Reg. No. :

Model Question Paper

Programme	**B.Tech.**	Semester	
Course Code	**BCSE332L**	Faculty Name	
Course Title	**Deep Learning**	Slot	**D2+TD2**
		Class Nbr	**CH2024250101109**
Time	**3 hours**	Max. Marks	**100**

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

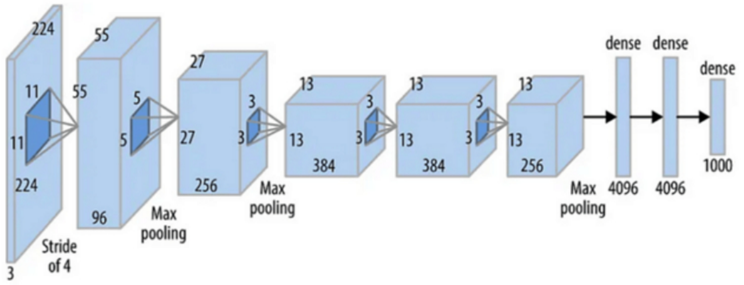
Course Outcomes

Section - I
Answer all Questions (10 × 10 Marks)

Q.No	Question
01.	Create a neural network with only one hidden layer (of any number of units) that implements $(A \lor \neg B)$. Draw your network, show all weights of each unit, and show the output produced by the network.
02.	a. Please take a look at the following training data points. Class Green ---(2,2), (2,4), (4,2), (4,3), (6,9), (8,8), (11,8), (8,10), (9,10) Class Red --(1,8), (3,6), (3,8), (4,11), (5,4), (5,6), (6,3), (6,6), (6,12) Plot a graph for the given data points and design your neural architecture with the justification for the choice of your number of neurons, layers, optimizer, and loss function to obtain the generalized model with maximum accuracy. (5) b. Give the appropriate names to Region 1 and Region 2 and the region of the double arrow. What do they indicate and how they can be addressed? brief the techniques. (5)

03. a. Identify the deep architecture in the given picture and explain the steps of its working with an input image size of 224*224. Discuss its uniqueness that has contributed to its success in the 2012 ImageNet competition, and what specific limitations did these choices introduce in terms of model scalability, interpretability, and transferability to other computer vision tasks? (7)

b. Calculate the trainable parameters in each step processed by the architecture below. (3)



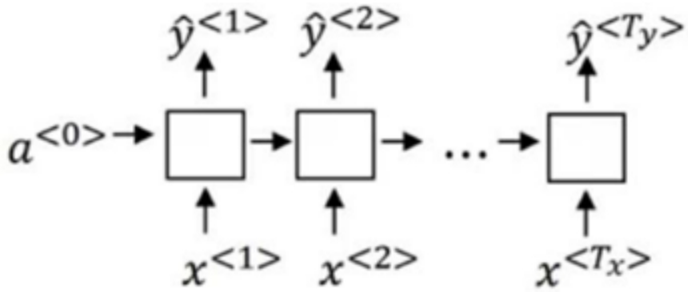
04. In an agricultural application, an Inception network is used to classify plant diseases from leaf images.

a. Explain how Inception's multi-scale feature extraction aids in identifying both small and large disease spots. Discuss the role of 1×1 convolutions for efficient processing, the challenges of deployment in field conditions, and strategies to improve accuracy with limited labeled data. (6)

b. Discuss the architectural layers you would choose to freeze and which ones you would unfreeze for fine-tuning. Justify your choices based on the nature of the new dataset and the pre-trained model. (4)

05. a. You are given a simple RNN network that uses identity functions as activation functions. Let the input at a given time, the hidden state and the output at a given time are scalar. Given, h0 = 1, x1 = 10, x2 = 10, y1 = 5, y2 = 5. Assume the initial values of the weights are: Wh = 1, Wx = 0.1, Wy = 2. Compute the predicted values of y1, y2, and the total loss. (4)

b. Identify the given architecture and how it differs from other RNN architectures. Sketch it's working with an example scenario and loss function. What are the challenges in training this RNN, particularly regarding vanishing and exploding gradients? (6)



06.	Consider a sentence, "The man who ate my pizza has purple hair", the RNN relates that purple hair with pizza. The purple hair is for the man and not the pizza. Identify the problem associated with RNNs working and explain how that problem is addressed using the below gates and states in an LSTM network. Illustrate with the same given example. **Gates:** $o_t = \sigma(W_o h_{t-1} + U_o x_t + b_o)$ $i_t = \sigma(W_i h_{t-1} + U_i x_t + b_i)$ $f_t = \sigma(W_f h_{t-1} + U_f x_t + b_f)$ **States:** $\tilde{s}_t = \sigma(W h_{t-1} + U x_t + b)$ $s_t = f_t \odot s_{t-1} + i_t \odot \tilde{s}_t$ $h_t = o_t \odot s_t$
07.	a. An autoencoder is designed with the following architecture: Input layer: 10 neurons Latent layer: 3 neurons Output layer: 10 neurons If each layer is fully connected and includes biases, calculate the total number of parameters (weights and biases) in the entire autoencoder (encoder + decoder). Show your calculations for each layer. (4) b. What are the roles of the encoder, decoder, and latent space in this representation? Explain the importance of normalizing the image data to the range [0, 1]. How does this affect the training process and the model's performance? (6)
08.	Imagine you are developing a GAN to generate high-resolution images of cats. During training, you notice that while the generator produces some realistic cat images, it frequently generates images of the same cat breed, leading to a lack of diversity in the outputs. a. Identify this problem of GANs. How can you modify the training process to promote convergence and enhance the diversity of generated images? (5) b. Compare Conditional GANs (cGANs) with standard GANs. In what scenarios would you prefer to use cGANs over standard GANs? (5)
09.	A YOLO object detection model is used to monitor a busy intersection, detecting cars, bicycles, and pedestrians in real-time. The model outputs 600 bounding boxes for an image captured at this location, each with associated confidence scores. a. How does YOLO generate bounding box predictions, class probabilities, and confidence scores? How many bounding boxes remain if 40% of the boxes have confidence scores above this threshold if you apply a confidence threshold of 0.5? (3) b. What role does NMS play in refining the detected bounding boxes? After filtering, you apply NMS with an IoU threshold of 0.4. If 25% of the remaining boxes overlap with an IoU greater than 0.4, calculate how many boxes are eliminated after NMS. (3) c. Discuss how increasing the IoU threshold to 0.6 might affect the detection results in a scenario where many vehicles are closely packed. What are the trade-offs of adjusting this threshold in a real-time monitoring system? (4)

10.	In a video game where a character navigates through levels, an agent learns to maximize its score by collecting items while avoiding enemies. Describe how the agent interacts with the game environment through states (character position, item locations), actions (moving, jumping), and rewards (points for items, penalties for hits). a. How can you implement a reinforcement learning algorithm to enhance the agent's performance? Explain. (5) b. Discuss the choice of reward structure, state representation, and potential challenges in training the agent within this dynamic gaming environment. (5)