Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–V EXAMINATION – WINTER 2025**

**Subject Code:3151908 Date:17-11-2025**

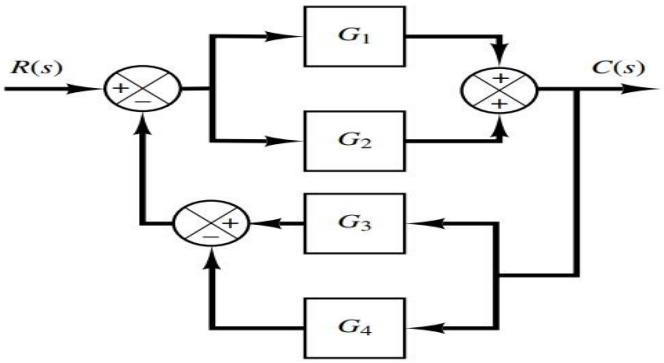
**Subject Name:Control Engineering**

**Time:10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Define: (i) Controlled variable (ii) Manipulated variable (iii) Error | **03** |
| | **(b)** | Define Control system. Explain the role of Servomechanism in Control systems. | **04** |
| | **(c)** | Draw the block diagram for a closed loop control system. List the advantages of closed loop control system over open loop control system. | **07** |
| **Q.2** | **(a)** | Determine Laplace transform of : (i) Step function, u(t) (ii) Impulse function, $\delta(t)$ (iii) $\sin\omega t$ | **03** |
| | **(b)** | Explain Principle of superposition and homogeneity for a linear system. Linearize $T = mgL\sin\theta$, about $\theta = 0^o$. | **04** |
| | **(c)** | Using Block diagram reduction method, find transfer function: | **07** |




**OR**

| | | | |
|---|---|---|---|
| | **(c)** | List the steps in finding transfer function using Mason's Gain formula. Define (a) Node (b) Path (c) Branch (d) Loop. | **07** |
| **Q.3** | **(a)** | Determine transfer function of : (i) Proportional controller (ii) Integral controller (iii) Derivative controller | **03** |
| | **(b)** | The transfer function of a system Y(s)/R(s) is $10(s+2) / s^2 + 8s + 15$. Determine y(t) when r(t) is a unit step function. | **04** |
| | **(c)** | Obtain state transition matrix and inverse of state transition matrix of following: | **07** |

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

**OR**

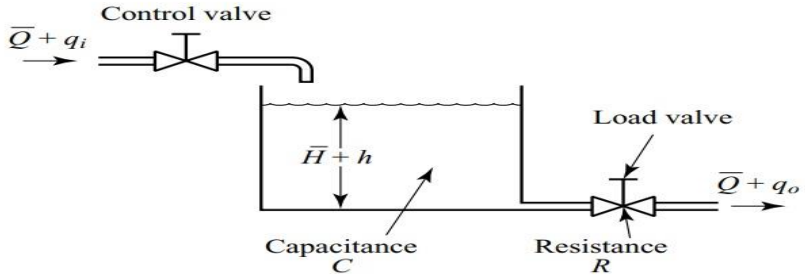
| | | | |
|---|---|---|---|
| **Q.3** | **(a)** | Determine the poles and zeroes of following control system and plot them on S-plane. | **03** |

$$G(s) = \frac{K(s+2)}{s^2 + 2s + 3}$$

**(b)** Determine the value of K for which, the control system with following characteristic equation will behave as stable system: **04**

$$S^3 + 3S^2 + 2S + K = 0$$

**(c)** Carry out mathematical modeling of given liquid level system and determine the transfer function: **07**




**Q.4** **(a)** Define following terms : (a) Absolute stability (b) Relative stability (c) Steady state error **03**

**(b)** Define: (i) Rise time (ii) Settling time (iii) Peak time (iv) Maximum overshoot **04**

**(c)** Explain in detail the steps involved in Nyquist stability criteria. **07**

**OR**

**Q.4** **(a)** Define (a) Bandwidth (b) Break frequency (c) Resonant frequency in reference with frequency response analysis. **03**

**(b)** Explain (a) Lead compensation (b) Lag compensation in connection with frequency response analysis. **04**

**(c)** Explain Ziegler- Nichols rules for Tuning of PID controllers. **07**

**Q.5** **(a)** List and explain the components of Hydraulic control system. **03**

**(b)** Write advantages of Hydraulic control system over Pneumatic control system. **04**

**(c)** With the help of neat diagram, Explain the working of Nozzle-Flapper device. Also draw the characteristic curve of it. **07**

**OR**

**Q.5** **(a)** Compare electrical control system and Hydraulic control system. **03**

**(b)** Differentiate Force-balance and Force-distance type controllers. **04**

**(c)** Carry out mathematical modeling of a hydraulic integral controller (Hydraulic servomotor) and determine its transfer function. **07**

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