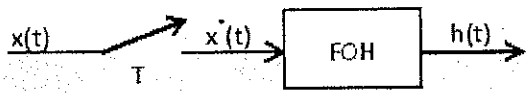
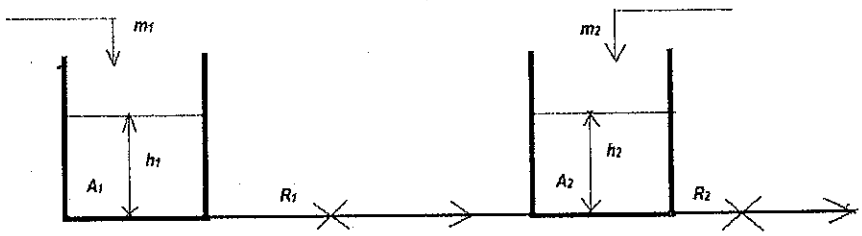
Ref. No. Ex/IEBE/T/412/2019

B. Instrumentation & Electronics Engg. 4th Year, 1st Semester Examination 2019

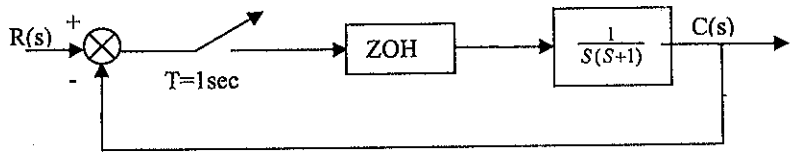
SUBJECT : Process Control – II

Time : Three hours **Full Marks 100**

Answer *any* **FIVE** questions

Q. No.		Marks
1.	a) Prove that a *practical sampler* is equivalent to an *ideal sampler* followed by an attenuator.	3
	b) An *impulse sampler* is followed by a *first-order hold* (FOH) as shown below. Draw the output of FOH, $h(t)$ for the pulse input, $x(t) = [1(t) - 1(t - T)]$ and hence derive the transfer function of FOH (T is the sampling period).	3+7
		
	c) A system is described by the following difference equation: $x(k+2) - 1.5x(k+1) + 0.5x(k) = u(k)$, where $x(0) = 1$ and $x(1) = \frac{5}{2}$. Find its response $x(k)$ for a unit-step input $u(k)$ applied at $t = 0$.	7
2.	a) Consider the system described by $y(k) - 0.6y(k-1) - 0.81y(k-2) + 0.67y(k-3) - 0.12y(k-4) = x(k)$ where $x(k)$ and $y(k)$ are the input and output of the system, respectively. Determine stability of the system using *Jury's test.*	10
	b) Consider the characteristic equation, $F(z) = z^3 - 1.7z^2 - z + 0.8 = 0$. Test the stability of the system using the bilinear transformation, $r = \frac{z+1}{z-1}$ and Routh-Hurwitz criterion.	10
3.	a) What is meant by adaptive control ? With suitable block diagrams explain the operating strategies of *model-reference adaptive control* and *self-tuning control.*	2+6
	b) Write down the basic hardware units of a DCS and explain their functionalities.	8
	c) Provide a brief comparison between PLC and DCS.	4
4.	a) What is meant by loop interaction in a multivariable control system ? What are the approaches to solve this problem ? In what situation decoupler is required ? Design the decoupler for a 2×2 close-loop control system for complete decoupling. What is meant by partial decoupling ?	3+1+1+4+1
	b) Find the relative gain array (RGA) of the system with two interacting tanks shown below, when cross-sectional areas $A_1 = A_2 = 1m^2$ and pipe resistances $R_1 = R_2 = 0.5 sec/m^2$.	10
		

Q. No.		Marks
5.	a) What are the advantages of fuzzy logic controllers (FLCs) over traditional model based controllers.	2
	b) Why PID-type FLCs are rarely designed in its direct form ? What are the usual techniques for realizing such types of FLCs ?	1+1
	c) Write down the steps involved in designing an FLC	4
	d) Form a typical two-dimensional rule-base for PI-or PD-type FLC defined on *error* and *change-of-error* (each having seven membership functions) following the principle of sliding mode control.	4
	e) What are meant by Self-tuning and Self-organizing FLCs ? Illustrate a self-tuning PI-type FLC with an online output scaling factor modifying scheme using fuzzy rules defined on *error* and *change of error* of the controlled variable.	2+6
6.	a) Discuss about the steady state error analysis of discrete data control systems.	10
	b) For the close-loop system shown below	10



Find the final value of $C(kT)$, when $R(s) = \frac{1}{s}$ and k is the sampling instant.

7.	Write short notes on:	10x2
	a) Flexibilities and limitations of fuzzy controller design.	
	b) Gain adaptive PID controller with an illustration.	