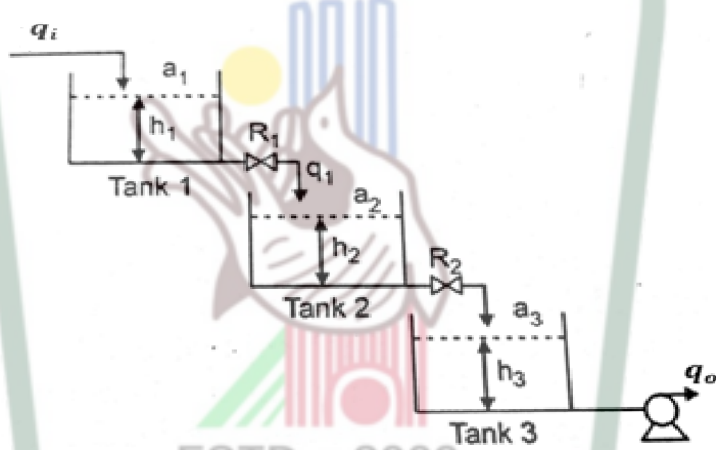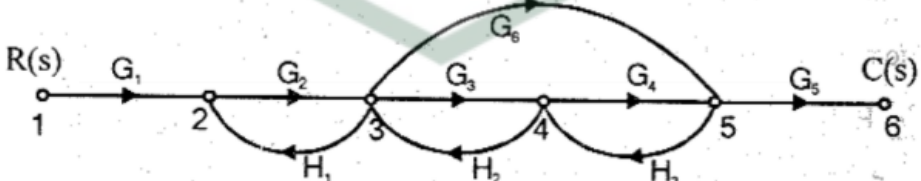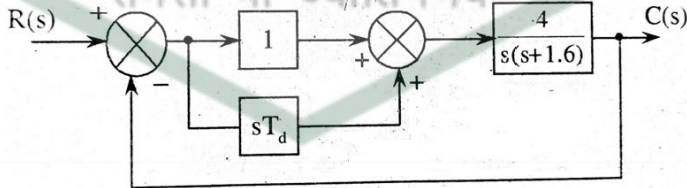**2025**

Process Control and Instrumentation

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	What are performance characteristics of an instrument, explain any four with example?	10
	b)	Derive the transfer function $(Q_o(s)/Q_i(s))$ of the liquid level system shown below? Figure 01	10
2	a)	Obtain the overall gain of the system whose signal flow graph is shown in fig.2. using mason's gain formula. Figure 2	10
	b)	How are second-order systems classified based on the value of the damping ratio? Also, comment on the location of their roots in the s-plane.	4+6
3	a)	The measurements conducted on servo mechanism shows the system response to be	10

		$$c(t) = 1 + 0.4e^{-50t} - 1.5e^{-10t},$$ When subjected to a unit step input. Obtain the expression for the closed loop transfer function.	
	b)	A unity feedback system has a forward path transfer function, $$G(s) = \frac{9}{s(s+1)}$$ Find the value of damping ratio, underdamped natural frequency of the system, percentage overshoot, peak time and settling time.	10
4		Consider the closed loop system given by $$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$ Determine the value of ξ and ω_n so that the system responds to a step input with approximately 5% peak overshoot and with a settling time of 2 sec (use the 2% criterion)	10
	b)	For the system, $$G(s)H(s) = \frac{K}{s^2(s+2)(s+3)}$$ Find the value of K to the limit the steady state error to 10 when the input to the system is $$r(t) = 1 + 10t + 20t^2$$	10
5	a)	The figure shows PD controller used for the system. Determine the value of T_d so that the system will be critically damped. Calculate its settling time. Figure 03	10
	b)	Find the step, ramp and parabolic error coefficients and their corresponding steady state error for unity feedback system having the transfer function, $$G(s) = \frac{14(s+3)}{s(s+5)(s^2+3s+2)}$$	10
6.	a)	What are the types of control valves? Explain the inherent characteristics of fluid control valves?	4+6

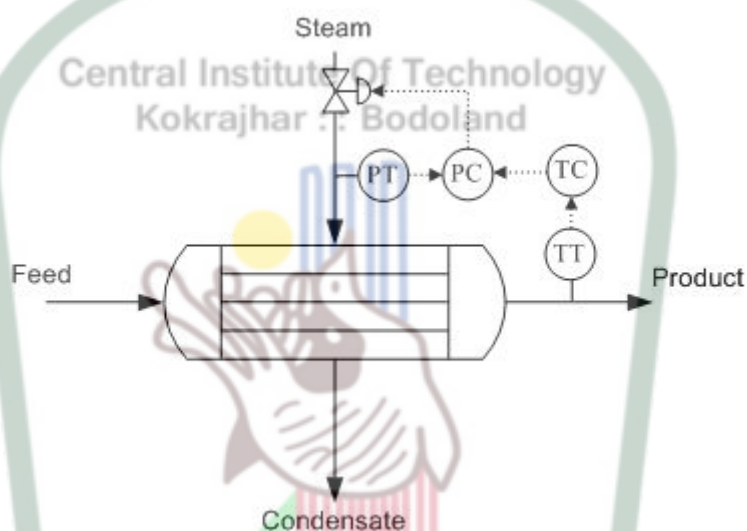|	b)	Write short note on I/P converter and pneumatic actuator?	5+5
7.	a)	The characteristic equation of a system is given below. Determine the stability of the system. $$1+G(s)H(s) = s^4 + 2s^3 + 3s^2 + 4s + 5 = 0$$	10
	b)	Explain the laws, principle & construction of thermocouple?	10
8.	a)	Distinguish between Resistance Temperature Detector and Thermistor? List its advantages, disadvantages & applications?	10
	b)	P&ID diagram: Identify the process and P&ID representations for the below fig.2? Explain the control scheme? Figure 04	10

****THE END****