(3 Hours) **Total Marks: 80**

N.B. : (1) Questions No.**1** is **compulsory**.
(2) Solve any **three** questions out of **remaining**
(3) Draw neat labeled diagram whenever necessary
(4) Assume suitable data if necessary

Q1. **Answer any 4 questions:**

a. Brief with suitable diagram the feature map extraction process of convolutional neural network for image recognition. 5

b. Prove De-Morgan's theorem If X and Y are two fuzzy sets with membership functions: μ_x ={0.3,0.7,0.2, 0.4 } μ_y= {0.1,0.4,0.8,0.3}. 5

c. Discuss competitive learning with a flow chart. 5

d. Brief about supervised and unsupervised learning? Give their examples 5

e. Explain cross validation error based stopping criteria used in neural network training. 5

Q2.a. What are activation functions in neural networks? What are their properties? Draw any four activation functions with their mathematical equations. 10

b. Explain the working of K-Means clustering algorithm with flowchart. 10

Q3.a. Explain with a flow chart the error backpropagation learning algorithm. 10

b. Explain a Mamdani fuzzy controller for deciding the wash time in a washing machine. Consider inputs as washing load and dirt. Use any suitable membership functions with three descriptors for input and output. 10

Q4.a. What is De-fuzzification? Discuss any two methods of De-fuzzification. 10

b. Implement AND function using perceptron network. Consider bipolar inputs and targets, initial bias and weights as 0 and the learning rate as 1. 10

Q5.a. With a flow chart explain the gradient descent algorithm. 10

b. Define the terms support vectors and hyperplane with reference to a support vector machine. How do support vector machines differ from conventional classifiers? What are the advantages and limitations of SVMs? 10

Q.6.a. What is the difference between machine learning and deep learning? Draw and explain the architecture of Convolution Neural Network. Discuss its applications. 10

b. Construct a discrete Hopfield network to store the patterns S1 = [1 -1 1 -1] and S2 = [-1 1 -1 1]. If the received pattern is [1 1 -1 1], identify the correct pattern. 10
