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

B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2023

Sixth Semester

CH18603 –PROCESS INSTRUMENTATION DYNAMICS & CONTROL

(Chemical Engineering)

(Regulation 2018)

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

CO1 Classify the working principle and Industrial applications of measuring devices.
CO2 Relate open loop and closed loop systems with standard input function and its responses.
CO3 Design controllers using open loop and closed loop methods of tuning.
CO4 Check the stability of closed loop control system
CO5 Discover the advance control strategies and its implementations in chemical processes

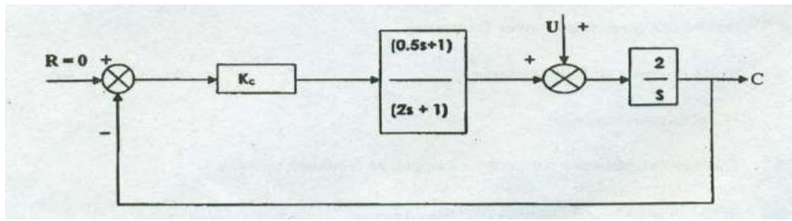
PART- A (10x2=20Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Indicate the objectives of chemical process control with suitable example.	**1**	**2**
2.	Indicate the standard temperature scales with their ranges.	**1**	**3**
3.	Write down the Laplace transform of $f(t) = e^{-2t} sin3t$.	**2**	**4**
4.	Differentiate between Interacting system and Non Interacting system.	**2**	**2**
5.	Sketch the block diagram of feedback control system and label the components.	**3**	**3**
6.	Distinguish between servo and regulatory problem.	**3**	**1**
7.	Show graphically the phase and gain margin.	**4**	**4**
8.	State phase margin and gain margin.	**4**	**1**
9.	Indicate the digital form of PID control algorithm.	**5**	**2**
10.	Name the controlled variables in a control of heat exchanger.	**5**	**1**

PART- B (5x 14=70Marks)

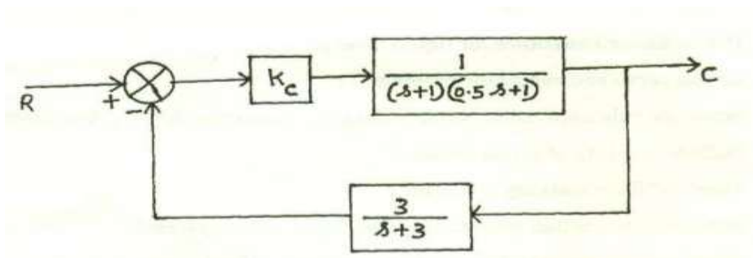
			Marks	CO	RBT LEVEL
11. (a)	**(i)**	Explain the principle and working of an optical pyrometer with a neat sketch.	**(7)**	**1**	**2**
	(ii)	Write in detail the measurements of humidity of gases.	**(7)**	**1**	
		(OR)			
(b)	**(i)**	Explain the working of a bimetallic thermometer along with its material of construction and range of operation with neat sketch.	**(7)**	**1**	**2**
	(ii)	With a neat sketch, explain the working of a McLeod gauge and its range of operation.	**(7)**	**1**	

12. (a)	**(i)**	A thermometer having a time constant of 1 min is placed in a temperature bath, Ti of 50^0C and after the thermometer comes to equilibrium with the bath, the temperature of the bath is suddenly increased to 75^0C for a period of 0.25 min and bath is brought back to 50^0C. Plot the response in temperature of the thermometer.	**(10)**	**2**	**3**
	(ii)	Explain the response of a first order system to a step input.	**(4)**		**3**
		(OR)			
(b)		The overall transfer function of the control system is given as $G(s) = 16/ (1.5 s^2 + 2.4s+6)$. A step change of magnitude 6 is introduced into the system. Calculate. (i) Overshoot (ii) Period of Oscillation (iii) Ultimate value $Y(t)$ (iv) Rise time	**(14)**	**2**	**3**
13. (a)		For the control system shown in the diagram. (1) Obtain the closed loop transfer C/U. (2) Evaluate the proportional gain for which the closed loop damping coefficient is 2. (3) Find the offset for a unit step change in U if $K_c = 2$.	**(14)**	**3**	**4**



(OR)

(b)	**(i)**	Write the characteristic equation and construct the Routh array for the control system shown in fig. Is the system stable for $K_c = 9.5$; $K_c = 11$; $K_c = 12$.	**(10)**	**3**	**4**



	(ii)	Compare pneumatic and electronic controller.	**(4)**		

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			Marks	CO	RBT LEVEL
14. (a)	Sketch the bode diagram for the two first order system having time constant τ_1 =10 and τ_2 = 0.5. A proportional controller with gain k_c is used to control the system. Assume the non-interacting first order system in series. $G(s) = K_c/(10s+1)(0.5s+1)$		**(14)**	**4**	**4**
		(OR)			
(b)	Explain in detail Z-N method of tuning, compare with Cohen-Coon method of tuning.		**(14)**	**4**	**4**
15. (a)	With a neat schematic diagram, explain various control strategies used for terminal composition control in a binary distillation column.		**(14)**	**5**	**2**
		(OR)			
(b)	Explain cascade control with examples. Derive the transfer function of for the cascade control system and discuss the advantages.		**(14)**	**5**	**2**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	There are N storage tanks of volume V arranged so that when water is fed into the first tank, an equal volume of water overflows from the first tank into the second tank, and so on. Each tank initially contains component A at some concentration C_o and is equipped with a perfect stirrer. At time zero, a stream of initial concentration is fed into the first tank at a volumetric rate q. Find the resulting concentration in each tank as a function of time.	**(10)**	**2**	**3**

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