GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER–IV EXAMINATION – WINTER 2015

Subject Code:X41102   **Date:21/12/2015**

Subject Name: Control Theory

Time: 02:30pm to 05:00pm   **Total Marks: 70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define the following term: **07**
   (a) Absolute stable system
   (b) Conditionally stable system
   (c) Relative stable system
   (d) Transfer function
   (e) Damping ratio
   (f) Chain node
   (g) Non touching loops

(b) A system is represented by a block diagram as shown in figure (a). Find the transfer function C(S) / R(S) by block reduction technique.   **07**
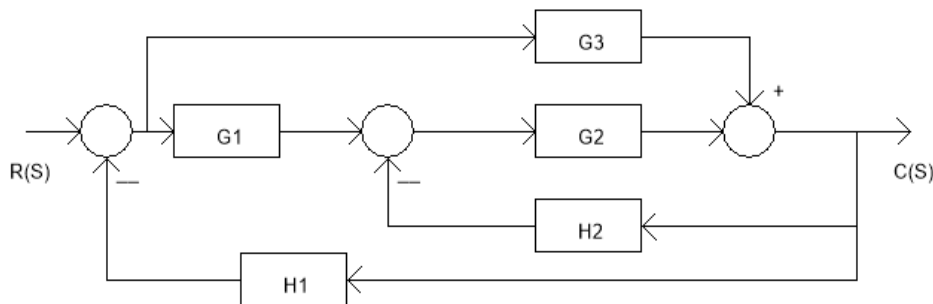

figure (a)

Q.2 **(a)** State the advantage of negative feedback system.   **07**
(b) Write the equation for RC Series circuit connected to DC supply. Obtain transfer function between capacitor voltage and supply voltage.   **07**

OR

(b) Define steady state error. Derive the steady state error in terms of static error coefficients Kp, Kv and Ka and discuss for type 0 system.   **07**

Q.3 **(a)** Tabulate the analogous quantities of mechanical and electrical system using (a) Force voltage analogy (b) Force current analogy   **07**
(b) Find time domain specification like damping factor, natural frequency, damping frequency, delay time, rise time, peak time, Peak overshoot to the given unity feedback systems   **07**

$$G(S) = \frac{25}{S(S+4)}$$

OR

Q.3 **(a)** Determine the stability to system having characteristics equation given by   **07**

$$S^5 + S^4 + 3S^3 + 3S^2 + 2S + 2 = 0$$

(b) Explain the Root locus construction rules in brief. **07**

Q.4 **(a)** The open loop transfer function of unity feedback system is: **07**

$$G(S) = \frac{K(S+2)}{5(3S^2 + 10S - a)}$$

Find the value of a and K so that system response oscillates are at a frequency of 2 rad/sec

(b) Draw the Bode plot of unity feedback control system with open loop transfer function **07**

$$G(s)H(s) = \frac{10}{S(S+2)(S+5)}$$

And find out Gain margin, Phase margin and phase cross over frequency.

OR

Q.4 **(a)** Draw the root locus plot for a system having open loop transfer function **07**

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

(b) For a unity feedback system, the open loop transfer function is, **07**

$$G(s) = \frac{0.25(1+0.5S)}{S(1+2S)(1+4S)}$$

Draw the log magnitude plot and phase plot and determine the stability criteria.

Q.5 **(a)** Explain in brief: Controllability and Observability **07**
(b) Draw the Nyquiest plot for the open loop transfer function given by **07**

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

And determine the stability

OR

Q.5 **(a)** Define the term sensitivity. Derive the effect of forward path transfer function parameter variation in a close loop control system. **07**
(b) Determine the transfer function from the state matrix A, input matrix B, output matrix C and transmission matrix D given as following: **07**

$$A = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \qquad B = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$$

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

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