GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
CONTROL SYSTEM – II
EE603

TIME ALLOTTED: 3HR **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 Z transform of a function is $\frac{Z}{Z-1}$, then the laplace transform of the function is a) 1 b) $\frac{1}{s}$ c) $\frac{1}{s-a}$ d) none of these	1	CO2
	(ii)	Which one of the following statements regarding the state transition matrix is Correct a) Φ (0) = 0 b) $\Phi^{-1}(t) = (\frac{1}{t})$ c) $\Phi(t_1+t_2) = \Phi(t_1) + \Phi(t_2)$ d) $\Phi(t_2-t_1)\ \Phi(t_1 - t_0) = \Phi(t_2 - t_0)$.	1	CO1
	(iii)	In series RLC circuit the number of state-variables is a) 3 b) 2 c) 1 d) none of these.	1	CO1
	(iv)	Z transform of an impulse function is a) 1 b) 0 c) infinity d) none of these	1	CO2
	(v)	The faithful reconstruction of a signal on account of sampling is obtained if *a*) $\omega_s = \omega_1$ b) $\omega_s \geq 2\omega_1$ c) $\omega_s \leq \omega_1$ d) $\omega_s \leq 2\omega_1$	1	CO2
	(vi)	The region of convergence of $f(k)=a^k$ for $k \geq 0$ is a) $\|z\|>a$ b) $\|z\|<a$ c) $\|z\|\geq a$ d) $\|z\|\leq a$	1	CO2

(vii)	Jury's stability test is used to judge stability of a) Continuous system b) Discrete system c) non linear system d) None of these	1	CO2
(viii)	On transformation using z = e^{sT} , a point (-1+j2) in the s-plane is placed in z-plane a) inside the unit circle b) outside the unit circle c) –ve real axis d)cannot be placed in the z-plane.	1	CO2
(ix)	Pulse transfer function of ZOH is a) $\frac{1-e^{-sT}}{s}$ b) 1 c) $1-e^{-sT}$ d) none of these	1	CO2
(x)	Hysteresis in a mechanical transmission is termed as a) damping b) backlash c) dead zone d) drift.	1	CO3
(xi)	The phase plane analysis method is restricted to a) second order systems b) nth order systems c) 4th order systems d) none of these.	1	CO3
(xii)	The State Transition Matrix depends only on _____and not on the initial time t_0 [fill in the gap] a) input matrix b) output matrix c) state matrix d) none of these	1	CO3

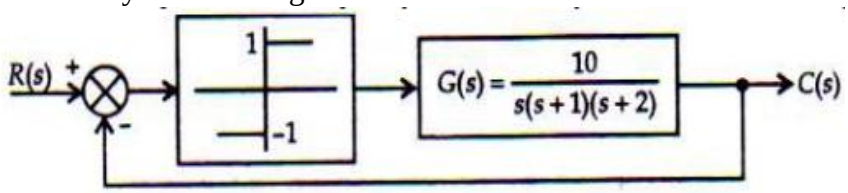
GROUP – B
(Short Answer Type Questions)
Answer any ***three***from the following:**3×5=15**

		Marks	**CO No.**
2.	Solve the following difference equation using z-transform method c (k+2) – 5c(k+1) + 6c(k) = u(k). Given c (0) = 0, c(1) = 1 and u (k) is unit step function.	5	CO2
3.	A system is described by the following rational transfer function, **G(s) =** $\frac{20(10s+1)}{s^3+3s^2+2s+1}$. Find out the state and output equation of the system.	5	CO1
4.	Given the following function find the inverse transform as discrete sequence $v(0), v(1), v(2), \cdots$ $$V(z) = \frac{z}{(z+0.5)(z-1)}$$	5	CO2
5.	Find out describing function for Ideal Relay.	5	CO3

6. Obtain inverse z transform of the following using partial function method: — 5 — CO1

GROUP – C
(Long Answer Type Questions)
Answer any ***three*** from the following:**3×15=45**

			Marks	CO No.
7.	(a)	Determine the amplitude and frequency of the limit cycle of the non-linearity shown in figure below:	10	CO3



	(b)	Explain Jury's stability test in brief.	5	CO2
8.	(a)	Check the controllability and observability of a system having following coefficient matrices. $A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}$, $B=\begin{bmatrix}1\\0\\1\end{bmatrix}$, $C=[10 \quad 5 \quad 1]$.	8	CO1
	(b)	Obtain the time response of the system given below: $\dot{X} = AX$. Where, $A=\begin{bmatrix}0 & 1\\ -2 & 0\end{bmatrix}$; $x(0) = [1 \quad 1]^T$ and $y = [1 \quad -1]\begin{bmatrix}x_1\\x_2\end{bmatrix}$.	7	CO1
9.	(a)	A DC armature controlled velocity mechanism has the only controlled variable as the angular velocity of the motor shaft. Derive a state-space model for the plant by clearly defining the relevant parameters and variables.	7	CO7
	(b)	Determine the pulse transfer function and stability of the sampled data control system shown in Fig. 1for sampling time T = 0.5 second.	8	CO2

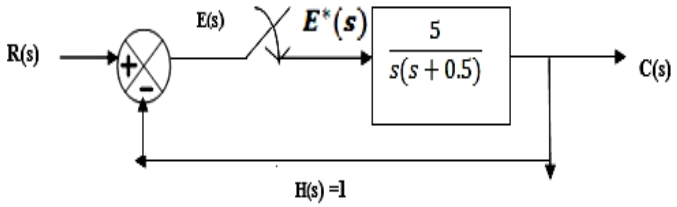
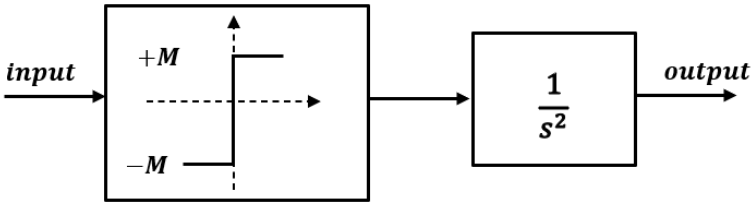


Fig. 1. Closed loop discrete time control system

10.	(a)	An ON-OFF device drives a system having a transfer function as shown in the figure below. Show that in assuming describing function of the ON-OFF device error due to fifth harmonic is only 0.8% of the actual output.	8	CO3



	(b)	The system is given by, $\dot{x}_1 = x_2$ *and* $\dot{x}_2 = -x_1 - x_2^3$. Investigate the stability of the system by Lyapunov's method using $v = x_1^2 + x_2^2$.	6	CO3
11.	(a)	Data Acquisition System	5	CO2
	(b)	Controllability & Observability test	5	CO1
	(c)	Liapunov's first and second method for determining the stability of nonlinear systems.	5	CO3