

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

CLASS: BTech  
BRANCH: ECE

SEMESTER : VII  
SESSION : MO/2025

**SUBJECT: EC415 NEURAL NETWORK AND FUZZY SYSTEM**

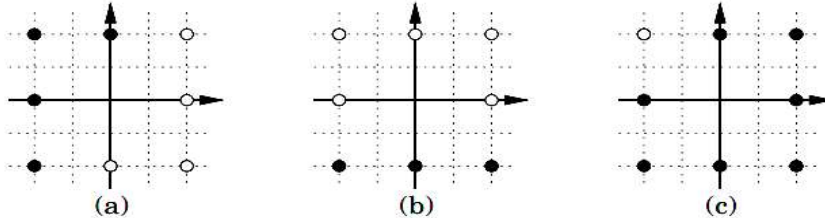
TIME: 3 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

- Q.1(a) Solve the following classification problems shown in following figures by drawing decision boundaries. Find weight and bias values that result in single perceptron with the chosen decision boundaries. [5] CO 1,2 BL 3



- Q.1(b) What is the difference between regression and classification in machine learning? For the following observations predict the value for  $x=9$  using linear regression model. [5] 1,2 2,3

x	1	2	3	4	5
y	2	5	7	8	10

- Q.2(a) A fully connected feedforward network has 10 source nodes, 2 hidden layers, one with 4 neurons and the other with 3 neurons, and a single output neuron. Construct an architectural graph of this network. Calculate the number of parameters involved in each layer. [5] 2,3 2
- Q.2(b) What is gradient descent, and how is it used with backpropagation? What are the different parameters that affects the convergence of training of the back propagation algorithm. Explain. [5] 2 2,3
- Q.3(a) i. Write two key advantages of using RBF networks over standard feedforward neural networks. [5] 1,3 2,4  
 ii. Consider an RBF network with three RBF neurons in the hidden layer, each using a Gaussian function as the activation function. If the input vector is  $\mathbf{x} = [2, 3]$  and the centres of the RBF neurons are  $\mathbf{c}_1 = [1, 1]$ ,  $\mathbf{c}_2 = [3, 4]$ , and  $\mathbf{c}_3 = [2, 2]$  with spread parameter (variance) of  $\sigma^2 = 1$ . Calculate the outputs of the RBF neurons.
- Q.3(b) Draw the block diagram of basic CNN architecture and write the function of each block. You have a convolutional layer with 8 filters, each of size  $5 \times 5$ , and it is applied to an input of dimensions  $32 \times 32 \times 3$  using a stride of 1 and with a padding of 2. Calculate the output's dimension [5] 1,3 1,4

Q.4(a) Construct the membership functions for the linguistic variables “more or less old”, “not young not old”, “young but not too young” and “extremely old”. The MFs given for old and young are given as,  $\mu_{old}(x)=bell(x,30,3,100)$ ,  $\mu_{young}(x)=bell(x,30,3,100)$ . Here ‘x’ is the age of a person and UOD= [0,100]. [5] 4 2,4

Q.4(b) Consider the following three fuzzy sets  $\underline{A}$ ,  $\underline{B}$  and  $\underline{C}$ . Find the fuzzy relations  $\underline{R} = \underline{A} \times \underline{B}$ ,  $\underline{S} = \underline{C} \times \underline{B}$ . Also find the relation  $\underline{C} \circ \underline{R}$  using max-min composition. [5] 4 3

$$\underline{A} = \left\{ \frac{1}{low} + \frac{0.2}{medium} + \frac{0.5}{high} \right\}$$

$$\underline{B} = \left\{ \frac{0.9}{positive} + \frac{0.4}{zero} + \frac{0.9}{negative} \right\}$$

$$\underline{C} = \left\{ \frac{0.1}{low} + \frac{0.2}{medium} + \frac{0.7}{high} \right\}$$

Q.5(a) Discuss fuzzy inference system with block diagram. Explain Mamdani fuzzy inference system with suitable example. [5] 4,5 2

Q.5(b) Consider two fuzzy sets  $\underline{A}$  and  $\underline{B}$ , both defined on  $X$ , given as follows: [5] 4,5 3

$\mu(x_i X)$	$x_1$	$x_1$	$x_1$	$x_1$	$x_1$
$\underline{A}$	0 . 2	0.3	0 . 4	0.7	0 . 1
$\underline{B}$	0 . 4	0.5	0 . 6	0.8	0 . 9

Express the following  $\alpha$ -cut sets :

- (a)  $(\underline{A})_{0.7}$  (b)  $(\underline{B})_{0.2}$  (c)  $(\underline{A} \cup \underline{B})_{0.6}$  (d)  $(\underline{A} \cap \underline{B})_{0.3}$  (e)  $(\overline{\underline{A}} \cap \overline{\underline{B}})_{0.8}$