Seat No.: _____  Enrolment No. 

# 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 transfer function is G=1/(S+6) | **04** |
| | **(c)** | Using block diagram reduction technique, find out overall transfer function C(s)/R(s) for the diagram shown in fig.1. | **07** |

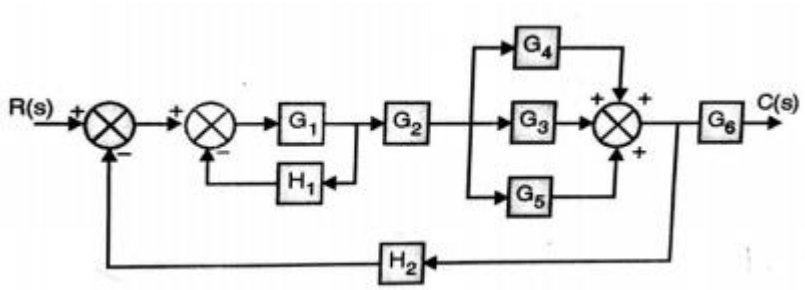


Fig. 1

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

**(c)** Draw the root locus plot of a control system whose open loop transfer function is given by **07**

$$G(s)H(s) = \frac{k}{s(s+1)(s+5)}$$

**Q.4** **(a)** Determine the transfer function of a system described by following state space model **03**

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

**(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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