17

GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022

PROCESS CONTROL-II

EI702A

TIME ALLOTTED: 3Hrs **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 unit step function is a) $1/(1+z^{-1})$ b) $1/(1-z^{-1})$ c) $1/(1+z)$ d) $1/(1-z)$	1	CO2
	(ii) The w-transform can be used for stability analysis of a) any system b) any continuous time system c) any discrete data system d) any linear time-invariant discrete data system	1	CO3
	(iii) In a first-order hold device, for reconstruction of signal a) last sampled data is used b) last two sampled data are used c) last three sampled data are used d) more than three sampled-data are used	1	CO1
	(iv) A signal has frequency 20 Hz. The minimum sampling frequency for proper sampling is a) 10 Hz b) 20 Hz c) 40 Hz d) none of these	1	CO1
	(v) The absolute stability of a discrete time system can be determined by a) Jury's test b) Bode plot c) Routh-Hurwitz criteria d) None of these	1	CO3

(vi) The final value theorem of z-transform can be used to determine — 1 — CO3
a) the settling time
b) the steady state value
c) time delay in the system
d) relative stability of the system

(vii) In fuzzy-logic system, the membership function is part of — 1 — CO6
a) rule base
b) data base
c) fuzzification technique
d) none of these

(viii) The defuzzifier is used in the — 1 — CO6
a) Mamdani's model
b) Sugeno's model
c) Tsukamoto's model
d) None of these

(ix) An example of an Industrial Control System (ICS) is — 1 — CO5
a) PLC
b) DCS
c) Both PLC & DCS
d) None of these

(x) Redundancy is a feature of — 1 — CO5
a) supervisory control system
b) distributed control system
c) open control system
d) field control system

(xi) Pulse transfer function in derived in — 1 — CO3
a) t-plane
b) s- plane
c) z- plane
d) w- plane

(xii) Gain margin of discrete-time control system can be found by using: — 1 — CO3
a) Jury's test
b) Routh-Hurwitz criteria
c) Root locus in r-plane
d) Nyquist plot in w-plane

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

		Marks	CO No
2.	Prove that a zero order hold device introduces a unit time delay in a discrete-time control system.	5	CO2
3.	Find the inverse z-transform of the function $F(z) = z/(z^2 + 0.2z + 0.1)$	5	CO2

4. The characteristic equation of a closed-loop discrete-time control system is given by: 5 CO3

$$F(z) = z^3 + 0.2z^2 + 0.5z + 0.1$$

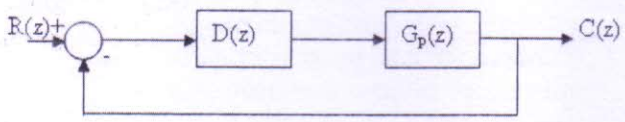
Use Jury's stability criteria to determine if the system is stable.

5. Map the region of stability in s-plane into z-plane. 5 CO3

6. Draw the basic block diagram of a fuzzy logic based control system (Mamdani's model) and briefly describe the role of each block. 5 CO6

GROUP – C
(Long Answer Type Questions)
(Answer any *three* of the following) **3 x 15 = 45**

		Marks	CO No
7. a)	Compare 1st order hold and zero order hold devices, with suitable diagrams.	5	CO1
b)	How can a practical sampler be used as an ideal sampler? Justify the answer mathematically.	5	CO1
c)	Why is Laplace transform not suitable for analysis of discrete-data systems?	2	CO2
d)	State the final value theorem of z-transform.	3	CO2
8. a)	What are causality and physical realisability of a digital controller?	5	CO3
b)	What is the drawback of a deadbeat controller?	2	CO4
c)	Design a deadbeat controller for the all-digital system given below, for unit step, where $G_p(z) = (z+0.2)/(z^2-z-1)$.	3	CO4



d)	Compare the position form and velocity form of a digital PID controller.	5	CO4
9.a)	Draw the basic architecture of a DCS.	4	CO5
b)	Why is redundancy used in DCS?	1	CO5
c)	Compare HART and Foundation Fieldbus protocols for DCS.	6	CO5
d)	What are the advantages and disadvantages of DCS?	4	CO5
10.	Answer any three from the following:	3X5=15	
a)	Dahlin's algorithm	5	CO4
b)	Safety interlocks in DCS	5	CO2
c)	Fuzzy inference system	5	CO6
d)	Aliasing of a signal	5	CO1
e)	Gateway in DCS	5	CO5