Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024**

**Subject Code:3150504 Date:31-05-2024**

**Subject Name:Instrumentation and Process Control**

**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.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | **MARKS** |
|---|---|---|---|
| **Q.1** | **(a)** | Give resistance capacitance lag for following systems.<br>(1) Liquid filled thermometer<br>(2) Liquid level in a tank<br>(3) Mixing tank | **03** |
| | **(b)** | Discuss the importance of process control in chemical industry. | **04** |
| | **(c)** | Derive transfer function for first order system using mercury in glass thermometer using suitable assumptions. | **07** |
| **Q.2** | **(a)** | Differentiate between Open loop and closed loop control system. | **03** |
| | **(b)** | Discuss servo problem and regulator problem. | **04** |
| | **(c)** | Define second order system. Derive the transfer function of U-Tube Manometer in which pressure P is acting in one limb and other limb is open to the atmosphere. | **07** |
| | | **OR** | |
| | **(c)** | For two interacting first order liquid level systems derive the transfer function. | **07** |
| **Q.3** | **(a)** | Draw the general block diagram of a simple control system with positive feedback and explain each term. | **03** |
| | **(b)** | Explain air to open & air to closed control valve with neat sketch. | **04** |
| | **(c)** | A step change of magnitude 4 is introduced into a system having the transfer function $\frac{y(s)}{x(s)} = \frac{16}{1.5s^2+2.4s+6}$<br>Determine (a) Percent overshoot (b) Rise time (c) Period of oscillation (d) Natural period of oscillation | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Discuss the various components of a control system with example. | **03** |
| | **(b)** | Derive and discuss the transfer function for PI & PD controller. | **04** |
| | **(c)** | Explain in details the terms used to describe an underdamped system. | **07** |
| **Q.4** | **(a)** | Describe PLC and SCADA in brief. | **03** |
| | **(b)** | Discuss Phase margin and Gain margin using stability criteria for Bode diagram. | **04** |
| | **(c)** | Given the characteristic equation, determine the stability by the Routh criterion<br>$s^4 + 3s^3 + 5s^2 + 4s + 2 = 0$ | **07** |

**OR**

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|---|---|---|---|
| **Q.4** | **(a)** | Mention advantages and disadvantages of Distributed Control System | **03** |
| | **(b)** | What are Bode diagrams? Explain the graphical rules for Bode diagrams. | **04** |
| | **(c)** | Explain Nyquist stability criteria. | **07** |
| **Q.5** | **(a)** | Discuss the principal of measurement in Bimetallic Thermometer. | **03** |
| | **(b)** | Explain any two static and dynamic characteristics of an instrument. | **04** |
| | **(c)** | Discuss pressure spring thermometer with neat sketch | **07** |

**OR**

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|---|---|---|---|
| **Q.5** | **(a)** | Discuss the principal of liquid level measurement in bubbler system | **03** |
| | **(b)** | Explain working of optical pyrometer with schematic | **04** |
| | **(c)** | Discuss construction and working of Rotameter. | **07** |

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