

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

PAPER ID : 2121 Roll No.

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B.Tech.

(SEM. V) THEORY EXAMINATION 2011-12

CONTROL SYSTEMS—I

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 effect of feedback on the following :
 - (i) Overall gain (ii) Stability (iii) Noise and Disturbance.
 - (b) Compare open loop control system with closed loop control system.
 - (c) Find the transfer function for the system whose block diagram representation is shown in fig. 1.

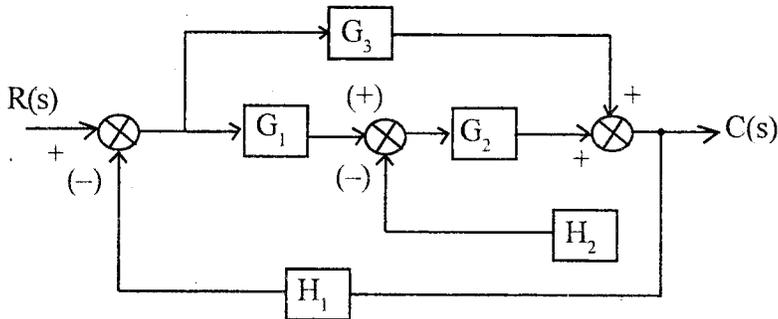


Fig. 1

- (d) Define the following :
- (i) Path (ii) Forward Path (iii) Path Gain (iv) Loop
 - (v) Non touching loop.
- (e) Write notes on (i) Control valves (ii) RTDs (iii) DC Tachometer Generator.

2. Attempt any **two** parts of the following : **(10×2=20)**

- (a) For the following state equation, determine the transfer function between $Y(s)$ $U(s)$ according to the formula :

$$\frac{Y(s)}{U(s)} = (C[SI - A]^{-1}B + D)$$

$$A = \begin{bmatrix} 0 & 3 \\ -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 3 \end{bmatrix}$$

$$C = [1 \quad 0] \quad D = 1$$

- (b) Construct the state model for a system characterized by the differential equations :

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = 4$$

Give the block diagram representation of the state model.

- (c) What is state transition matrix ? Discuss its properties. Also discuss controllability.

3. Attempt any **four** parts of the following : **(5×4=20)**

(a) Define the following :

- (i) Peak Overshoot (ii) Stelling time (iii) Rise Time
(iv) Steady state error.

(b) Derive expressions for Peak overshoot for the second order control system.

(c) Measurement conducted on a servomechanism show the system response to be

$$c(t) = 1 + 0.2 e^{-60t} - 1.2 e^{-10t}$$

when subjected to a unit step input. Obtain the expression for the closed loop transfer function.

(d) The open loop transfer function of a servo system with unity feedback is

$$G(s) = \frac{10}{s(0.1s+1)}$$

Evaluate the static error constants (K_p , K_v and K_a).

(e) Discuss the effect of adding a zero to a system.

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

(a) Determine whether the largest time constant of the characteristic equation given below is greater than less than, or equal to 1.0 sec :

$$s^3 + 4s^2 + 6s + 4 = 0.$$

- (b) Determine the range of values of k such that the characteristic equation :

$$s^3 + 3(k+1)s^2 + (7k+5)s + (4k+7) = 0$$

has roots more negative than $s = -1$.

- (c) State the Routh stability criterion. Discuss its advantages over Hurwitz Stability criterion. Also discuss relative stability concept.

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

- (a) Sketch the Bode plot for the system having

$$G(s) H(s) = \frac{20}{s(0.1s+1)}$$

- (b) (i) Establish correlation between frequency domain response and time domain response.

- (ii) Define the following :

(1) Resonant Peak

(2) Gain Margin

(3) Phase Margin

- (c) Sketch the Nyquist plot for the following system having

$$G(s) = \frac{100}{s(s+10)}, \quad H(s) = 1 \text{ consider negative feedback.}$$

Comment on the stability of the system.