BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER: VI**
BRANCH: CHEMICAL ENGINEERING **SESSION: SP/2024**

SUBJECT: CL333 PROCESS CONTROL & INSTRUMENTATION

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates:

			CO	BL
Q1. (a)	Find the inverse Laplace of $G_p(s) = \frac{1}{(s^2+1)(s-3)(s-4)}$	[5]	2	3
Q1. (b)	Examine the effect that various values of the gain K_m of a measuring device will have on the closed-loop response of a process with the following transfer function: $G_p(s) = \frac{1}{(s+1)(2s+1)}$ Assume that $G_m = K_m$, $G_f = 1$ and the controller is proportional with $K_c = 1$	[5]	2	4
Q2. (a)	The characteristic equation for the system is, $s^3 + 9s^2 + 26s + 12(2 + k_c) = 0$ Using Routh test find the value of k_c that will keep the system on the verge of instability.	[4]	3	4
Q2. (b)	For loop system whose transfer function is given by, $G(s)H(s) = \frac{K}{s(s+5)(s+10)}$, Determine the values of angle of asymptotes, break away point, intersection to imaginary axis and position of Root locus.	[6]	3	5
Q3.a)	The transfer function of a system with unity feedback is given, $G(s) = \frac{100(s+4)}{s(s+0.5)(s+10)}$ Determine the gain margin, phase margin, gain and phase crossover frequency using graphical method and comment on stability of the process.	[7]	3	5
Q3.b)	The open loop transfer function of a unity feedback control system is, $\frac{10}{(s+5)^3}$, Find the crossover frequency?	[3]	3	4
Q4.a)	The open loop transfer function is given below. Determine the settings for a PID controller as per Ziegler-Nichols recommendation: $G(s) = \frac{K(1-s)}{(s+1)(0.5s+1)}$	[6]	4	4
Q4.b)	Explain the Cohen-coon tuning method to find the tuning parameters of PI controller using process reaction curve.	[4]	4	3
Q5.	(a) Develop a feedforward-feedback control system for a process with the following transfer functions: $G_p(s) = \frac{\bar{y}(s)}{\bar{m}(s)} = \frac{s+1}{(s+2)(2s+3)}$ and $G_d(s) = \frac{\bar{y}(s)}{\bar{d}(s)} = \frac{5}{(s+2)}$ The following specifications are also given: (1) use a PI controller for the feedback loop, and (2) the feedforward system should have both disturbance rejection and set point tracking capabilities. (b) Show how you would tune the feedback PI controller. (c) Derive the conditions that you must be satisfied to stable closed-loop response.	[10]	5	3,4

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