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| C:\Users\RAJESH\Downloads\Logo 2.png |  | ***Go, Change the World*** | | | | | | | | | | |
| **Academic Year 2024-25 (ODD Semester)** | | | | | | | | | | |
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| **Department of Artificial Intelligence and Machine Learning** | | | | | | | | | | | | |

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| **ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING** | | | | | |
| **Course Code** | **:** | **AI253IA** | **Date** | **:** | **31/1/2024** |
| **Semester** | **:** | **V Sem** | **Time** | **:** | **9:30am to 11:30am** |
| **Max Marks** | **:** | **10 (Q) + 50(CIE)** | **Duration** | **:** | **30 + 90=120 min** |

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| **QUIZ** | | | | | |
| **Note: Answer all the Questions** | | | | | |
| **Q. No** | | **Questions** | **M** | **BT** | **CO** |
| **1** | **a)** | Consider a gradient descent-based learning rate annealing with a learning rate. The initial learning rate is 0.1 and the learning rate decays with a rate parameter of 0.5 per iteration. Calculate the learning rate after the 5th and 10th iteration | **2** | **3** | **3** |
|  | **b)** | List two stopping criteria of Back proportion algorithm | **2** | **1** | **1** |
|  | **c)** | In which scenarios might **sequential learning** be preferred over **batch learning**, and why? | **2** | **4** | **2** |
|  | **d)** | Define Delta rule for weight updating | **2** | **2** | **1** |
|  | **e)** | In memory-based learning, what is the main technique used to make predictions? | **2** | **1** | **1** |

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| **CIE** | | | | | |
| **Note: Answer all the Questions** | | | | | |
| **Q. No** | | **Questions** | **M** | **BT** | **CO** |
| **2** | **a)** | Compare the following activation functions: threshold, sigmoid, and piecewise linear functions. Include their mathematical expressions and graphs. | 5 | 4 | 2 |
| **b)** | With neat diagram briefly explain non linear mathematical model of Neuron and mention the importance of bias. | 5 | 2 | 1 |
| **3** | **a)** | Consider an adaptive filter designed to remove noise from a desired signal d(n). The input signal x(n) to the filter is a combination of the signal s(n) and a noise v(n), such that x(n)=s(n)+v(n)  a) Define the adaptive filter's objective and the role of the error signal e(n). b) Briefly explain how the Least Mean Squares (LMS) algorithm updates the filter coefficients to minimize the error | 5 | 3 | 3 |
| **b)** | Describe Hebb's learning rule and its limitations and explain how the covariance hypothesis addresses the limitations of Hebb’s learning | 5 | 2 | 1 |
| **4** | **a)** | A competitive learning network has three neurons with initial weights w1=0.3, w2=0.5, and w3=0.2. For an input x1=0.4, x2=0.6, x3=0.8, draw fully connected architecture and identify the winning neuron | 5 | 3 | 3 |
| **b)** | Consider the cost function e(w), where d2 is some constant, and input value (x) is 1, find the optimum value of w for which the given cost function reaches its minimum value    Rx =  r = | 5 | 3 | 3 |
| **5** | **a)** | Suppose we are training a neural network to learn a function that takes three integers as input, representing weight, fuel capacity, and passenger numbers, and outputs either “car” or “bus”. Suppose the ANN currently looks like shown in Fig. 2b.  **Fig: 2b.**   1. Does the network predict a bus or a car for this triple of inputs: (1, 10, 12, 13)? 2. Suppose that the triple (1, 10, 12, 13) has been miscategorized by the perceptron. Using the perceptron learning rule, calculate the weight change for the weights in the network in light of this training network, if we use a learning rate of 0.1. 3. What does the re-trained network look like? 4. Does the re-trained network (feed-forward) correctly categorize the example (10, 12, 13)?   Has the network over-corrected? This triple: (5,7,7) used to be (correctly) categorized as a car. Is it still correctly categorized? | 7 | 4 | 2 |
| **b)** | The Correlation Matrix Rx of the input vector x(n) in the LMS algorithm is defined by  Rx =  Define the range of the values for the learning rate parameter of the LMS algorithm for it to be convergent in the mean square | 3 | 3 | 3 |
| **6** | **a)** | The network weights have been initialized as shown in Fig.2a. Analyze the Multilayer perceptron Back Propagation algorithm for the initialized network by doing the following (use the sigmoid function):   1. Compute the output of hidden layers and output layer. 2. Calculate the error and delta values. 3. Find the new weights and show how the new error is reduced (Up to 2 iterations) | 10 | 5 | 4 |

**M-Marks, BT-Blooms Taxonomy Levels, CO-Course Outcomes**

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| **Marks Distribution** | **Particulars** | **CO1** | **CO2** | **CO3** | **CO4** | **L1** | **L2** | **L3** | **L4** | **L5** | **L6** |
| **Max Marks CIE & Quiz** | 16 | 14 | 20 | 10 | 4 | 12 | 20 | 14 | 10 | - |

**Course Outcomes**

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| **CO1:** | Describe basic concepts of neural networks, its applications and various learning models |
| **CO2:** | Analyze different network architectures, learning tasks, CNN, and deep learning models |
| **CO3:** | Investigate and apply neural networks model and learning techniques to solve problems related to society and industry. |
| **CO4:** | Demonstrate a prototype application developed using any NN tools and APIs. |
| **CO5** | Appraise the knowledge of neural networks and deep learning as an individual/as an team member. |