GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2141708   **Date:13/05/2019**
Subject Name: Control System
Time:02:30 PM TO 05:00 PM   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

                                                                            MARKS

Q.1 **(a)** Differentiate between open loop system and closed loop systems.   **03**
       (b) Define transfer function. Find the impulse response of a system whose   **04**
             transfer function is G=1/(S+6)
       (c) Using block diagram reduction technique, find out overall transfer   **07**
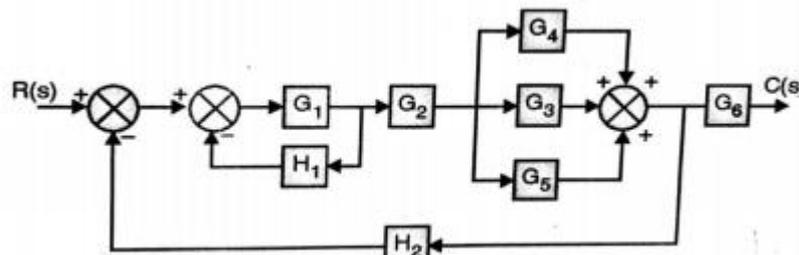   function C(s)/R(s) for the diagram shown in fig.1.

Fig. 1

Q.2 **(a)** Write Meason's gain formula and define each term of the formula.   **03**
       (b) Differentiate between signal flow graph and block diagram   **04**
             representation of system.
       (c) The open loop transfer function of a unity feedback system is   **07**
             $$G(s)H(s) = \frac{k(s + 13)}{s(s + 3)(s + 7)}$$
             Using Routh's criterion, calculate the range of k for system to be
             stable. If the value of k=1, comment on stability.
                                    OR
       (c) Derive and draw the unit step response of second order   **07**
             underdamped system.
Q.3 **(a)** Define the following terms: **03**
             (1) Type of a system
             (2) BIBO stability
             (3) Time constant
       (b) Briefly explain the first order system and its response to unit step   **04**
             input.
       (c) Sketch the root locus plot of a control system whose open loop   **07**
             transfer function is given by
             $$G(s)H(s) = \frac{k}{s(s + 4)(s^2 + 4s + 8)}$$
                                    OR
Q.3 **(a)** Explain the concept of linearity and time invariance in the context   **03**
             of control system.
       (b) Define following terms: **04**
             (1) rise time (2) peak time (3) settling time (4) peak overshoot

(c) Draw the root locus plot of a control system whose open loop transfer function is given by
$$G(s)H(s) = \frac{k}{s(s+1)(s+5)}$$
07

Q.4 **(a)** Determine the transfer function of a system described by following state space model

$$A = \begin{bmatrix} -2 & 1 \\ 0 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad C = [1 \quad 1], \quad D=0$$
03

(b) State the properties of state transition matrix. **04**

(c) Consider an open loop transfer function **07**
$$G(s)H(s) = \frac{50}{(s+1)(s+2)}$$
Using Nyquist stability criterion, determine whether the system is stable when the feedback path is closed.

OR

Q.4 **(a)** Discuss the limitations of transfer functions and advantages of analysis of control systems using state space. **03**

(b) Write a note on steady state error and error constants. **04**

(c) Explain Nyquist stability criterion. **07**

Q.5 **(a)** Define bandwidth, gain margin and phase margin for frequency response. **03**

(b) Draw the polar plot of G(s) =10/[s(s+2)]. **04**

(c) The open loop transfer function of a unity feedback system is **07**
$$G(s)H(s) = \frac{50}{s(s+10)(s+5)(s+1)}$$
From the Bode plot, determine gain margin and phase margin.

OR

Q.5 **(a)** Discuss the effect of time delay on the stability of the process. **03**

(b) Discuss Nichol's chart and its application. **04**

(c) The open loop transfer function of a unity feedback system is given by **07**
$$G(s)H(s) = \frac{10(1+0.5s)}{s(0.1s+1)(0.2s+1)}$$
Draw the Bode plot and determine gain margin and phase margin.

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