Q. Code:865292

Reg. No. | | | | | | | | | | | | | | |

B.E / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Sixth Semester

CH18603 – PROCESS INSTRUMENTATION DYNAMICS AND CONTROL

(Chemical Engineering)

(Regulation 2018 / 2018A)

TIME: 3 HOURS **MAX. MARKS: 100**

CO 1 Classify the working principle and Industrial applications of measuring devices.
CO 2 Relate open loop and closed loop systems with standard input function and its responses.
CO 3 Design controllers using open loop and closed loop methods of tuning.
CO 4 Check the stability of closed loop control system.
CO 5 Discover the advance control strategies and its implementations in chemical processes.

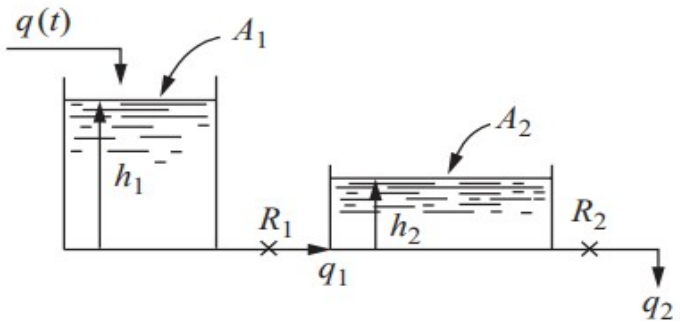
PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

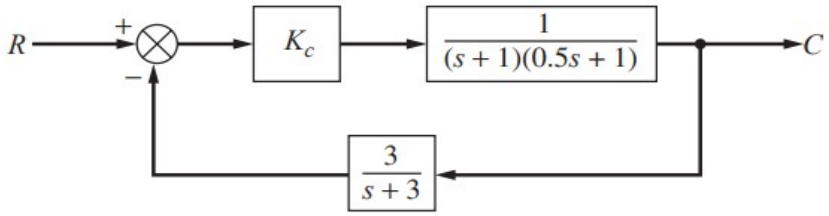
		CO	RBT LEVEL
1.	Identify the types of flow meters commonly employed in industrial processes.	**1**	**2**
2.	Summarize the factors influencing the accuracy of viscosity measurements using rotational viscometers.	**1**	**2**
3.	Classify the forcing functions and give any two examples.	**2**	**2**
4.	Mention how the transient response of first-order systems differs for step, ramp, and impulse input functions.	**2**	**2**
5.	Differentiate between servo and regulatory control problems in process control applications.	**3**	**2**
6.	Illustrate the block diagram representation of a feedback control system using a specific example from process control.	**3**	**2**
7.	Highlight the significance of frequency response analysis in understanding the behavior of closed-loop control systems.	**4**	**2**
8.	Compare the advantages and limitations of Ziegler-Nichols and Cohen-Coon tuning rules for tuning PID controllers in industrial applications.	**4**	**2**
9.	Distinguish between the cascade control from traditional single-loop control systems, and how does it enhance control performance?	**5**	**2**
10.	Interpret how do the manipulated variables impact the functioning of a binary distillation column.	**5**	**2**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Describe the principles of fluid flow measurement in industrial processes and discuss the importance of accurate flow measurement in process control. Provide examples of at least two different techniques used for measuring fluid flow rates and explain their respective operating principles.	**(14)**	**1**	**3**
	(OR)			
(b)	Discuss the operation and working principles of pressure measurement in industrial processes, highlighting the significance of accurate pressure control. Provide examples of at least two different techniques used for measuring pressure.	**(14)**	**1**	**3**
12. (a)	Consider the thermometer to be located in a flowing stream of fluid for which the temperature x varies with time. Determine the response or the time variation of the thermometer reading y for a particular change in x. Develop the transfer function for a first-order system by considering the unsteady-state behavior of an ordinary mercury-in-glass thermometer. Find the transient response for a step input.	**(14)**	**2**	**3**
	(OR)			
(b)	Consider two liquid surge tanks that are placed in series so that the output from the first tank is an input to the second tank. If the outlet flow rate from each tank is linearly related to the height of the liquid (head) in that tank, Derive the transfer function relating changes in flow rate from the second tank to changes in flow rate into the first tank.	**(14)**	**2**	**3**



13. (a)	Write the characteristic equation and construct the Routh array for the control system shown in following figure. Is the system stable for (a) K_c = 9.5, (b) K_c =11, and (c) K_c = 12.	**(14)**	**3**	**3**



(OR)

(b)	Discuss the closed loop response of PI controller to a first order process for a step change in set point. Also, evaluate the offset.	**(14)**	**3**	**3**
14. (a)	Construct the Bode Diagram for the transfer function given below find the actual gain and phase angle at w = 10 $\frac{s+1}{(0.1s+1)(10s+1)}$	**(14)**	**4**	**3**

(OR)

(b)	Draw the Bode plot for the open loop transfer function, $G(s)=\frac{0.5}{(0.5s+1)(s+1)}$ Determine the stability using Bode stability criterion.	**(14)**	**4**	**3**
15. (a)	Discuss the principles of controlling heat exchangers in industrial processes, highlighting the challenges and control strategies involved. Provide examples of industrial applications where advanced control techniques, such as cascade control and feedforward control, have been utilized to optimize heat exchanger operation.	**(14)**	**4**	**3**

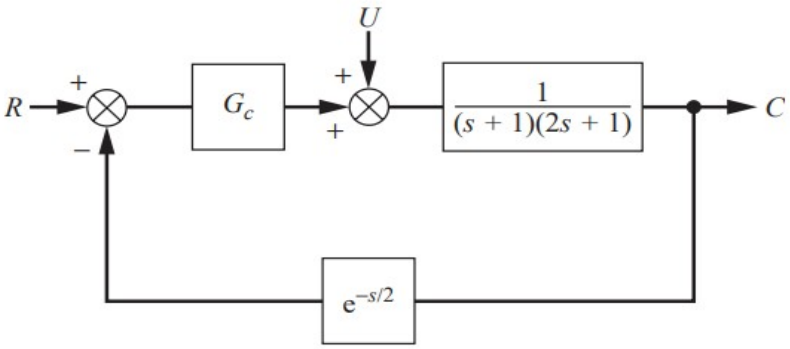
(OR)

(b)	Discuss how feedforward and feedback control systems operate with practical examples	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Using the Ziegler-Nichols rules, determine the controller settings for PID control of the following closed loop system.	**(10)**	**4**	**3**


U
R
+
−
G_c
+
+
$\frac{1}{(s+1)(2s+1)}$
C
$e^{-s/2}$