Assignment 7

1. Explain briefly the principle of Mamdani Approach of fuzzy logic controller. State its advantages and disadvantages.
2. Discuss briefly various methods of defuzzification.
3. Explain the prinicple of Takagi and Sugeno's Approach of FLC.
4. When and why do we go for hierarchical FLC ?
5. What do you mean by fuzzy clustering ?
6. Explain the principles of fuzzy C-means algorithm and entropy-based fuzzy clustering algorithm.
7. There are two inputs (I_1 and I_2) and one output (O) of a process. It is required to develop a fuzzy logic-based expert system based on Mamdani Approach. Let us assume that the inputs and output are expressed using three linguistic terms, namely Low (LW), Medium (M) and High (H). The membership function distributions of the above inputs and output are shown in Fig. 8.19. The rule base of the fuzzy logic

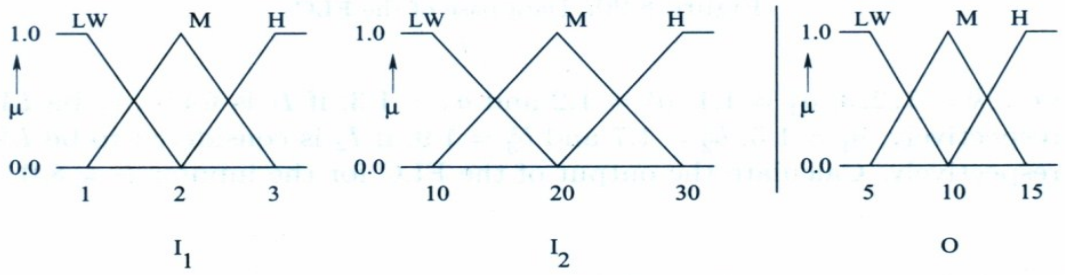

Figure 8.19: Data Base of the fuzzy logic controller.

Table 8.4: Rule Base of the fuzzy logic controller

		I_2		
		LW	M	H
I_1	LW	LW	LW	M
	M	LW	M	H
	H	M	H	H

controller is shown in Table 8.4. Determine the output of the controller for a set of inputs: $I_1 = 1.6$, $I_2 = 22.0$. Use the following methods of defuzzification: (i) Center of sums method, (ii) Centroid method, (iii) Mean of maxima method.

8. An expert system based on Takagi and Sugeno's approach of FLC is to be developed to predict the output of a process. The membership function distributions of the input and output variables are shown in Fig. 8.20. As there are two inputs: I_1 and I_2, and each input is represented using three linguistic terms (such as, LW, M, H), there is a maximum of $3 \times 3 = 9$ feasible rules. The output of i-th rule, that is, y^i $(i = 1, 2, \ldots, 9)$ is expressed as follows:

$$y^i = f(I_1, I_2) = a_j^i I_1 + b_k^i I_2,$$

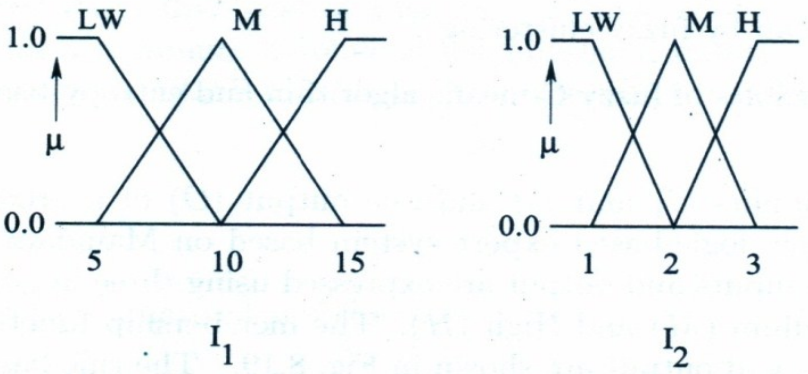

Figure 8.20: Data base of the FLC.

where $j, k = 1, 2, 3$; $a_1^i = 1.1$, $a_2^i = 1.2$ and $a_3^i = 1.3$, if I_1 is found to be LW, M and H, respectively; $b_1^i = 1.5$, $b_2^i = 1.7$ and $b_3^i = 1.9$, if I_2 is considered to be LW, M and H, respectively. Calculate the output of the FLC for the inputs: $I_1 = 8.0$, $I_2 = 2.5$.

9. Table 8.5 shows a set of 20×4 data.

Table 8.5: A set of 20×4 data

5.2	3.6	1.5	0.2
4.9	3.1	1.5	0.2
4.7	3.2	1.3	0.2
4.6	3.4	1.4	0.3
5.4	3.7	1.5	0.2
5.2	3.5	1.5	0.2
5.2	3.4	1.4	0.2
4.7	3.2	1.6	0.2
5.5	4.2	1.4	0.2
4.5	2.3	1.3	0.3
5.2	3.9	1.9	0.5
4.8	3.0	1.4	0.3
5.7	2.5	5.0	2.0
5.8	2.8	5.1	2.4
6.1	3.0	4.9	1.8
7.9	3.8	6.4	2.0
6.3	3.4	5.6	2.4
6.4	3.1	5.5	1.8
6.3	3.5	5.5	2.4
5.9	3.0	5.1	1.8

- Carry out clustering of this data set using fuzzy C-means algorithm. Assume the level of fuzziness $g = 1.5$ and termination criterion $\epsilon = 0.001$.

- Determine the clusters and outliers (if any) using entropy-based fuzzy clustering algorithm. Assume the threshold value of similarity $\beta = 0.52$ and $\gamma = 10\%$.