CBCS SCHEME

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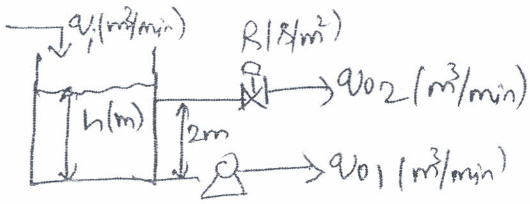
BBT601

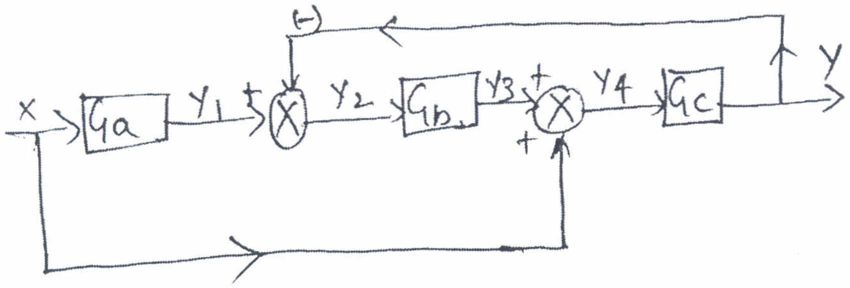
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Bioprocess Control and Automation + Lab

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Mention any 5 static and dynamic characteristics of measuring instruments.	10	L2	CO1
	b.	With the neat sketch, explain the construction and working principle of any two pressure measuring devices.	10	L2	CO1
		OR			
Q.2	a.	With the neat sketch explain the typical instrumentation requirements of bioreactors.	10	L2	CO1
	b.	With the neat sketch explain the construction and working principle of any two temperature measuring devices.	10	L2	CO1
		Module – 2			
Q.3	a.	Determine the Laplace transform of "e^{-at} sinhkt" mathematical function.	5	L2	CO1
	b.	With usual notations obtain the transfer function for mercury thermometer system.	8	L3	CO3
	c.	A thermometer having time constant 0.1 min, is steady at 30°C. At t = 0, it is placed in a bath maintained at 40°C. Determine time needed by thermometer to read 38°C.	7	L3	CO3
		OR			
Q.4	a.	Determine Laplace inverse for the given function $\frac{d^2x}{dt^2}+4\frac{dx}{dt}+4x=2$	5	L2	CO1
	b.	With usual notations derive the transfer function for mixing process in CSTR without any chemical reactions.	8	L3	CO3

	c.	Derive the transfer function $\frac{H(S)}{Q(S)}$ for the liquid level system shown in below Fig.Q.4(c), when the tank level operates around steady state height of 3m. Assume $q_{o_1} = 10 m^3/min$, $R = 0.5 min/m^2$.  Fig.Q.4(c)	7	L3	CO3
		Module – 3			
Q.5	a.	With usual notations obtain the step response equation of non interacting system for equal time constants.	**10**	**L3**	**CO1**
	b.	Two interacting systems are connected in series whose time constants are $\tau_1 = 10$ sec and $\tau_2 = 5$ sec. Obtain the unit step response equation for the tank no. 2, if area of tank 1 is 10 m^2 and $R_2 = 0.5$ s/m^2.	**10**	**L3**	**CO3**
		OR			
Q.6	a.	With usual notations derive the step response equation of second order system for critically damped system.	**10**	**L3**	**CO1**
	b.	A step change of magnitude 4 is introduced into a system whose transfer function is given as $\frac{Y(S)}{X(S)} = \frac{10}{(S^2 + 1.6S + 4)}$ Determine : i) % Overshoot ii) Rise time iii) Ultimate value iv) Maximum value of y(t) v) Period of oscillation	**10**	**L3**	**CO1**
		Module – 4			
Q.7	a.	With the neat sketch explain the construction and working principle of pneumatic control value. Also explain the various industrial plugs for pneumatic values.	**10**	**L2**	**CO2**
	b.	A unit step change in error is introduced to PID controller. If $K_C = 10$; $\tau_I = 1$ and $\tau_D = 0.5$ sec plot the response of controller against time.	**10**	**L3**	**CO3**
		OR			
Q.8	a.	With usual notations obtain transfer function for servo and regulatory problems.	**10**	**L2**	**CO2**

	b.	Determine the transfer function $\frac{Y(S)}{X(S)}$ for the given block diagram  Fig.Q.8(b)	10	L3	CO3
		Module – 5			
Q.9	a.	Define the term stability of control system and hence, explain the criteria of stability of control system.	10	L2	CO4
	b.	Determine the stability of control system whose characteristics equation is $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. Find number of roots with positive real parts.	10	L3	CO4
		OR			
Q.10	a.	Briefly discuss how bode stability criterion is used for determining absolute and relative stability of the control system.	10	L2	CO4
	b.	The characteristic equation of control system is given as $1+\left[\frac{K}{(s)(s+1)(s+2)(s+3)}\right]=0$ Determine the value of K for which the system is stable.	10	L3	CO4

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