SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

VI SEMESTER – B.E - COMPUTER SCIENCE AND ENGINEERING

PCS504 – NEURAL NETWORKS

Regulation – 2023

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Prepared by

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SUBJECT CODE / NAME : PCS504 – NEURAL NETWORKS

SEM / YEAR: III / VI

UNIT - I: INTRODUCTION			
Introduction- Basic concepts of Neural Network- Model of an Artificial Neuron- Characteristics of Neural Network- Learning Methods- Back propagation Network Architecture Back propagation Learning-Counter Propagation Network- Hopfield/Recurrent Network Adaptive Resonance Theory.			
PART A (2 Marks)			
Q. No	**Questions**	**Level**	**Competence**
1.	What is a Neural Network?	BTL-2	Understand
2.	Define an artificial neuron.	BTL-1	Remember
3.	What are the basic components of a neural network?	BTL-2	Understand
4.	Define ANN and Neural computing.	BTL-1	Remember
5.	Define Adaptive System and Generalization.	BTL-1	Remember
6.	Mention the characteristics of problems suitable for Neural Networks.	BTL-2	Understand
7.	List some applications of Neural Networks.	BTL-2	Understand
8.	Define Learning and Learning Law.	BTL-1	Remember
9.	Distinguish between Learning and Training.	BTL-2	Understand
10.	Draw the model of a single artificial neuron and derive its output.	BTL-1	Remember
11.	Compare physical neuron and artificial neuron	BTL-2	Understand
12.	What is called weight or connection strength?	BTL-2	Understand
13.	What is the function of the hidden layer in neural networks?	BTL-2	Understand
14.	List out some applications of BPN.	BTL-2	Understand
15.	What are the two types of signals identified in the Back Propagation network?	BTL-2	Understand
16.	Why the layers in the Bidirectional Associative Memory are called x and y layers?	BTL-2	Understand
17.	What is an activation function in a neural network?	BTL-2	Understand
18.	What is the architecture of a Back propagation Network?	BTL-2	Understand
19.	List few advantages of back propagation learning.	BTL-2	Understand
20.	What is a Counter propagation Network (CPN)?	BTL-2	Understand
21.	Mention the layers present in a Counter propagation Network.	BTL-2	Understand
22.	What is a Hopfield Network? Write the features of it.	BTL-2	Understand

23.	Define Adaptive Resonance Theory (ART). What is the role of the vigilance parameter in ART?	BTL-1	Remember
24.	A two layer network is to have four inputs and six outputs. The range of the outputs is to be continuous between 0 and 1. What can you tell about the network architecture? Specifically, (a) How many neurons are required in each layer? (b) What are the dimensions of the first-layer and second layer weight matrices? (Hidden layer neurons are 5) (c) What kinds of transfer functions can be used in each layer?	BTL-2	Understand
	PART B (16 Marks)		
1.	Draw the structure of a biological Neuron and explain in detail.	BTL-3	Apply
2.	Explain the fundamentals of Neural Networks. Discuss the basic concepts, architecture, and applications of neural networks in detail.	BTL-4	Analyze
3.	Discuss the key characteristics of Neural Networks. How do these characteristics make neural networks suitable for real-world applications?	BTL-4	Analyze
4.	Explain in detail the various learning methods used in neural networks: supervised, unsupervised, and reinforcement learning. Give suitable examples.	BTL-4	Analyze
5.	Explain the three basic neurons which are used to develop complex ANN.	BTL-3	Apply
6.	Draw the architecture of Back Propagation Network (BPN) and explain in detail.	BTL-3	Apply
7.	(i) Explain the significance of adding momentum to the training procedure. (8) (ii) Write the algorithm of generalized delta rule for Back Propagation Algorithm. (8)	BTL-5	Evaluate
8.	Draw the architecture of Bidirectional Associative memory(BAM) and explain in detail	BTL-3	Apply
9.	Describe the concept of transfer learning in neural networks, and provide a detailed example demonstrating its application in a specific domain.	BTL-6	Create
10.	Define and explain the significance of activation functions in neural networks.	BTL-4	Analyze
11.	Describe the concept of weight initialization in neural networks.	BTL-4	Analyze
12.	Evaluate the effectiveness and limitations of Hopfield Networks in solving specific problem domains.	BTL-5	Evaluate
13.	Discuss Hopfield Networks in detail. Explain their structure, energy function, storage capacity, and pattern recall mechanism.	BTL-4	Analyze
14.	Explain Recurrent Neural Networks (Hopfield-type). Discuss their architecture, dynamics, convergence, and associative memory capabilities.	BTL-4	Analyze

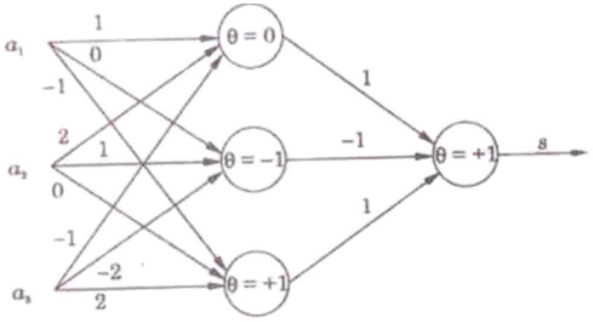
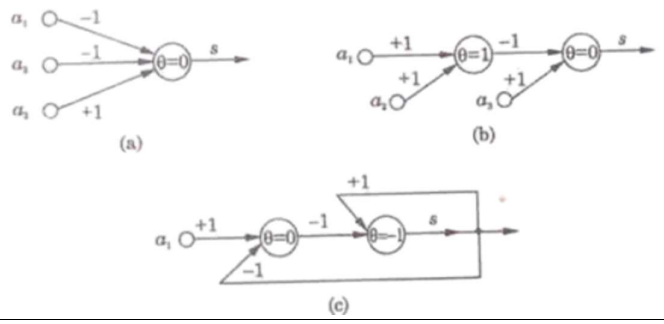
15.	Evaluate the adaptability and learning capabilities of Adaptive Resonance Theory Network (ART) in dynamic environments.	BTL-5	Evaluate
16.	Assess the effectiveness of Counter propagation Networks in tasks involving high-dimensional data.	BTL-5	Evaluate
17.	Compare and contrast Back propagation Networks, Counter propagation Networks, Hopfield Networks, and Adaptive Resonance Theory (ART). Explain their architectures, learning mechanisms, and applications in detail.	BTL-4	Analyze

UNIT – II: PERCEPTRON LEARNING RULE

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.

PART – A (2 Marks)

Q.No	Question	Level	Competence
1.	Define a single-layer perceptron.	BTL-1	Remember
2.	What is perceptron? Write the differences between Single Layer Perceptron (SLP) and Multilayer Perceptron (MLP).	BTL-2	Understand
3.	What is an adaptive filtering problem?	BTL-1	Remember
4.	What is meant by unconstrained organization technique?	BTL-1	Remember
5.	Define a linear least square filter.	BTL-1	Remember
6.	What is the Least Mean Square (LMS) algorithm?	BTL-1	Remember
7.	Define Perceptron convergence theorem.	BTL-1	Remember
8.	Define learning curve in neural networks.	BTL-1	Remember
9.	What is learning rate annealing?	BTL-1	Remember
10.	Define a multilayer perceptron (MLP).	BTL-1	Remember
11.	What is XOR problem?	BTL-1	Remember
12.	Simulate (AND-NOT) function using MP model	BTL-2	Understand
13.	State how the decision boundary changes with OR and AND functions	BTL-2	Understand
14.	Draw the model of MP (McCulloch Pitts) neuron and state its characteristics.	BTL-2	Understand
15.	Explain (a) Neuron Biasing (b) Threshold of Neuron	BTL-2	Understand
16.	What is a Bayes classifier?	BTL-1	Remember
17.	What are the two approaches to add a bias input?	BTL-1	Remember
18.	Distinguish between linearly separable and nonlinearly separable problems. Give examples.	BTL-2	Understand
19.	What is meant by feature detection?	BTL-1	Remember
20.	Define back propagation algorithm.	BTL-1	Remember
21.	Consider a 4 input, 1 output parity detector. The output is 1 if the number of inputs is even. Otherwise, it is 0. Is this problem linearly	BTL-2	Understand

	separable? Justify your answer.		
22.	What is α-LMS algorithm?	BTL-1	Remember
23.	Draw the ADALINE implementation for AND and OR functions.	BTL-2	Understand
24.	How is ADALINE different from MADALINE ?	BTL-2	Understand
PART – B (16 Marks)			
Q. No	**Question**	**Level**	**Competence**
1.	(i) Draw the architecture of a single layer perceptron (SLP) and explain its operation. Mention its advantages and disadvantages. (8) (ii) Draw the architecture of a Multilayer perceptron (MLP) and explain its operation. Mention its advantages and disadvantages. (8)	BTL-3	Apply
2.	State and Prove Perceptron Convergence theorem.	BTL-4	Analyze
3.	Explain Why XOR problem cannot be solved by a single layer perceptron and how it is solved by a Multilayer Perceptron.	BTL-4	Analyze
4.	(a) Write short notes on Sigmoid Squashing Function Extensions to sigmoid (b)Develop simple ANNs to implement the three input AND, OR and XOR functions using MP neurons.	BTL-3	Apply
5.	Write the various Activation Functions used in ANN, along with their graphical representation	BTL-3	Apply
6.	Explain ADALINE and MADALINE. List some applications.	BTL-4	Analyze
7.	(i) Distinguish between Perceptron Learning law and LMS Learning law. (6) (ii) Give the output of the network given below for the input [1 1 1]T  (10)	BTL-4	Analyze
8.	(i) Explain the logic functions performed by the following networks with MP neurons given below. (8)  	BTL-3	Apply

	(ii) Design ANN using MP neurons to realize the following logic functions using ±1 for the weights. (8) $s(a1,a2,a3) = \overline{a1}\ a3 + a2\ \overline{a3}$ $s(a1,a2,a3) = a1a2a3 + \overline{a1}\ \overline{a2}\ \overline{a3}$		
9.	Explain why XOR cannot be solved using single layer network? Give a solution for it.	BTL-4	Analyze
10.	Discuss with an Algorithm and Application for the following networks (i) Hebb Net (8) (ii) Perceptron net (8)	BTL-4	Analyze
11.	Apply the Back propagation algorithm to solve the XOR problem using a multilayer perceptron. Explain each training step with diagrams.	BTL-3	Apply
12.	Apply learning rate annealing techniques to improve the training of a perceptron and explain their effect on learning curves.	BTL-3	Apply
13.	Analyze the relationship between the perceptron classifier and Bayes classifier in a Gaussian environment.	BTL-4	Analyze
14.	Evaluate the effectiveness of learning rate annealing techniques in improving convergence speed and stability of perceptron learning.	BTL-5	Evaluate
15.	Develop and justify a neural network architecture that overcomes the limitations of single-layer perceptrons in solving nonlinear classification problems.	BTL-6	Create
16.	Design a multilayer perceptron using the Back propagation algorithm to perform feature detection in a real-world application. Explain the design choices and learning process.	BTL-6	Create
17.	Develop and justify a neural network architecture that overcomes the limitations of single-layer perceptrons in solving nonlinear classification problems.	BTL-6	Create

UNIT - III: RADIAL BASIS NETWORKS

Radial basis networks: Radial basis networks: Radial basis network - training RBF networks- grossberg network: Basic non linear model - two layer competitive network - Adaptive resonance theory: Overview of adaptive resonance-Layer 1-Layer 2 - Learning Law:L1-L2 and L2-L1-Hopfield network

PART-A (2 Marks)

Q. No	Question	Level	Competence
1.	Define a Radial Basis Function (RBF) network.	BTL-1	Remember
2.	What are the two processes involved in RBF network design?	BTL-2	Understand
3.	List some applications of RBF network.	BTL-1	Remember
4.	What is the role of the hidden layer in an RBF network?	BTL-1	Remember
5.	State any two advantages of Radial Basis Function networks.	BTL-1	Remember
6.	What is a Gaussian radial basis function?	BTL-1	Remember
7.	What is meant by center selection in RBF network training?	BTL-1	Remember

8.	How does an RBF network differ from a multilayer perceptron in activation functions?	BTL-2	Understand
9.	Why is clustering used during RBF training?	BTL-2	Understand
10.	Define the Grossberg network.	BTL-1	Remember
11.	What is meant by a basic nonlinear model in Grossberg networks?	BTL-1	Remember
12.	State the function of the competitive layer in a Grossberg network.	BTL-2	Understand
13.	What is the role of weight adaptation in Grossberg networks?	BTL-2	Understand
14.	What is Adaptive Resonance Theory (ART)?	BTL-1	Remember
15.	Why is normalization required in competitive networks?	BTL-2	Understand
16.	Mention the need for Adaptive Resonance Theory networks.	BTL-2	Understand
17.	What is Layer-1 in an ART network?	BTL-1	Remember
18.	What is the role of Layer-2 in ART networks?	BTL-2	Understand
19.	What is meant by the L2→L1 learning law in ART?	BTL-2	Understand
20.	Define vigilance parameter in Adaptive Resonance Theory.	BTL-1	Remember
21.	State one advantage of ART networks.	BTL-1	Remember
22.	Define a Hopfield network.	BTL-1	Remember
23.	State any two applications of Hopfield networks.	BTL-1	Remember
24.	What is meant by stable state in a Hopfield network?	BTL-2	Understand
PART-B (16 Marks)			
1.	Draw the architecture of RBF network and explain in detail.	BTL-3	Apply
2.	Analyze the training process of an RBF network and explain how centers and output weights are determined.	BTL-4	Analyze
3.	Evaluate the advantages and limitations of Radial Basis Function networks.	BTL-5	Evaluate
4.	Explain Grossberg network in detail.	BTL-3	Apply
5.	Compare RBF networks and Grossberg networks with respect to learning method, architecture, and applications.	BTL-4	Analyze
6.	Explain the working of a two-layer competitive Grossberg network with suitable example.	BTL-3	Apply
7.	Design a two-layer competitive Grossberg network to solve a nonlinear decision-making problem and explain the learning mechanism in detail.	BTL-6	Create
8.	Evaluate the effectiveness of Grossberg networks in pattern recognition applications.	BTL-5	Evaluate
9.	Analyze the stability–plasticity problem and explain how ART networks overcome it.	BTL-4	Analyze
10.	Explain the working principle of Adaptive Resonance Theory (ART) network with respect to Layer-1 and Layer-2.	BTL-3	Apply
11.	Develop an Adaptive Resonance Theory (ART) network model for incremental clustering of streaming data. Justify the selection of Layer-1, Layer-2, and learning laws (L1→L2 and L2→L1).	BTL-6	Create

12.	Evaluate the performance of Adaptive Resonance Theory (ART) networks in dynamic environments.	BTL-5	Evaluate
13.	Explain Hopfield network in detail.	BTL-3	Apply
14.	Evaluate Hopfield networks as associative memory models.	BTL-5	Evaluate
15.	Explain how a Hopfield network stores and recalls patterns using an energy function.	BTL-3	Apply
16.	Design a Hopfield network to store and recall multiple binary patterns. Explain weight calculation, energy function formulation, and recall dynamics.	BTL-6	Create
17.	(i) Compare and contrast Radial Basis Function (RBF) networks, Grossberg networks, Adaptive Resonance Theory (ART) networks, and Hopfield networks. (6) (ii) Discuss their architecture, learning mechanism, convergence behavior, advantages, limitations, and applications with suitable diagrams. (10)	BTL-4	Analyze

UNIT - IV: CONVOLUTION & RECURRENT NETWORKS

Convolutional Neural Networks: The Convolution Operation - Motivation - Pooling - Variants of the basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms. Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks - Recursive Neural Networks.

PART-A (2 Marks)

Q. No	Question	Level	Competence
1.	Define the convolution operation in CNNs.	BTL-1	Remember
2.	State the purpose of padding in convolution.	BTL-1	Remember
3.	Define stride in convolutional neural networks.	BTL-1	Remember
4.	What is pooling in CNNs?	BTL-1	Remember
5.	Name any two pooling techniques used in CNNs.	BTL-1	Remember
6.	How does max pooling differ from average pooling?	BTL-2	Understand
7.	What is meant by local connectivity in CNNs?	BTL-1	Remember
8.	Define parameter sharing in convolution layers.	BTL-1	Remember
9.	What is a 1×1 convolution?	BTL-1	Remember
10.	Explain the importance of different data types (image, video, audio) in CNN design.	BTL-1	Remember
11.	Why is convolution preferred over fully connected layers for image	BTL-2	Understand
12.	Define a Recurrent Neural Network (RNN).	BTL-1	Remember
13.	Define Deep Recurrent Network.	BTL-1	Remember
14.	What is meant by recursive neural network?	BTL-1	Remember
15.	State one application of Bidirectional RNNs.	BTL-1	Remember
16.	Define sequence modeling.	BTL-1	Remember

17.	Why are Bidirectional RNNs more effective than unidirectional	BTL-2	Understand
18.	Explain the advantage of stacking multiple RNN layers.	BTL-2	Understand
19.	Why are recursive neural networks suitable for tree-structured	BTL-2	Understand
20.	How does a Deep RNN differ from a shallow RNN?	BTL-2	Understand
21.	Why are RNNs preferred for sequential data?	BTL-2	Understand
22.	Explain the importance of context in Bidirectional RNNs.	BTL-2	Understand
23.	Explain one real-time application of Deep or Bidirectional RNNs.	BTL-2	Understand
24.	Give some examples for Non-recurrent and Recurrent ANNs. Specify the learning law used by each ANN.	BTL-2	Understand
	PART – B (16 Marks)		
1.	Explain the process of training a convolutional neural network (CNN) for image classification. Detail the architecture, including	BTL-3	Apply
2.	Explain the convolution operation in CNNs and apply it to a sample input image showing stride and padding.	BTL-3	Apply
3.	Demonstrate how max pooling and average pooling are applied in CNNs with suitable examples.	BTL-3	Apply
4.	Explain how CNNs process different data types such as images and videos with suitable examples.	BTL-3	Apply
5.	Compare and analyze different pooling techniques used in CNNs.	BTL-4	Analyze
6.	Analyze the motivation behind using convolution and pooling layers instead of fully connected layers.	BTL-4	Analyze
7.	Design a CNN architecture incorporating convolution variants and pooling layers for an image classification task.	BTL-6	Create
8.	Evaluate the suitability of CNNs for handling multiple data types like images, audio, and video.	BLT-5	Evaluate
9.	Propose an optimized CNN using efficient convolution algorithms for a resource-constrained system.	BTL-6	Create
10.	Design a CNN model that produces structured outputs for image segmentation.	BTL-6	Create
11.	Explain the process of training a recurrent neural network (RNN) for sequential data analysis.	BTL-3	Apply
12.	Develop a hybrid deep learning model combining CNN and Recursive RNN for a real-world application.	BLT-5	Evaluate
13.	Analyze the performance of Bidirectional RNNs versus unidirectional RNNs.	BTL-4	Analyze
14.	Create a Deep Recurrent Network for time-series prediction and justify your design.	BTL-6	Create
15.	Evaluate the role of recursive neural networks in structured data processing.	BLT-5	Evaluate

16.	Demonstrate how a Deep Recurrent Network processes long-term dependencies in sequential data.	BLT-5	Evaluate
17.	Design a Bidirectional RNN model for natural language processing applications.	BTL-6	Create

UNIT - V: CASE STUDY

Pre-Training Steps - Training the Network - Post Training Analysis – Function Approximation - Probability Estimation - Pattern Recognition - Clustering - Prediction.

PART A (2 Marks)

Q. No	Question	Level	Competence
1.	Define pre-training steps in neural network modeling.	BTL-1	Remember
2.	What is meant by training a neural network?	BTL-1	Remember
3.	Define post-training analysis.	BTL-1	Remember
4.	What is function approximation in neural networks?	BTL-1	Remember
5.	Define probability estimation.	BTL-1	Remember
6.	Why are pre-training steps essential before training a network?	BTL-2	Understand
7.	Explain the purpose of training the network.	BTL-2	Understand
8.	Why is post-training analysis required?	BTL-2	Understand
9.	Explain how neural networks perform function approximation.	BTL-2	Understand
10.	How is probability estimation useful in decision-making systems?	BTL-2	Understand
11.	Explain the role of neural networks in pattern recognition.	BTL-2	Understand
12.	How does overfitting affect post-training analysis?	BTL-2	Understand
13.	Differentiate classification and prediction with a simple explanation.	BTL-2	Understand
14.	What is meant by pattern recognition?	BTL-1	Remember
15.	Define clustering.	BTL-1	Remember
16.	What is prediction in machine learning applications?	BTL-1	Remember
17.	What is a training dataset?	BTL-1	Remember
18.	What is meant by data normalization?	BTL-1	Remember
19.	Define feature extraction.	BTL-1	Remember
20.	What is an error function used during training?	BTL-1	Remember
21.	What is meant by model generalization?	BTL-1	Remember
22.	How does data normalization affect training performance?	BTL-2	Understand
23.	Define the term clustering in ANN.	BTL-1	Remember
24.	How will you measure the clustering similarity?	BTL-1	Remember

PART – B (16 Marks)			
1.	Apply the pre-training steps required to build a neural network for a pattern recognition problem.	BTL-3	Apply
2.	Demonstrate the training process of a neural network using a suitable dataset and learning algorithm.	BTL-3	Apply
3.	Design a neural network model including pre-training, training, and post-training analysis for a real-world application.	BTL-6	Create
4.	Apply a neural network for function approximation with a suitable example.	BTL-3	Apply
5.	Design a neural network for function approximation and explain your design choices.	BTL-6	Create
6.	Illustrate how neural networks are used for probability estimation in classification problems.	BTL-3	Apply
7.	Develop a neural network-based system for probability estimation in decision-making applications.	BTL-6	Create
8.	Apply a neural network model for pattern recognition with necessary steps.	BTL-3	Apply
9.	Create a neural network architecture for pattern recognition and justify the selected parameters.	BTL-6	Create
10.	Analyze the training and post-training phases of a neural network.	BTL-4	Analyze
11.	Compare and analyze supervised and unsupervised learning in pattern recognition and clustering.	BTL-4	Analyze
12.	Evaluate the impact of data preprocessing and normalization on network training.	BTL-5	Evaluate
13.	Evaluate the suitability of neural networks for clustering large datasets.	BTL-5	Evaluate
14.	Evaluate different performance metrics used in post-training analysis.	BTL-5	Evaluate
15.	Demonstrate the use of neural networks for clustering an unlabeled dataset.	BTL-3	Apply
16.	Design a neural network-based clustering system for unsupervised data analysis.	BTL-6	Create
17.	Propose a complete neural network framework for prediction of time-dependent data.	BTL-6	Create