Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 15-12-2025 **Time:** 1.00pm to 04.00pm

School: SOE	**Program:** B.Tech.-PET	
Course Code: PET2005	**Course Name:** Fundamentals of Instrumentation and Control Engineering	
Semester: V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	N.A.	N.A.	22	22	26	30

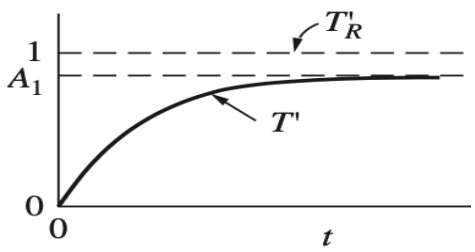
Instructions:

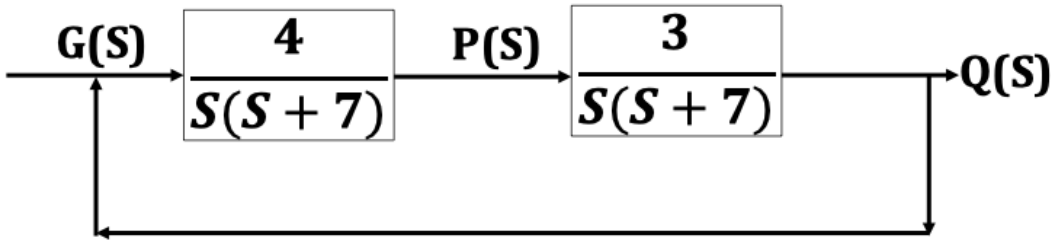
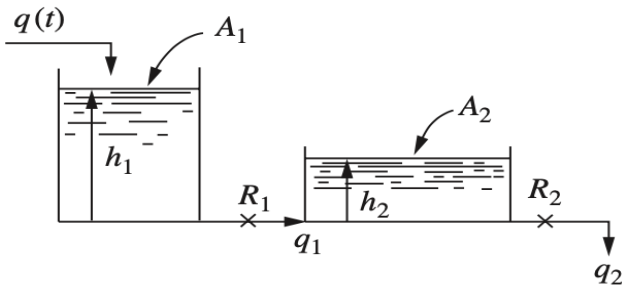
(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2 marks. **10Q x 2M=20M**

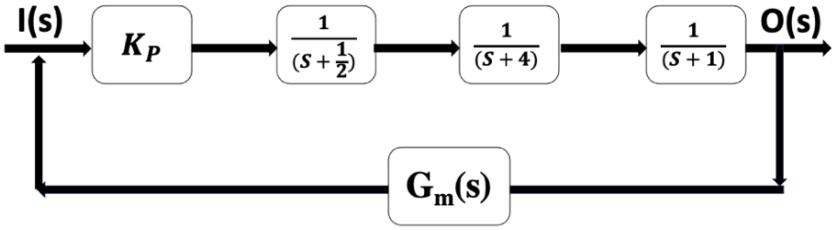
1.	Reproduce the unity-feedback system with a proper diagram.	**2 Marks**	**L1**	**CO3**
2.	A proportional controller has a gain K_p=12. If the error signal is 4 units, reproduce the control action (output signal of the controller).	**2 Marks**	**L1**	**CO4**
3.	List the various modes of control and reproduce the corresponding graphs with proper labels. **(Draw the graph)**	**2 Marks**	**L1**	**CO5**
4.	The Unit-step response for set point change of a Proportional controller is shown in above figure. Let say For the case of a unit-step change in set point, T' approaches $A_1 = K_C A/(1 + K_C A)$. Reproduce the offset of the system. 	**2 Marks**	**L1**	**CO5**

5.	State the mathematical expression while n number of tanks are connected by nonintegrating way.	**2 Marks**	**L1**	**CO5**
6.	Reproduce the Laplace transform when $f(t) = 6$. **(Don't skip the steps)**	**2 Marks**	**L1**	**CO6**
7.	Reproduce the transfer function of the given system.  	**2 Marks**	**L1**	**CO6**
8.	Reproduce the Laplace transform of a function f(t) = 1. **(Don't skip the steps)**	**2 Marks**	**L1**	**CO6**
9.	Define the term Decay Ratio as used in the context of an underdamped response in control systems. Also state what it indicates about the behavior of a system during successive oscillations.	**2 Marks**	**L1**	**CO6**
10.	Reproduce the transfer function of the below mentioned process.  (b)	**2 Marks**	**L1**	**CO6**

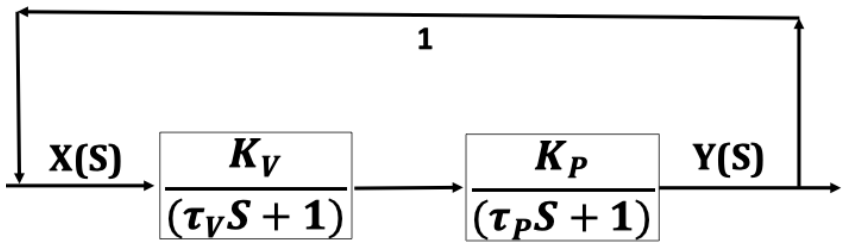
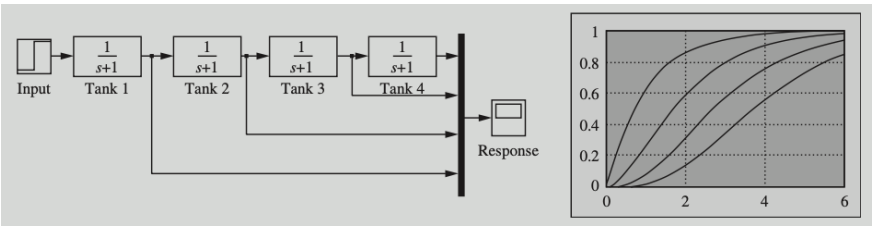
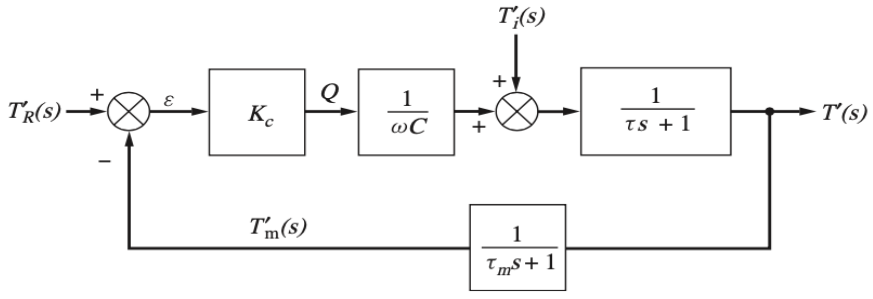
Part B

Answer the Questions. **Total Marks 80M**

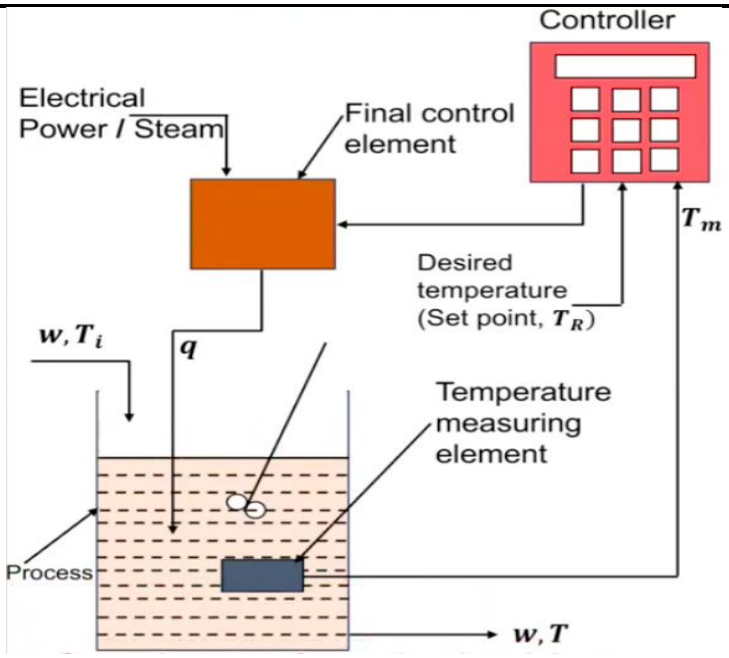
11.	**a.**	Consider, you have a stirred tank reactor which is controlled by an open loop system. The reactor temperature was maintained at a constant temperature. The transfer function is given by $\frac{K_G}{\tau_P S+7}$. After sometimes one unit step change was introduced into the system. Solve the output response of the given system at time t i.e., Y(t).	**10 Marks**	**L3**	**CO3**
	b.	The below diagram shows a closed-loop control system, having an open-loop transfer function of $\frac{16}{1.5S^2+2.4S+6}$. Solve the followings: i) Decay ratio	**10 Marks**	**L3**	**CO3**

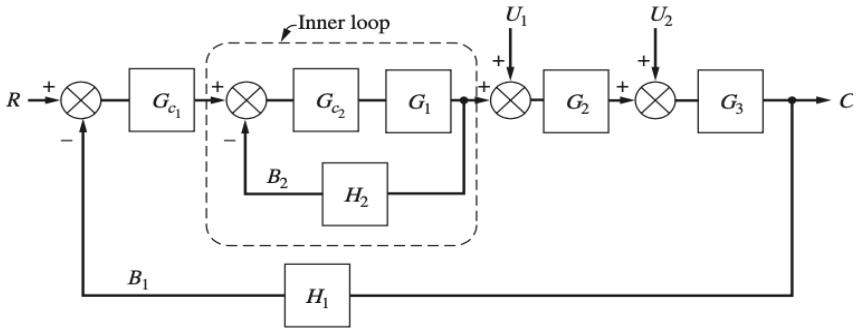
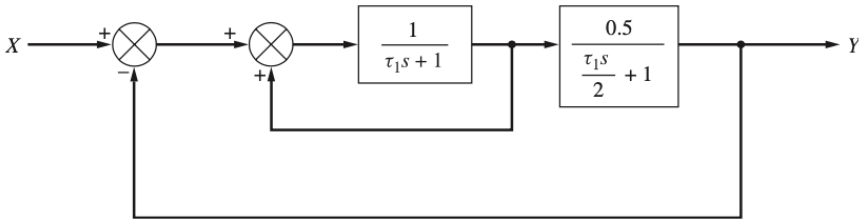
		ii) Overshoot iii) Rise time iv) Period of Oscillation v) Natural period of Oscillation			
		Or			
12.	**a.**	A closed-loop control system is shown in the below figure. A unit-step input of magnitude 1 is applied to the system. Using the given block diagram, apply the standard transient-response formulas to compute the time-domain output response O(t). Demonstrate how to use the inverse Laplace transform method to obtain O(t) for any specified time t, and calculate its numerical value at that instant. [Consider the feedback transfer function of this system is 1] 	**10 Marks**	**L3**	**CO3**
	b.	Using the principles of process dynamics, demonstrate how to develop the transfer function of a two-tank non-interacting system by sketching the system layout and applying mass-balance equations to obtain the final expression.	**10 Marks**	**L3**	**CO3**

13.	**a.**	A thermometer having a time constant of 0.5 minute is at a steady-state temperature of 75°F. At time t=0 the thermometer is placed in a temperature bath and maintained at 100°F. Determine the time needed for the thermometer to read 90°F. **[Do not skip the steps]**	**10 Marks**	**L4**	**CO4**
	b.	Calculate the Laplace transform of the function f(t) = e^{at}. **(Do not skip any step)**	**10 Marks**	**L4**	**CO4**
		Or			
14.	**a.**	The figure below illustrates a pneumatic valve process modeled as a first-order dynamic system. Analyze the system by deconstructing the given process diagram to determine the transfer function, identifying the relationships among key variables and parameters. Further, investigate how the system's dynamic behavior changes by deriving and interpreting the output response Y(t) for a unit step input.	**10 Marks**	**L4**	**CO4**

					
	b.	Using the concept of transfer function examine the dynamic behavior of a first order lag system while unit step input will be introduced into the system.	**10 Marks**	**L4**	**CO4**
15.	**a.**	The transfer function of a given system is given below. Where P(s) is the response. Compute the response of the system at time t that is P(t). $$\frac{S^2-2}{S(S-1)(S-4)(S+1)}$$	**10 Marks**	**L2**	**CO5**
	b.	The below diagram represents noninteracting first-order systems in series for four tractor tanks. Summarize the overall transfer function of the given tank system. 	**10 Marks**	**L2**	**CO5**
Or					
16.	**a.**	The block diagram of a closed-loop system is given in the below figure. Generalize the followings: i) Overall transfer function ii) Transfer function of the system while considering servo problem. iii) Transfer function of the system while considering regulator problem. iv) Transfer function of the system while forcing function and load are changed simultaneously. 	**10 Marks**	**L2**	**CO5**

	b.	The transfer function of a given system is given below. Where T(s) is the response. Compute the response of the system at time t that is T(t). $$\frac{S^2 + s + 1}{S(S-1)(S-4)(S+1)}$$	**10 Marks**	**L2**	**CO5**

17.	**a.**	 The above figure represents the single tank stirred-tank heater. i) Breakdown the system into a simple block diagram ii) Examine the transfer function of the system while considering Regulator problem iii) Examine the transfer function while considering Servo problem iv) From the diagram identify and calculate the error.	**10 Marks**	**L4**	**CO6**
	b.	The below block diagram depicts the cascade control system having two loads. Examine the followings: i) Overall transfer function of the system ii) Overall transfer function while considering regulator problem iii) Overall transfer function for change in load (U_1) iv) Overall transfer function for change in load (U_2)	**10 Marks**	**L4**	**CO6**

					
Or					
18.	**a.**	Examine the transfer function Y(S)/X(S) of the given system.  **[Do not skip any step]**	**10 Marks**	**L4**	**CO6**
	b.	An open-loop control system is shown in the below figure. A unit step impulse is introduced into the system. Calculate the output value at time "t" i.e., Q(t). **P(S)** $\rightarrow \frac{1}{(S-1)(S-4)(S+5)} \rightarrow$ **Q(S)**	**10 Marks**	**L4**	**CO6**