

**END SEMESTER EXAMINATION - APRIL 2026****SEMESTER 8 : INTEGRATED M. Sc. PROGRAMME IN COMPUTER SCIENCE - DATA SCIENCE****COURSE: 21UP8CRMCP25 - ADVANCED DEEP LEARNING TECHNIQUES***(For Regular 2022 Admission and Improvement/Supplementary 2021 Admission)*

Time: Three Hours

Max. Weightage: 30

**PART A****Answer any 8**

1. List any five features of ResNet model. (R,CO2)
2. List any four advantages of transfer learning. (R,CO3)
3. Define and differentiate: Classification, Localization, Object Detection, Semantic Segmentation and Instance Segmentation. (R,CO5)
4. What are the primary differences between DenseNet and standard CNNs (U,CO3)
5. Draw the architectural design of a forget gate in an LSTM model. (Cr,CO5)
6. Define autoencoder. List the various types of autoencoders. (R,CO4)
7. Write Python code for a neural network with 4-input features, 2-dense hidden layers, and 1-output neuron for binary classification. Use ReLU for hidden layers and Sigmoid for output, and compile the model. (Cr,CO1)
8. Why linear activation function generally avoided in the hidden layers of a deep neural network (U,CO1)
9. Define the term - fine tuning a model. (R,CO4)
10. What is early stopping? Explain its working with respect to validation error and mention how It is implemented in Keras. (U,CO2)

**(1 x 8 = 8 Weight)****PART B****Answer any 6**

11. Explain the architecture of AlexNet and describe its key features. (U,CO2)
12. Prepare short notes on the following:  
a) Advantages and disadvantages of BiRNN    b) Applications of BiRNN (U,CO4)

13. Explain the concept of unsupervised training in neural networks using autoencoders, including their components, training process, and a simple diagram. (U,CO1)
14. Explain the concept of feature reuse and how it is implemented in DenseNet. Discuss its advantages and include a simple diagram of a DenseNet block. (U,CO3)
15. Differentiate between Feedforward Neural Networks (FNN), Convolutional Neural Networks (CNN), and Recurrent Neural Networks (RNN). (An,CO4)
16. Define parameter sharing in Convolutional Neural Networks (CNNs), and what are its main advantages. (U,CO2)
17. Create a model that implements Inductive transfer learning. (Cr,CO3)
18. A GRU cell has ( $h_0 = 0.0$ ), input ( $x_1 = 1.0$ ), and gate parameters  $z(Wx=0.4, Wh=0.6, b=0.1)$ ,  $r(Wx=0.3, Wh=0.5, b=0.0)$ ,  $\hat{h}(Wx=0.5, Wh=0.7, b=0.0)$ . Compute the next hidden state ( $h_1$ ). (A,CO5)

**(2 x 6 = 12 Weight)**

**PART C**  
**Answer any 2**

19. Write a detailed note on AlexNet architecture. (U,CO2)
20. Given a sequence with inputs  $x = [1.5, 2.5, 3.5]$  and outputs  $y = [2, 3.5, 5]$ , consider a simple RNN with  $h_0 = 0$ ,  $Wx = 0.5$ ,  $Wh = 0.2$ ,  $Wy = 1$ , and linear activation. Perform the forward pass and explain Backpropagation Through Time with detailed computations and gradient derivation. (A,CO4)
21. Explain the Gated Recurrent Unit (GRU) model with its architecture, advantages, and applications. Support your answer with a neat diagram. (U,CO5)
22. Consider a Restricted Boltzmann Machine (RBM) consisting of three visible units and two hidden units with sigmoid activation function. The weight matrix, visible bias vector, and hidden bias vector are given below.

$$W = \begin{bmatrix} 0.2 & -0.4 \\ 0.7 & 0.1 \\ -0.5 & 0.3 \end{bmatrix}, \quad b = [0.1, -0.2, 0.05], \quad c = [0.0, 0.2]$$

For the visible input vector  $v=[1,0,1]$

- a) Compute the total input received by each hidden neuron.
- b) Determine the probability of activation of each hidden unit.
- c) Obtain the hidden layer activation vector.
- d) Reconstruct the visible layer by computing the activation probabilities of visible units.

(A,CO1)

**(5 x 2 = 10 Weight)**

