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

PAPER ID : 2121 Roll No.

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.

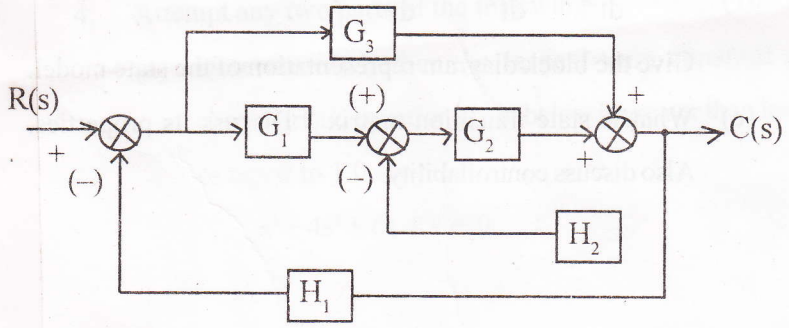

Fig. 1

(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 :

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

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

$$C = \begin{bmatrix} 1 & 0 \end{bmatrix} \quad D = 1$$

(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

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

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

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

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

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

Comment on the stability of the system.