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Printed Pages : 4 EE-507

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2008 Roll No.

B. Tech.

(SEM. V) EXAMINATION, 2007-08

AUTOMATIC CONTROL SYSTEM

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt **all** the questions.*

1 Attempt any **four** parts of the following : **5×4 = 20**

(a) Discuss the effects of feedback on performance of control system.

(b) Determine the response to a unit step input of a unity feedback control system having forward path transfer function as $\frac{10}{1+5s}$.

(c) Describe the rules of block diagram algebra. Obtain $C(s)/R(s)$ of the block diagram shown in **Fig. 1**

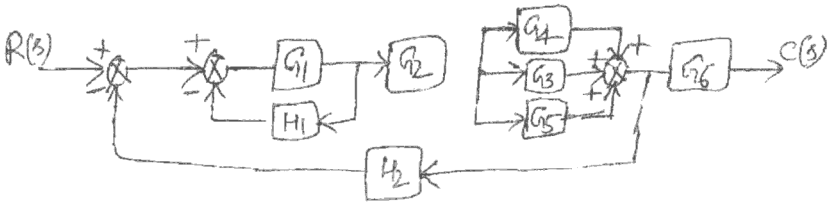

Fig. 1

(d) What are the test signals for transient response analysis of control systems ? Give their Laplace transform.

(e) Draw the block diagram of the circuit shown in **Fig. 2**

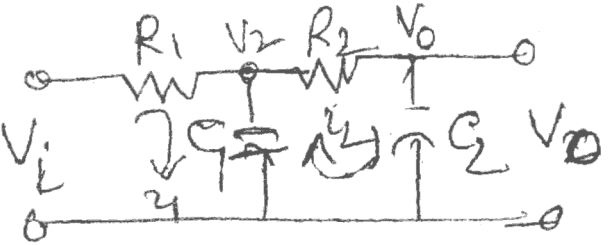

Fig. 2

(f) Describe the various performance criterion for time domain analysis of control systems.

2 Answer any **four** parts of the following : **5×4 = 20**

(a) The following transfer function represents the foreword path of a position control system. Draw polar plot :

$$G(s) = \frac{10}{s(s+1)}$$

(b) Sketch the asymptotic gain plot (Bode plot) for the following transfer function :

$$G(s) = \frac{20s}{(s+1)(s+10)}$$

(c) State the rules for sketching gain and phase plots. What information is obtained from these plots ?

(d) What are open-loop and closed-loop frequency domain specifications ?

(e) Explain the importance of M and N circles.

(f) What are static and dynamic error coefficients ?

3 Attempt any **two** parts of the following : **10×2 = 20**

(a) Sketch the root loci for the system shown in **Fig. 3.** The gain K is assumed to the positive :

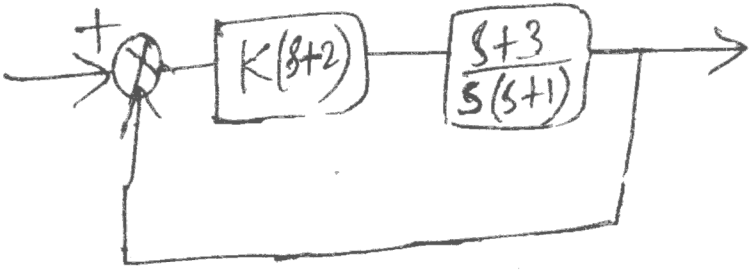

Fig. 3.

(b) (i) Explain the term conditional stability.

(ii) Consider the characteristic equation

$$D(s) = s^5 + s^4 + 3s^3 + 3s^2 + 6s + 4$$

Comment on the stability by R-H criterion.

(c) Determine the stability of the system. Use Nyquist criterion :

$$G(s)H(s) = \frac{10}{s(s+1)(s+4)}$$

4 Attempt any **two** parts of the following : **10×2 = 20**

(a) Describe any one standard method of compensation.

(b) Obtain the transfer function and frequency response of a lead network.

(c) Design a compensating network for the system $G(s)=\frac{k}{s(s+1)}$ the specifications are :

(i) Steady state error should be less than 0.1 for velocity input.

(ii) Phase margin should be greater than $40°$.

5 Attempt any **two** parts of the following : **10×2 = 20**

(a) (i) Define state transition matrix and controllability.

(ii) Obtain the solution of the state equation

$$\dot{x}=\begin{bmatrix}0 & 1\\ -1 & -2\end{bmatrix}x+\begin{bmatrix}0\\ 1\end{bmatrix}u$$

given $x(0)=\begin{bmatrix}0 & 1\end{bmatrix}^T$ and u is a unit step input.

(b) (i) Obtain the transfer function of the following system :

$$\dot{x}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -2 & -3 & -4\end{bmatrix}x+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u \quad y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}x$$

(ii) Describe the various canonical forms of state space representative.

(e) Consider the system

$\dot{x}=\begin{bmatrix}0 & 1\\ 20.6 & 0\end{bmatrix}x+\begin{bmatrix}0\\ 1\end{bmatrix}x$. Show that the system is unstable. By using state feedback, it is desired to have closed loop poles at $-1.8+j2.4$ and at $-1.8-j2.4$. Determine the state feedback gain matrix.