

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**

**BE - SEMESTER-V (NEW) - EXAMINATION – SUMMER 2017**

**Subject Code: 2150909**

**Date: 05/05/2017**

**Subject Name: Control System Engineering**

**Time: 02:30 PM to 05:00 PM**

**Total Marks: 70**

**Instructions:**

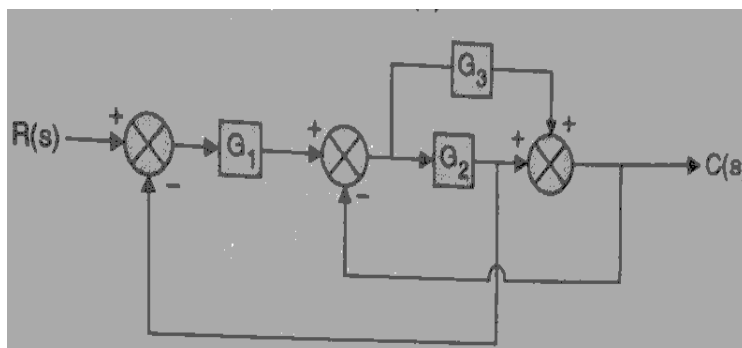
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

**MARKS**

- |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>Q.1</b> | <b>Short Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>14</b>                                          |
|            | <ol style="list-style-type: none"><li>1 Define open loop and close loop control system.</li><li>2 Write equation of mason gain formula.</li><li>3 How 'type' of the system can be defined?</li><li>4 Define transfer function.</li><li>5 Define proportional control.</li><li>6 Define frequency domain.</li><li>7 Define lead compensators and lag compensators.</li><li>8 Define term stability in context of control engineering.</li><li>9 Give approx value of damping factor in normal control system</li><li>10 Define signal flow graph.</li><li>11 Why do you use log scales on X-axis?</li><li>12 Write any two frequency domain specification.</li><li>13 Write any two time domain specification.</li><li>14 Write standard characteristic equation for 2<sup>nd</sup> order system.</li></ol> |                                                    |
| <b>Q.2</b> | <p>(a) Compare Open Loop versus Closed Loop control systems.</p> <p>(b) Explain Standard Test Signals used in control system.</p> <p>(c) Explain following terms with respect to second order system.<br/>Draw necessary diagrams.</p> <ul style="list-style-type: none"><li>▪ Delay Time</li><li>▪ Rise Time</li><li>▪ Peak Time</li><li>▪ Steady state error</li><li>▪ Settling Time</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>03</b></p> <p><b>04</b></p> <p><b>07</b></p> |
|            | <p style="text-align: center;"><b>OR</b></p> <p>(c) Prepare a mathematical model of a series R-C circuit connected to a DC supply. Obtain the transfer function between capacitor voltage and supply voltage.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p><b>07</b></p>                                   |
| <b>Q.3</b> | <p>(a) Explain with example the first order system.</p> <p>(b) Explain types of the system and steady state error constants for the same.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p><b>03</b></p> <p><b>04</b></p>                  |

(c)

07



Determine overall transfer function of the system using block diagram reduction technique.

OR

**Q.3 (a)** Define following terms. **03**

1) State variable      2) State trajectory      3) State vector

**(b)** Explain the effect of integral control action on system performance. **04**

**(c)** The close loop transfer function of a given second order system is  $100/(S^2 + 10S + 100)$ . **07**

Determine damping ratio, natural frequency, delay time, rise time, settling time and peak overshoot.

**Q.4 (a)** Write short note on “feedback control system” **03**

**(b)** Derive mathematical model of any mechanical system of your choice. **04**

**(c)**  $S^6 + 4S^5 + 3S^4 - 16S^2 - 64S - 48 = 0$  Check the stability of the given characteristic equation using Routh method. **07**

OR

**Q.4 (a)** Write short note on marginally stable system. **03**

**(b)** Explain the effect of derivative control action on system performance. **04**

**(c)** For unity feedback control system  $G(s) = \frac{800(S+2)}{S^2(S+10)(S+40)}$ . Sketch the bode plot. **07**

**Q.5 (a)** Explain gain margin and phase margin. **03**

**(b)** Write the transfer function of second order unity feedback system for step response. Explain briefly each parameter of equation. **04**

**(c)** For unity feedback control system  $G(s) = \frac{K}{S(S+6)(S+9)}$ . Draw its root locus. **07**

OR

**Q.5 (a)** Write difference between state space analysis and transfer function. **03**

**(b)** Briefly explain about polar plots. **04**

**(c)** Explain in detail the Nyquist criteria to predict stability of system. **07**

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