MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

Third Semester MCA Degree Examination, 2025-26

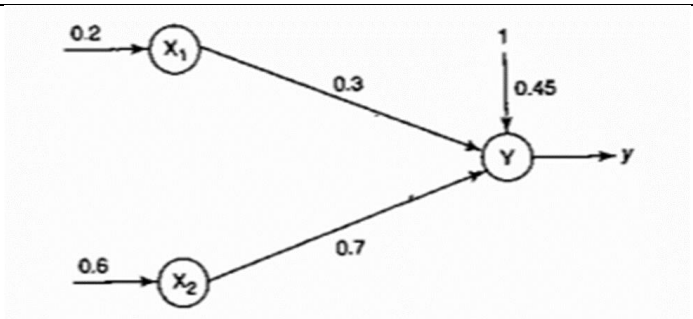
Deep Learning

Time: 3 Hours **Max. Marks: 100**

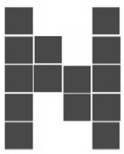
Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

<table>
<tr><th colspan="3">Module -1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td rowspan="2">Q1</td><td>a.</td><td>A biological neuron receives signals through dendrites, integrates them in the cell body, and produces an output through the axon when a threshold is exceeded.

Given Data:
Inputs: x=[1,0.5,−1]
Weights: w=[0.4,0.6,0.2]
Bias: b=−0.3

Map the biological neuron components to an artificial neuron and compute the output of the artificial neuron using a sigmoid activation function.</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td>b.</td><td><table><tr><th>Ear shape</th><th>Tail length</th><th>Fur color</th><th>Eye shape</th><th>Snout length</th><th>Body size</th><th>Class</th></tr><tr><td>Triangular</td><td>Short</td><td>Black</td><td>Round</td><td>Long</td><td>large</td><td>Dog</td></tr><tr><td>floppy</td><td>Medium</td><td>Brown</td><td>Round</td><td>Long</td><td>Medium</td><td>Dog</td></tr><tr><td>Pointed</td><td>Long</td><td>White</td><td>Almond shape</td><td>Small</td><td>Small</td><td>Cat</td></tr><tr><td>Pointed</td><td>Medium</td><td>Black</td><td>Slit shaped</td><td>Small</td><td>small</td><td>Cat</td></tr></table>
Build a neural network for the given classification data set. Apply sigmoid function and predict the classification for new data with "Triangular, medium, brown, round, long, medium".</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="2">Q2</td><td>a.</td><td> 

Calculate the net input for the network shown in the figure with bias included in the network. Discuss the need for activation function in the neural networks. Illustrate your answer with a suitable example.</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td>b.</td><td>A perceptron has weights
w=[0.6,−0.4]
inputs x=[1,0] and</td><td>10</td><td>L3</td><td>CO1</td></tr>
</table>

<table>
<tr><td></td><td></td><td>bias b=0.2
Apply the perceptron learning model to compute the output and classify the input.</td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Module- 2</td></tr>
<tr><td rowspan="2">Q3</td><td>a.</td><td>A neural network uses gradient descent to minimize loss.
Given Data:
• Weight = 1.2
• Gradient = 0.6
• Learning rate = 0.05
Apply one iteration of gradient descent and calculate the updated weight. Discuss how gradient descent enhances the accuracy of the model.</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td>b.</td><td>An AI system is used to classify news articles into one of the following three categories:
• Class 1: Sports
• Class 2: Politics
• Class 3: Technology
For a particular article Actual class = Technology
The model outputs the following predicted probabilities:
<table><tr><td>Class</td><td>Predicted Probability</td></tr><tr><td>Sports</td><td>0.1</td></tr><tr><td>Politics</td><td>0.2</td></tr><tr><td>Technology</td><td>0.7</td></tr></table>Calculate the Binary Cross-Entropy Loss for this multi-class prediction and interpret the results.</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="2">Q4</td><td>a.</td><td> 
A letter N is represented in 4X5 pixel image. Design a neural network architecture and apply forward propagation, loss function, back propagation and weights update to train and build an accurate classification model.</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td>b.</td><td>A single-layer neural network is trained using backpropagation.
Given Data:
• Learning rate = 0.1
• Error = 0.4
• Input = 0.8
• Initial weight = 0.5
Apply the backpropagation learning rule and compute the updated weight.</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td rowspan="2">Q5</td><td>a.</td><td>An autoencoder has an input of 784 features, a hidden layer of 64 neurons, and an output layer of 784 neurons. Explain how the network compresses and reconstructs the data, and why it is suitable for dimensionality reduction.</td><td>10</td><td>L3</td><td>CO3</td></tr>
<tr><td>b.</td><td>A handwriting recognition system is trained using limited labeled data. Explain how DBNs perform unsupervised pretraining and why this improves classification accuracy.</td><td>10</td><td>L3</td><td>CO3</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q6</td><td>a.</td><td>A healthcare organization has 50,000 unlabeled chest X-ray images. Explain how an autoencoder can be used to learn meaningful features from these images before performing disease classification.</td><td>10</td><td>L3</td><td>CO3</td></tr>
</table>

	b.	An image of size **28 × 28** is convolved with a **3 × 3 filter**, stride 1, no padding. Utilize the Convolutional layers to show the steps involved and the operations. Calculate the output feature map size and explain the operation.	10	L3	CO3
Module – 4					
Q7	a.	A smart hospital records a patient's heart rate every minute for 24 hours**.** Doctors observe that single readings are not sufficient to detect abnormalities. Make use of the time dimension modeling and explain how it helps to capture temporal patterns and trends in this data. Describe how the input sequence would be represented to a neural network.	10	L3	CO4
	b.	A sentiment analysis task needs to understand nested phrases like "*not at all good*". Apply recursive neural networks and explain how it captures such hierarchical meaning.	10	L3	CO4
OR					
Q8	a.	Weather states are defined as {Sunny, Rainy, Cloudy}. Given transition probabilities: **From \ To** / **Sunny** / **Rainy** / **Cloudy** Sunny / 0.6 / 0.2 / 0.2 Apply Markov model and explain how it predicts tomorrow's weather given today is sunny.	10	L3	CO4
	b.	A standard RNN fails to remember events from several hours ago in patient health records. Apply LSTM networks and explain how solve this problem using memory cells and gates.	10	L3	CO4
Module – 5					
Q9	a.	A healthcare AI system processes raw sensor data, images, and text. Apply PPCA, autoencoders, and transfer learning at different stages of the pipeline. Illustrate the process with suitable example.	10	L3	CO5
	b.	Given a dataset of 100 samples with 20 correlated features, engineers want to visualize the data in 2 dimensions. Apply PPCA and explain step-by-step on how it transforms the data into a lower-dimensional latent space.	10	L3	CO5
OR					
Q10	a.	In a smart meeting room, two microphones are installed to record conversations for automatic transcription. During a meeting, two people speak simultaneously, and each microphone records a mixture of both **voices** rather than a single speaker. Apply Independent Component Analysis (ICA) and explain how can it be applied to mathematically separate the individual speakers' voices from the mixed microphone recordings	10	L3	CO5
	b.	A psychology study measures 10 observed behaviors to understand 3 hidden personality traits. Make use of Factor Analysis and explain how it models the relationship between observed variables and latent factors.	10	L3	CO5

-*****-