GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
CONTROL SYSTEM
EC602

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.
1.	(i)	The phase cross over frequency(PCF) at which phase angle is a) -90 degree b) 90 degree c) 180 degree d) -180 degree	1	CO3
	(ii)	For type 3 system the initial slope of bode plot will be a) -40 db/decade b) +60 db/decade c) +20 db/ decade d) -60 db/decade	1	CO3
	(iii)	Derivative error control a) increases the overshoot b) decreases the overshoot c) increases steady state error d) decreases	1	CO5
	(iv)	The number of forward path for Fig.1 is	1	CO1

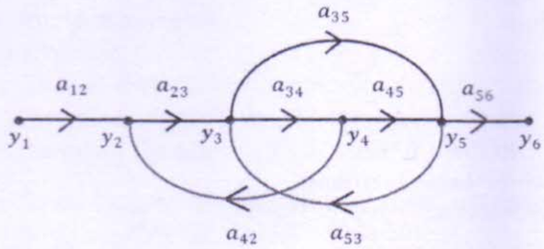


Fig.1

a) 1
b) 2
c) 3
d) 4

	(v)	If the gain margin is negative, it indicates the system is a) stable b) unstable c) marginally stable d) None of these	1	CO3

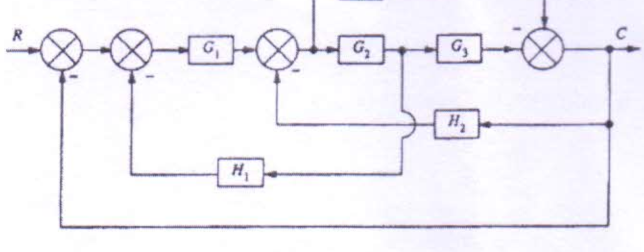
(vi)	The system with the open loop transfer function 1/s(5+s) is: a) Type 2 and order 1 b) Type 1 and order 1 c) Type 0 and order 0 d) Type 1 and order 2	1	CO1
(vii)	The Routh-Hurwitz criterion gives a) Relative stability b) Absolute stability c) Gain margin d) Phrase margin	1	CO4
(viii)	When the gain K of a system becomes 0, the roots of the loci a) terminates at the zeros b) move away from the poles c) coincide with the zeros d) coincide with the pole	1	CO3
(ix)	For G(s)=(s+1)/s(0.5s+1). The corner frequencies are a) 0.5 and 1 b) 0 and 2 c) 2 and 1 d) None	1	CO3
(x)	The characteristics equation of a closed loop second order system is given as s^2 + 4s + 4 = 0, the damping factor is: a) 1 b) 2 c) 0.5 d) 4	1	CO2
(xi)	In terms of Bode plot , the system is unstable if a) P.M=G.M b) P.M and G.M both are positive c) P.M and G.M both are negative d) P.M negative but G.M positive	1	CO3
(xii)	State variable approach converts a n^{th} order system into a) n first order differential equation b) n second order differential equation c) two differential equation d) a lower order system	1	CO5

GROUP – B

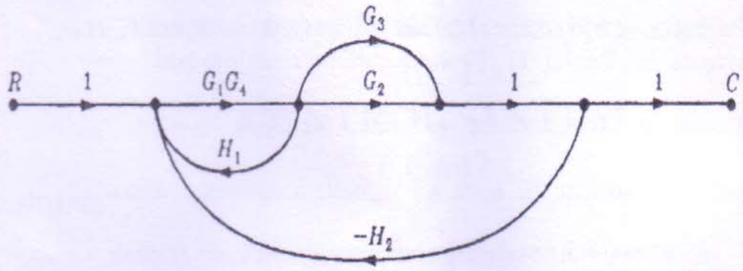
(Short Answer Type Questions)

Answer any *three* from the following: **3×5=15**

		Marks	CO No.
2.	Draw the Signal flow graph and determine C/ R for the block diagram shown in Figure below.(using Mason's gain formula)	5	CO3



3. Define forward path and self-loop. Compute the overall transfer function using Mason's Gain formula. — 5 — CO2

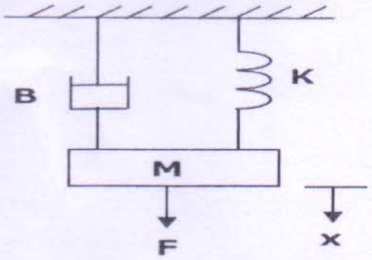


4. Consider the characteristic equation: — 5 — CO4

$S^4 + 15S^3 + 5S^2 + 20S + K = 0$

Apply R.H criteria and obtain the value of gain k so that the system will be marginally stable.

5. Define the term transfer function and obtain the transfer function of mechanical system as shown below: — 5 — CO2



6 Derive the expression of error constant (K_p, K_a, K_v) and obtain the value of steady state error for a unity feedback system with G(s) = 10/(10+s) for unit step input . — 5 — CO1

GROUP – C

(Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

		Marks	CO No.
7.	The open loop transfer function of a unity feedback system is G(s)=K/[S(S+1)(S+2)] . Sketch the root locus and obtain the values of following parameters: i)Break away point ii)Angle of asymptotes iii)Centroid iv)The value of range K for which system is stable v)The value of gain K at which the locus crosses the imaginary axis	15	CO3
8 (a)	Write down the drawbacks of transfer function.	3	CO1
(b)	A closed loop transfer function of a unity feedback system is $C(s)/R(s)=1/(S^4+10S^3+15S^2+12S+10)$ Obtain the state model of the above system.	7	CO5
(c)	Define Controllability and check the controllability of the following system:	5	CO5

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u.$$

$$Y = [0 \;\; 1 \;\; 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

9.	(a)	Define time response and obtain the expression of parabolic response of first order system.	5	CO2
	(b)	Draw the unit step response of second order under damped system and define the following terms: Peak time, Peak overshoot, rise time and settling time.	5	CO2
	(c)	The open loop transfer function of a unity feedback system is $G(s)=K/s(10+s)$. Determine the gain of K so that the system will have a damping ratio of 0.5. For this value of K determine settling time (2%), peak time & peak overshoot.	5	CO2
10.	(a)	Draw the bode plot for the transfer function $G(s)=\frac{50}{s(1+0.25s)(1+0.1s)}$ From the graph determine the following:--------------	5	CO4
	(b)	Gain Crossover Frequency	2	CO4
	(c)	Phase crossover frequency	2	CO4
	(d)	Gain margin	2	CO4
	(e)	Phase Margin	2	CO4
	(f)	Stability of the system	2	CO4
11.		Write Short notes on any three of the following	5x3=15	
	(a)	Gain margin and Phase margin	5	CO3
	(b)	PID controller	5	CO5
	(c)	Mason's gain Formula	5	CO1
	(d)	Nyquist Stablity Criteria	5	CO3
	(e)	Analogous System	5	CO1