GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2710312 Subject Name: Intelligent Systems and Control Time: 2:30 pm to 5:00 pm Instructions:

Date:05/01/2017

Total Marks: 70

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- **0.1** Water tank has a pipe flowing in and a pipe flowing out. The input flow rate is 14 variable by a control valve. The output flow rate is dependent on the amount of water in the tank; more water in the tank results in a faster output flow rate. The water will drain out of the tank faster when there is more water in the tank and slower when there is less water in the tank. The goal of the control system is to take a set value and change the input valve so that the inflow rate will compensate for the outflow. The fuzzy controller inputs are the amount of error in the tank water level and the rate of change for the tank water level. These two inputs will be considered when the fuzzy logic controller determines the proper input valve setting. The error input will be in the range of -1 to 1 and the rate input will be in the range of -0.1 to 0.1 while the valve output will be in the range of -1 to 1 (Normalized). There are three membership functions for the error input, negative, okay, and positive. The negative function is a trapezoidal membership function which has the following parameters: [-1.2 -1.1 -0.8 0]. The okay membership function is triangular with the following parameters:

[-0.6 0 0.6]. The positive membership function is trapezoidal and it has parameters: [0 0.8 1.1 1.7]. The error rate input also has three membership functions: negative, none and positive. The negative membership function is trapezoidal with parameters: [-0.17 -0.11 -0.06 0]. The none membership function is triangular with parameters: [-0.07 0 0.07]. The positive membership function is trapezoidal with parameters: [0 0.06 0.11 0.17]. This set of membership functions act on the rate input of the controller. There are five output membership functions for the valve output on the system: close fast, close slow, no change, open slow, and open fast. They are all triangular functions with the following parameters: close fast: [-1 -0.9 -0.8], close slow:

[-0.6 -0.5 -0.4], no change: [-0.1 0 0.1], open slow: [0.4 0.5 0.6], open fast: [0.8 0.9 1]. Use following fuzzy rules to calculate fuzzy controller output when error is 0.3 and error rate is -0.05. Use Mamdani fuzzy inference and weighted average method for defuzzification.

If (error is okay) then (valve is no_change) (1)

If (error is positive) then (valve is open_fast) (1)

- 3. If (error is negative) then (valve is close_fast) (1)
- If (error is okay) and (rate is positive) then (valve is close_slow) (1)
- If (error is okay) and (rate is negative) then (valve is open_slow) (1).

- Q.2 A Discuss about relay feedback experiment and its importance for the auto tuning of PID 07 controller with necessary derivations.
 - **B** Discuss about the step response method for the identification of FOPTD model for the **07** auto tuning of PID controller with necessary derivations.

OR

B Discuss about the step response method for the identification of SOPTD model for the **07** auto tuning of PID controller with necessary derivations.

Q.3 Let X={a,b,c,d}, Y={1,2,3,4} and
$$\tilde{A} = \{(a, 0), (b, 0.8), (c, 0.6), (d, 1)\}$$

 $\tilde{B} = \{(1,0.2), (2,1), (3,0.8), (4,0)\}$
 $\tilde{C} = \{(1,0), (2,0.4), (3,1), (4,0.8)\}$

Determine the implication relations

- (1) If x is \widetilde{A} then y is \widetilde{B}
- (2) If x is \widetilde{A} then y is \widetilde{B} else y is \widetilde{C}

OR

Q.3 Consider MFNN architecture where there are two input nodes, two nodes in hidden layer 14 and one output node. Train the neural network with back propagation learning algorithm using following five training sets. Use unipolar sigmoidal function for activation. Initialize the weights randomly in the range of -1 to 1.

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Sr.No	Inputs		Output
	I_1	I_2	0
1	0.4	-0.7	0.1
2	0.3	-0.5	0.05
3	0.6	0.1	0.3
4	0.2	0.4	0.25
5	0.1	-0.2	0.12

Q.4 Discuss about Takagi-sugeno (T-S) fuzzy modelling and its importance in detail with 14 necessary example

OR

- Q.4 Discuss about GA based autotuing of PID controller and its importance in detail with 14 necessary example.
- Q.5 Give explanation on Hopfield network and its training algorithm in detail with necessary 14 example.

OR

Q.5 Give explanation on Radial Basis Function Networks (RBFN) and its training algorithm 14 in detail with necessary example.
