QP Code: RA22BTECH405 | Reg. No | | | | | | | | | | | AR 21/22

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Sixth Semester) Examinations, April 2025

21BCHPC36002/22BCHPC36002 – Process Control

(Chemical Engineering)

Time: 3 hrs | Maximum: 70 Marks

Graph paper and Semi log paper are to be provided.
(The figures in the right-hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. Define Forcing Function. What are different types of forcing function generally used in process control.	CO1	K2
b. Define Phase and gain margins.	CO3	K2
c. Difference between Sampling period and Sampling rate.	CO4	K2
d. Distinguish the amplitude ratio for first order & second order control system.	CO4	K2
e. State the needs of control system.	CO1	K2

PART – B **(15 x 4 = 60 Marks)**

Answer ***All*** the questions	Marks	CO #	Blooms Level
2.a. In a process consist of non- interacting two tank multicapacity control system in series. The inflow 'q_1' would be considered as the variable to be controlled. Inflows q_1& q_2 considered as load variables. Downstream head at the lower tank is considered constant, 'h_1' is the head in the upper tank & 'q_r & q_o' are the outflows at the upper & the lower tanks respectively. Assume the flow resistance to be linear. i. Determine the operational equation for the overall system relating q, q_1, q_2 & q_o with the time constant τ_1 & τ_2 of the respective tank. ii. Assuming that the inflows q_1 & q_2 are turned off and allowing a unit step change in the flow rate q. Determine the process response equation.	15	CO2	K2
(OR)			
b. The transfer function of second order system is given as: G(s) = $\frac{Y(S)}{X(S)} = \frac{16}{1.5S^2+2.4S+6}$. A step change of magnitude 6 is given in the input variable of the system. Determine overshoot, rise time, period of oscillation, natural period of oscillation, ultimate value of response & maximum value of response.	9	CO3	K3
c. Derive transfer function of U-tube manometer.	6	CO1	K2
3.a. A PD-Controller is used for the control of first order control system having time constant τ_1=30sec. The value of gain of PD-Controller is K_c=6 and derivative time as 4sec. The control system has a measuring element for which the time constant τ_2=6sec. If a step change of magnitude 0.16 is given to load variable. Determine offset.	6	CO3	K3
b. The transfer function of a control system is given as G(s)= $\frac{Kc(0.5s+1}{s(s+1)(s+0.5)}$. Determine the Value of Kc of the controller which just causes instability. Use the Routh	9	CO3	K3

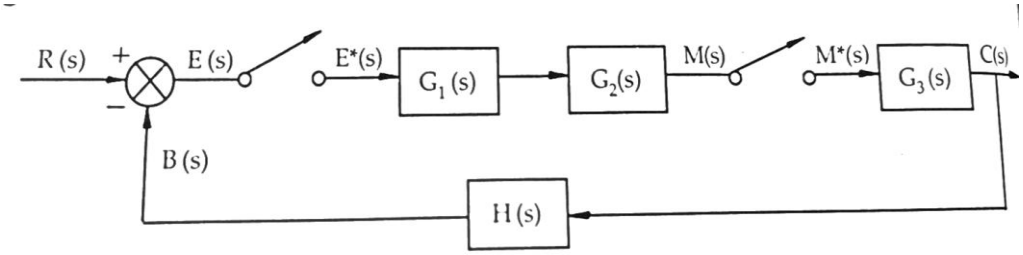
Criteria and determine the location of the pair of roots lie on the imaginary axis of the control system

(OR)

c.	The open loop transfer function is given as G(ol)s= $\frac{Kc}{s(s+1)(s+2)}$. Sketch the root locus diagram of the system by indicating the open loop poles, zeroes, breakaway point, asymptotic line, the direction with which the root locus travels. Also determine the value of K for which the system becomes unstable.	10	CO3	K2
d.	Analyse the effects of different modes of controller with a graphical representation.	5	CO2	K3
4.a.	Design the Frequency response for 1st order control system.	10	CO2	K
b.	Explain phase and gain margin with neat labelled graph.	5	CO2	K5

(OR)

c.	The open loop transfer function of a control system is G(s) = $\frac{k_c(s+1)}{(10s+1)(0.2s+1)}$. Sketch the asymptotic bode diagram of the control system.	12	CO3	K2
d.	State the Limitations for feed forward control system.	3	CO2	K1
5.a.	Define Sampling Switch. Briefly explain Sampling Period & Sampling rate.	5	CO2	K2
b.	Determine the Z-transform equation for the discrete time control system for the following figure:	10	CO2	K2



(OR)

c.	The open loop transfer function of a feedback discrete time control system is GH(s) = $\frac{k(1-e^{-Ts})}{s(s+2)(s+4)}$. Taking sampling period T = 1sec. Determine the value of K for which the system is just unstable.	10	CO3	K3
d.	Discuss the stability criterion for the discrete time control system.	5	CO4	K2

--- End of Paper ---