it affect the response of the system?

   (d) What is Bounded Input and Bounded Output (BIBO) stability? Explain.

   (e) What causes the appearance of entire row of zeros in Routh's table? Explain.

   (f) Explain the terms resonant peak and bandwidth in case of frequency response of a LTI system.

   (g) What are the effects of addition of a pole to forward path of a second order system?

   (h) Draw the Bode plot for a open loop transfer function with n-poles at origin.

   (i) Find the unit step response of a system given by transfer function $G(s)=\frac{1}{s(s+2)}$.

   (j) What are the advantages of frequency response technique of analysis? Explain. (10×2=20)