

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2022****Subject Code:3150504****Date:09-01-2023****Subject Name:Instrumentation and Process Control****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) Give the Laplace Transform of the following	03
a. Cosh (kt)	
b. Cos (t)	
c. Sin (kt)	
(b) If the Laplace transform of a function $\frac{4}{s(s+2)(s+4)}$ is time domain, as $t \rightarrow \infty$, Determine the final value of the response.	04
(c) Derive the transfer function of mercury thermometer as first order system.	07
Q.2 (a) Summarize the time constant of first order system: Thermometer, Liquid-level process and Mixing process.	03
(b) Differentiate between Interacting systems and Non-interacting system.	04
(c) Explain various component and variable of control system for stirred-tank heater.	07
OR	
(c) The transfer function of a control system is given by	07
$G(s) = \frac{1}{(1 + 5s)^2}$	
Determine the value of damping factor (ζ) and predict the output response for unit step change in input. Find the output response after 30 second.	
Q.3 (a) What is regulator type problem? Explain with examples.	03
(b) Discuss the merits and demerits of Feed-forward control strategy.	04
(c) Derive the transfer function of mercury manometer.	07
OR	
Q.3 (a) What is servo type problem? Explain with examples.	03
(b) Discuss the merits and demerits of Feed-back control strategy.	04
(c) The characteristic equation of control system is given as $S^4 + 20S^3 + 15S^2 + 2S + K = 0$	07
Determine	
1. The value of K for which system is stable using routh stability criteria.	
2. Value of K for which stem is marginally stable and Complex roots of the system.	
Q.4 (a) Write a short note: ON/OFF controller.	03
(b) Discuss the advantages and limitations of Internal Model Control (IMC).	04
(c) Discuss the Nyquist stability criteria.	07

OR

- Q.4** (a) Derive the transfer function of PID controller and discuss advantages of PID control. **03**
(b) What is the objective of ratio control system? Give Three applications in chemical industry. **04**
(c) Discuss various static characteristics of instrument. **07**

- Q.5** (a) List the advantages of DCS. **03**
(b) Explain seebeck effect of Thermocouple. **04**
(c) Explain construction and working of optical pyrometer. **07**

OR

- Q.5** (a) Explain method for direct measurement of liquid level. **03**
(b) Discuss dry bulb and wet bulb method for measurement of humidity. **04**
(c) Explain construction and working of McLeod gauge. **07**
