Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1) Using Genetic algorithm maximize $f(x) = x^2 + 6 * x$, where x value varies between 0 and 31 using 4 children chromosomes and digital encoding.   **CO-2 (5)**

Q2) Suppose we have a simple fuzzy inference system to control the speed of a fan based on the temperature in a room. The input temperature is crisp and ranges from 0 to 100 degrees Fahrenheit. The output fan speed is also crisp and ranges from 0 to 10. The system has three fuzzy sets for the temperature input: "Cold", "Warm", and "Hot". The following rules govern the system:

1.   IF temperature is Cold THEN fan speed y = 0.03x+2

2.   IF temperature is Warm THEN fan speed y = 0.05x

3.   IF temperature is Hot THEN fan speed y = 0.04x+1

Suppose the input temperature is 75 degrees Fahrenheit. What should the output fan speed be according to the Sugeno fuzzy inference system? Use triangular membership function.   **CO-3 (5)**

Q3) Implement OR gate using Widrow Hoff Delta learning rule for artificial neural networks.

CO-3 (5)

Q4) Using Hebb's rule find weights required to perform the following classification of given input pattern. '+' symbol represents the value +1 and empty symbol equals -1. Consider " I " belongs to the members of the class and hence target value = 1 and " O " does not belong to the members of the class and hence target value = -1.   **CO-3 (5)**

+		+
	+	
+		+

"I"

+	+	+
+	+	+

"O"

Q5) Write short notes on   **CO-4 (5)**

a) Multi Layer Perceptron
b) Convolutional Neural Network
c) Radial Basis Function Neural Network
d) Competitive learning rule
e) Credit Assignment Problem