MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

VI SEMESTER B. TECH (MECHATRONICS)

End Semester Make up Examination June 2024

Subject: Artificial Intelligence **Subject Code: MTE 4059**

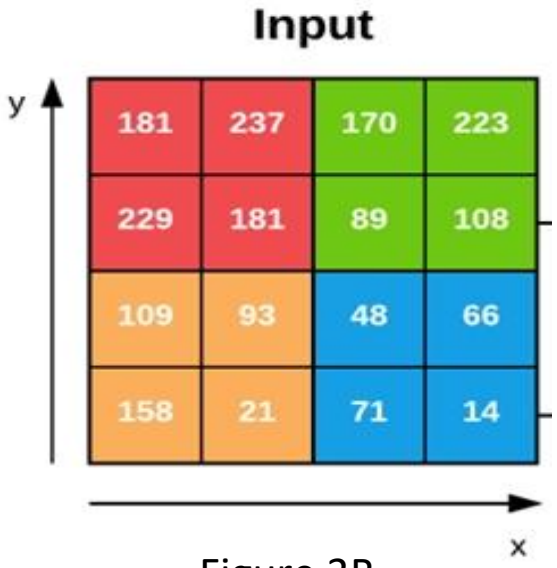
Time: 180 Minutes **Exam Time: 2:30 PM to 5:30 PM**

Date of examination: 22 June 2024 **MAX. MARKS: 50**

Instructions to Candidates:

- ***Answer ALL the questions.***
- *Missing data may be suitably assumed and justified.*

		M	CO	PO	LO	BL
1A	Illustrate the architecture of deep cascade forward backpropagation (DCFBP) neural network model for predicting the engine performance and emission (BSFC, BSEC, BTE, UHC, CO, NO_x, Smoke Density) of a CI engine. Also, enlist and explain the performance parameters used for the analysis of the of the DCFBP neural network.	4	1	1	1	4
1B	Assemble the FFBP ANN model architecture for total coliform removal in a sequential batch reactor-based WWTP employing an intermittent cycle extended aeration system. The influent parameters include pH, COD, BOD, TSS, TKN, O&G, AN, TP, FC, and TC. Define the performance metrics that were employed to evaluate the FFBP ANN model.	4	1	1	3	4
1C	Examine and contrast the Mini-Batch Gradient Descent with the Batch Gradient Descent.	2	2	2	2	4
2A	Explain and compare the Momentum based gradient descent and Nesterov accelerated gradient descent.	5	2	2	2	4
2B	Given a set of input values (x_1, x_2, x_3) and corresponding weights (w_1, w_2, w_3), compute the output of a McCulloch-Pitts neuron using a threshold activation function.	3	1	1	1	3
2C	Explain Xavier and He's initialization and provide the weight initialization equations for logistic, hyperbolic tangent, and normal distributions, as well as the ReLU activation function.	2	2	2	3	4
3A	Illustrate the architecture of AlexNet with the help of block diagram and furnish full details. Enlist the advantages and limitation of AlexNet for the Image classification.	4	3	2	3	3

3B	Given the input data, Calculate the output of the pooling layer considering a scenario with 2x2 max pooling and a stride of 1. Compare and contrast the resulting output representations in terms of dimensionality reduction and feature preservation.  Figure 3B	4	3	2	2	3
3C	Evaluate the significance and multifaceted role of privacy within the context of an information society, considering its implications for individual rights, societal norms, and technological advancements.	2	5	8	8	4
4A	Explain the architecture of a convolutional neural network (CNN) that uses sliding windows and localization for classification and object identification. Additionally, explain how to assess its effectiveness in identifying background elements, motorbikes, vehicles, and pedestrians.	4	3	2	3	5
4B	Evaluate the following fuzzy relation equations by Mamdani Max-Min composition: If rainfall is 'High', drought is 'Low'. Deduce the drought level when rainfall is very high. Let High (rainfall) = $\{\frac{0.4}{2} + \frac{0.8}{3} + \frac{1}{4}\}$ and Low (drought) = $\{\frac{1}{1} + \frac{0.7}{2} + \frac{0.2}{3}\}$ The universe of discourse for the 'rainfall rate' is X and 'drought level' is Y as $X = \{1, 2, 3, 4\},\ Y = \{1, 2, 3\}$.	4	4	1	2	4
4C	Analyze the structure and key elements of a fuzzy inference system (FIS) using a detailed diagram. Elucidate the significance of FIS in facilitating decision-making processes.	2	4	1	1	4
5A	Let x be a linguistic variable that measures a company's employee performance, which takes values from the universe of discourse $U = \{1,2,3,4,5,6,7,8,9,10\}$.	5	4	1	2	4

	Suppose the term set of x includes Excellent, Good, Fair and Bad. The membership functions of these linguistic labels are listed as follows: $\mu_{Excellent} = \{(8, 0.4), (9, 0.6), (10, 1)\}$ $\mu_{Good} = \{(6, 0.3), (7, 0.6), (8, 0.9), (9, 1), (10,1)\}$ $\mu_{Fair} = \{(3, 0.4), (4, 0.6), (5, 0.9), (6, 0.9), (7, 0.5), (8, 0.1)\}$ $\mu_{Bad} = \{(1, 1), (2, 0.7), (3, 0.6), (4, 0.4)\}$ Construct the membership functions of the following compound sets: (i) Not bad but not very good (ii) Good but not excellent					
5B	Explain the working principles of the Sugeno Fuzzy Model.	2	4	1	1	3
5C	Evaluate the following fuzzy arithmetic operation $C = A + B$ through extension principal by fuzzifying the function $z(x, y) = x + y$ for the given set. $A = \frac{0}{0} + \frac{0.3}{1} + \frac{0.5}{2} + \frac{0.6}{3} + \frac{0.7}{4} + \frac{1}{5}$ $B = \frac{1}{0} + \frac{0.7}{1} + \frac{0.5}{2} + \frac{0.4}{3} + \frac{0.3}{4} + \frac{0}{5}$	3	4	1	2	5