

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2021****Subject Code:3153618****Date:17/12/2021****Subject Name:Process Instrumentation Dynamics & 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**

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|------------|---|-----------|
| <b>Q.1</b> | <b>(a)</b> Define (i) Error (ii) Positive feedback (iii) Positive feedback  | <b>03</b> |
|            | <b>(b)</b> Write the types of input with example.   | <b>04</b> |
|            | <b>(c)</b> A thermometer exhibiting first order dynamics having a time constant of 5 sec is at a steady state temperature of 25 °C. At time $t = 0$ , the thermometer is placed in a temperature bath at 70 °C. Show that value of response reaches 63.2 % of its ultimate vale when time elapsed is equal to one time constant | <b>07</b> |
| <b>Q.2</b> | <b>(a)</b> Find the Laplace transform of $e^{-t} \cos 2t$ .   | <b>03</b> |
|            | <b>(b)</b> Explain the terms: overshoot, decay ratio, rise time, response time.   | <b>04</b> |
|            | <b>(c)</b> Write a short note on various controllers used in process industries.  | <b>07</b> |
|            | <b>OR</b>   |           |
|            | <b>(c)</b> Derive the transient response of Proportional control for Set point change and for load change.  | <b>07</b> |
| <b>Q.3</b> | <b>(a)</b> Write the systematic procedure for determining transfer function of a process.   | <b>03</b> |
|            | <b>(b)</b> Explain the control hardware relating to control system  | <b>04</b> |
|            | <b>(c)</b> Find the stability of system using routh stability criteria having characteristic equation: $3s^4 + 10s^3 + 5s^2 + 5s + 2 = 0$   | <b>07</b> |
|            | <b>OR</b>   |           |
| <b>Q.3</b> | <b>(a)</b> Define first order system. Also mention characteristic of its transfer function.   | <b>03</b> |
|            | <b>(b)</b> Differentiate between Air to Close and Air to Open Control Valve.  | <b>04</b> |
|            | <b>(c)</b> The characteristic equation: $s^3 + 9s^2 + 26s + (24 + 48K_C) = 0$ Determine the value of $K_C$ for which the system is stable by routh stability criteria.  | <b>07</b> |
| <b>Q.4</b> | <b>(a)</b> For the case of a servo problem prove that an increase in controller gain will reduce the value of offset.   | <b>03</b> |
|            | <b>(b)</b> What is Transportation lag? Derive the transfer function of a system with a transfer lag.  | <b>04</b> |
|            | <b>(c)</b> Describe the working of pressure spring thermometer  | <b>07</b> |
|            | <b>OR</b>   |           |
| <b>Q.4</b> | <b>(a)</b> Derive transfer function of PD-Controller.   | <b>03</b> |
|            | <b>(b)</b> Derive the step response of an underdamped second order system.  | <b>04</b> |
|            | <b>(c)</b> Describe any instrument for liquid level measurement with neat sketch.   | <b>07</b> |

- Q.5** (a) Explain Zero's and Pole's with example. **03**  
(b) Explain the importance of block diagram in control system. **04**  
(c) Write a short note on McLeod Vacuum gauge. **07**
- OR**
- Q.5** (a) Write down the limitation of Routh Test. **03**  
(b) Differentiate feedback and feed forward control system **04**  
(c) With neat sketch explain principle, working and function of Venturi meter. **07**

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