GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2020-2021
CONTROL SYSTEM-I
EE503

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)	Signal flow graph is used to obtain the a) stability of a system. b) transfer function of a system. c) controllability of a system. d) observability of a system.	1	CO1
(ii)	AC servomotor is basically a a) universal motor. b) single phase induction motor. c) two phase induction motor. d) three phase induction motor.	1	CO2
(iii)	In torque-current analogy, displacement is analogous to a) flux b) moment of inertia c) voltage d) current	1	CO2
(iv)	Number of roots on the equation $2s^4 + s^3 + 3s^2 + 5s + 7 = 0$ that in lie in the right half of s-plane is a) zero b) one c) two d) three	1	CO3
(v)	A position control is a) an automatic regulating system b) a servomechanism c) a process control system d) a stochastic control system.	1	CO3
(vi)	A system has a single pole at origin. Its impulse response will be a) constant b) ramp c)decaying exponentially d) oscillatory	1	CO2

(vii)	$G(s)=\frac{1+s}{s(1+0.5s)}$. The corner frequencies are a) 0 & 1 b) 0 & 2 c) 0 & -1 d) 1 & 2	1	CO4
(viii)	Addition of zero to the closed loop transfer function a) increase rise time b) decrease rise time c) increase overshoot d) has no effect	1	CO3
(ix)	By the use of a PD control of a second order system, the rise time a) decreases. b) increases. c) remains same. d) has no effect.	1	CO3
(x)	Phase margin of a system is used to specify a) time response b) frequency response c) absolute stability d) relative stability	1	CO3
(xi)	The value of ξ for a system is unity. The system response will be a) over damped b) critically damped c) Under damped d) oscillatory	1	CO2
(xii)	The initial slope of the Bode plot for a transfer function having a simple pole at origin is: a) -20 db/decade b) 10 db/decade c) 20 db/decade d) -10 db/decade.	1	CO3

GROUP – B
(Short Answer Type Questions)

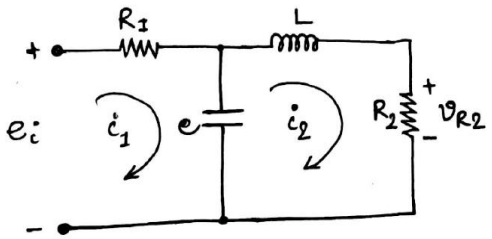
Answer any ***three*** from the following: **3×5=15**

			Marks	**CO No**
2.	(a)	The open loop transfer function of a unity feedback control system is G(s)=20/s(s+2). Determine its steady state error when the input is $r(t)=a_0+a_1t$	3	CO2
	(b)	The open loop transfer function of a unity feedback system is given by $G(s)=\frac{4}{s(s+1)}$.Determine the rise time, peak time, peak overshoot and settling time.	2	CO2

3. Calculate the angles of asymptotes and their centroid for the system having open loop transfer function as, $G(s)H(s) = \frac{K(s+1)}{s^2(s+3.6)}$. — 5 — CO3

4. Draw the polar plot of a type zero system which is given by, $G(S) = \frac{k}{(1+ST_1)(1+ST_2)}$ — 5 — CO3

5. Determine the transfer function $\frac{V_{R2}(s)}{E_i(s)}$ of the network given below. — 5 — CO2

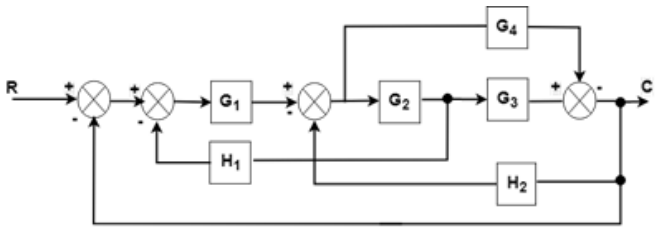


6. Using Routh's criterion determine the stability, indicating the number of roots in the right half s-plane of a closed loop system that has the characteristic equation $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ — 5 — CO3

GROUP – C
(Long Answer Type Questions)

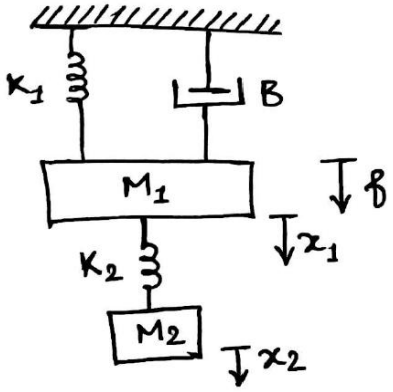
Answer any ***three*** from the following: **3×15=45**

			Marks	CO No
7.	(a)	Draw the Signal Flow Diagram and determine C/R for the block diagram shown in the figure.	5	CO2



(b) A system having a forward path transfer function G(s) = 16/s(s+1) is configured with unity negative feedback. Determine the value of (i) damping ratio, (ii) rise time and (iii) 2% settling time. — 5 — CO2

(c) A unity negative feedback servomechanism is designed to keep a radar antenna pointed at a flying object. If the object is flying with a velocity of 600km/h, at a range of 2 km and the minimum tracking error is to be within 0.1^o, determine the required velocity error constant. The open loop transfer function is a type-1 third order system. — 5 — CO2

8.	(a)	Draw the electrical analogous circuit using force voltage analogy for the mechanical system as shown in figure. 	8	CO2
	(b)	Determine the transfer function of a armature controlled DC motor.	7	CO1
9.	(a)	Sketch the root locus plot for the open loop transfer function of the system as $G(s)H(s)=\frac{K(s+5)}{(s+3)(s-1)}$	8	CO2
	(b)	Find the value of *K* of the above system so that the damping ratio of the closed loop system is 0.5.	4	CO2
	(c)	Is the closed loop system is stable for *K*=2?	3	CO2
10.	(a)	Define the term Absolute and relative stability of a system.	5	CO2
	(b)	Draw the Bode plot for the system whose open loop transfer function is $G(s)=\frac{50}{s(1+0.25s)(1+0.1s)}$. From the graph determine (a) Gain crossover frequency. (b) Phase crossover frequency. (c) GM and PM. (d) Stability of the system	10	CO3
11.		Write short notes on any ***three*** of the following:		
	(a)	Effect of addition of poles and zeros in closed loop transfer function	5	CO2
	(b)	P, PI & PID control.	5	CO3
	(c)	Tachometer	5	CO2
	(d)	Masson's Gain Formula	5	CO2
	(e)	Servomotors	5	CO2