GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2020-2021

CONTROL ENGINEERING

EI503

TIME ALLOTTED: 3 HOURS **FULL MARKS: 70**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

Answer any *ten* from the following, choosing the correct alternative of each question: 10×1=10

		Marks	CO No
(i)	For a stable system, the poles should lie on the __ side of the imaginary axis. a) Right b) left c) middle d) none of these.	1	CO1
(ii)	The order of a system is equals to the number of a) zeroes b) multipliers c) adders d) poles	1	CO2
(iii)	The type of a system is equals to the number of a) polesat origin b) polesnot at origin c) zeroesat origin d) zeroesnot at origin	1	CO3
(iv)	The roots of the characteristics equation is called a) zero b) pole c) gain d) scale	1	CO4
(v)	The definition of transfer function is applicable for a) Linear system b) Non-linear system c) Both of the above d) None of the above	1	CO1
(vi)	In Bode plot, if gain margin is positive, the system is a) Stable b) Unstable c) None of the above d) Cannot be determined	1	CO2

(vii)	If two poles are added in the transfer function, the magnitude plot slope is changed by a) 20 db/Decade b) 40 db/Decade c) -20 db/Decade d) -40 db/Decade	1	CO2
(viii)	If a zero is added in the transfer function, the magnitude plot slope is changed by a) 20 db/Decade b) 40 db/Decade c) -20 db/Decade d) -40 db/Decade	1	CO3
(ix)	Nyquist Plot is a) Variation of complex transfer function with the variation of angular frequency from –infinity to +infinity b) Variation of complex transfer function with the variation of angular frequency from zero to +infinity c) Variation of complex transfer function with the variation of angular frequency from –infinity to zero d) None of the above	1	CO4
(x)	Overshoot can be seen at a) Underdamped system b) Overdamped system c) Nonlinear system d) Critically damped system	1	CO4
(xi)	The stability is higher for a) Open loop system b) Closed loop system c) Equal d) Undetermined	1	CO3
(xii)	The bandwidth is higher for a) Open loop system b) Closed loop system c) Equal d) Undetermined	1	CO1

GROUP – B
(Short Answer Type Questions)
(Answer any *three* of the following) **3 x 5 = 15**

			Marks	CO No
2.	(a)	The characteristic equation of the system is given by s4 + 2s3 + (4 + k) s2 +9s + 25 = 0. Determine the range of k for the system to be stable.	4	CO1 CO2
	(b)	Is it possible to find the relative Stability using Root Locus Plot?	1	CO4
3.		Find whether the system is stable or not using Routh Hurwitz criteria s5 + s4 + 2s3 + 2s2 + 3s + 5 = 0	5	CO2

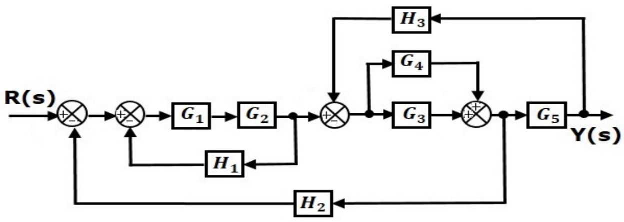
4.		Find the total gain using Mason's gain formula X2 = a12 . X1 + a32. X3 + a42. X4 + a52. X5 X3 = a23. X2 X4 = a34. X3 + a44. X4 X5 = a35. X3 + a45. X4	5	CO1
5.		Calculate the steady state error of the close loop system of transfer function G(s) = 2 / S(S+2) and H(s) = 1 with the I/P signal $3 + t + 7t^2/2$	4	CO1 CO3
		What do you mean by static Error coefficient?	1	CO3
6.		Find the condition of stability for open loop gain (unit feedback) G(s) = K(s-2)/(s+1)2 using Nyquist stability criteria.	5	CO1

GROUP – C

(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

			Marks	CO No
7.	(a)	Find the root locus showing all the steps for a unity feedback open loop gain G(s) = K/[s(s+4)(s2 + 4s + 20)].	10	CO4
	(b)	Find the root locus showing all the steps for a unity feedback open loop gain G(s) = K/[s(s+1)(s + 2)].	5	CO2
8.	(a)	Find the Gain Margin and Phase Margin of the transfer function using Bode Plot G(s) = 100000(s+1) / [s(s+5)(s+100)(s+500)]	13	CO2
	(b)	Define Gain Margin, Phase Margin, Gain crossover frequency and Phase crossover frequency	2	CO3
9	(a)	Find the total transfer function of the system.	9	CO1



	(b)	Find steady state error for Type 0, 1, 2 systems for unit step, ramp and parabolic inputs	6	CO3
10	(a)	A unity feedback system with open-loop transfer function has two poles at -0.1 and 1, zeroes at -2 and -1 and a variable gain 'K'. Using Routh's criteria, find the range of K for which the closed loop system will have 0, 1, 2 poles in the right side.	6	CO4
	(b)	Find whether the system is stable or not using Routh Hurwitz criteria s6 + 2s5 + 8s4 + 12s3 + 20s2 + 16s + 16 = 0	6	CO2
	(c)	Describe different performance indices	3	CO2

11		Write short notes on any three of the following:	3x5	
	(a)	State equation and output equation of the transfer function T(s) = [b0s3 + b1s2 + b2s + b3] / [s3 + a1s2 + a2s + a3]	5	CO1
	(b)	Effects of adding a zero to a system	5	CO1
	(c)	System controllability and Observability	5	CO4
	(d)	Analogy between mechanical systems (translational and rotational), electrical systems (voltage and current analogy), thermal system and fluid system	5	CO4
	(e)	Lead-lag compensation	5	CO2