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

DEPARTMENT OF MECHATRONICS

VI SEMESTER B. TECH (MECHATRONICS)

End Semester Assessment May 2024

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

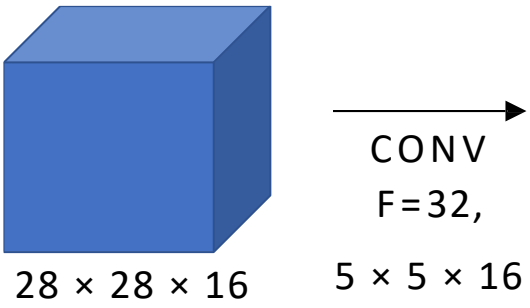
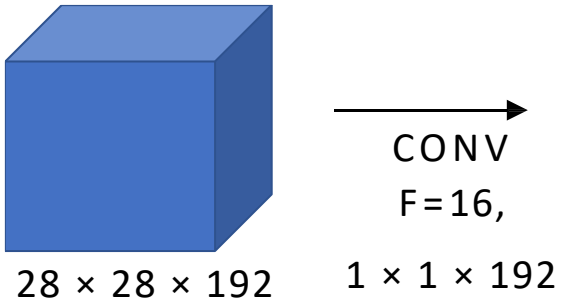
Time: 180 Minutes **Exam Time: 2:30 PM to 5:30 PM**

Date of examination: 6 May 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 effluent quality (BOD, COD, TSS, TKN, AN, TP) of a combined upflow anaerobic sludge blanket and facultative pond. Also analyse the performance of the DCFBP neural network with the help of performance parameters.	4	1	1	1	4
1B	Construct the architecture of FFBP ANN model for faecal coliform removal in an intermittent cycle extended aeration system-sequential batch reactor based WWTP with influent parameters pH, COD, BOD, TSS, TKN, O&G, AN, TP, FC, TC. Explain the performance parameters used to test the performance of the FFBP ANN model.	4	1	1	3	4
1C	Explain Batch Gradient Descent and Mini-Batch Gradient Descent with the implementation's steps.	2	2	2	2	4
2A	Explain the importance of optimizers in NN model training. Illustrate following optimizers with associated mathematical equations: (i) AdaGrad, (ii) RMSprop, (iii) Adam	5	2	2	2	4
2B	Given a set of input values (x_1, x_2, x_3, x_4) and corresponding weights (w_1, w_2, w_3, w_4), compute the output of a McCulloch-Pitts neuron using a threshold activation function.	3	1	1	1	3
2C	Explain Xavier and He initialization, List the weight initialization equation for uniform and normal distribution of logistic, hyperbolic tangent and ReLU activation function.	2	2	2	3	4

3A	Illustrate the architecture of YOLO with the help of block diagram and furnish full details. Enlist the advantages and limitation of YOLO for the Real-Time Object Detection.	4	3	2	3	3
3B	Calculate the dimensions of the output volume in a CNN network for Figure 3B(i) and Figure 3B(ii):  Figure 3B(i)  Figure 3B(ii)	4	3	2	2	3
3C	Distinguish between accountability and responsibility for artificial intelligence-based application.	2	5	8	8	4
4A	Appraise a convolutional neural network (CNN) architecture for object detection utilizing sliding windows and classification with localization. Evaluate its efficacy in detecting pedestrians, cars, motorcycles, and background elements.	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) = $\{\frac{0.5}{2}+\frac{0.8}{3}+\frac{1}{4}\}$ and Low (drought) = $\{\frac{1}{1}+\frac{0.6}{2}+\frac{0.2}{3}\}$ 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	Illustrate the structure and main components of a fuzzy inference system (FIS) with a clear diagram. Explain the concept of a fuzzy inference system and its relevance in decision-making processes.	2	4	1	1	3
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: $\mu_{Excellent} = \{(8, 0.3), (9, 0.5), (10, 1)\}$ $\mu_{Good} = \{(6, 0.2), (7, 0.6), (8, 0.8), (9, 1), (10,1)\}$ $\mu_{Fair} = \{(3, 0.4), (4, 0.6), (5, 0.9), (6, 0.9), (7, 0.5), (8, 0.1)\}$ $\mu_{Bad} = \{(1, 1), (2, 0.8), (3, 0.7), (4, 0.4)\}$ Deduce the membership functions of the following compound sets: (i) Not bad but not very good (ii) Good but not excellent					
5B	Explain Ebrahim Mamdani's Fuzzy Model, outlining the Two Rules of Mamdani with Min and Max Operators, supported by a clear illustration.	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. $A = \frac{0}{0} + \frac{0.2}{1} + \frac{0.4}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{1}{5}$ $B = \frac{1}{0} + \frac{0.8}{1} + \frac{0.6}{2} + \frac{0.4}{3} + \frac{0.2}{4} + \frac{0}{5}$	3	4	1	2	5