INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

NEURAL COMPUTING AND DEEP LEARNING LABORATORY									
VI Semester: CSE / IT									
Course Code	Category	Hours / Week			Credits	Maximum Marks			
ACSD42	Core	L	T	P	C	CIA	SEE	Total	
		0	0	2	1	40	60	100	
Contact Classes: NIL	Tutorial Classes: NIL	Practical Classes: 45				Total Classes: 45			
Prerequisite: Datamining and Machine Learning, Essentials of Problem Solving									

I. COURSE OVERVIEW:

This course provides hands-on experience with the key concepts and techniques in neural computing and deep learning, covering a wide range of topics from basic neural networks to advanced models used in real-world applications. Each experiment allows students to apply theoretical knowledge to practical tasks, thus enhancing their understanding of how neural networks work and how they can be used to solve different types of problems.

II. COURSE OBJECTIVES:

The students will try to learn

I. Understand the Fundamentals of Neural Networks and Deep Learning
II. Hands-on Experience with Different Neural Network Architectures
III. Understand and Apply Transfer Learning and pre-trained Models

III. COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Gain a deep understanding of the basic structure and functioning of artificial neural networks (ANNs),
CO2: Apply neural network models such as MLPs, CNNs, RNNs, and autoencoders,
CO3: Understand advanced techniques such as transfer learning, reinforcement learning, and hyperparameter tuning
CO4: Evaluate the performance of the Models using various metrics, including accuracy, precision, recall, F1-score, and ROC curve.
CO5: Experiment with different activation functions and their effects on learning
CO6: Develop the ability to visualize and interpret different aspects of deep learning models

IV. COURSE SYLLABUS:

Week 1: INTRODUCTION TO NEURAL NETWORKS

Implement a single-layer perceptron, Train the perceptron on a simple dataset (e.g., AND/OR gate). Visualize the decision boundary.

Week 2: FEEDFORWARD NEURAL NETWORKS

Implement a 3-layer Multi-Layer Perceptron(MLP). Train the network using the backpropagation algorithm on a simple dataset (e.g., Iris dataset). Analyze the convergence of training error

Week 3: GRADIENT DESCENT AND OPTIMIZATION

a) Implement stochastic gradient descent (SGD) for training a neural network.
b) Experiment with different learning rates and batch sizes.
c) Compare performance with mini-batch gradient descent.

Week-4: ACTIVATION FUNCTIONS

a) Implement networks with Rectified Linear Unit (ReLU), sigmoid, and tanh activation functions.
b) Compare performance on a simple classification problem.
c) Investigate the vanishing gradient problem with sigmoid/tanh.

Week 5: CONVOLUTIONAL NEURAL NETWORKS (CNNs)

a) Implement a basic CNN model using frameworks like TensorFlow or PyTorch.
b) Train the CNN on a simple dataset (e.g., MNIST or CIFAR-10).
c) Visualize the filters and feature maps learned by the network.

Week 6 POOLING AND DROPOUT IN CNNs

a) Implement max pooling and average pooling layers.
b) Apply dropout layers for regularization.
c) Compare the performance of models with and without dropout on a classification task.

Week-7: RECURRENT NEURAL NETWORKS (RNNs)

a) Implement a simple RNN for a time-series prediction task (e.g., predicting sine wave).
b) Experiment with different sequence lengths and hidden units.
c) Analyze the vanishing gradient problem in RNNs.

Week-8: LONG SHORT-TERM MEMORY (LSTM) NETWORKS

a) Implement an LSTM network for time-series forecasting or text generation.
b) Train the LSTM on a sequence prediction task.
c) Compare the results with a standard RNN.

Week-9: GENERATIVE ADVERSARIAL NETWORKS (GANS)

a) Implement a basic GAN model.
b) Train the GAN on a simple dataset (e.g., MNIST).
c) Evaluate the quality of generated images using qualitative methods.

Week 10: AUTOENCODERS AND DIMENSIONALITY REDUCTION

a) Implement a basic autoencoder.
b) Train the autoencoder on a dataset (e.g., MNIST or fashion MNIST).
c) Use the encoded features for clustering or classification

Week-11: TRANSFER LEARNING

a) Load a pre-trained CNN model (e.g., VGG16, ResNet) and fine-tune it on a new dataset.
b) Evaluate the performance of the fine-tuned model

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Week-12 REINFORCEMENT LEARNING (RL) BASICS

a) Implement a simple Q-learning algorithm to solve a grid-world problem.
b) Explore the exploration-exploitation trade-off.

Week-13 REINFORCEMENT LEARNING (RL) BASICS

a) Use grid search or random search to find optimal hyperparameters (e.g., learning rate, batch size, number of layers).
b) Implement cross-validation for model selection.
c) Analyze the impact of hyperparameters on model performance.

Week-14 MODEL EVALUATION AND METRICS

a) Implement various evaluation metrics (accuracy, precision, recall, F1-score, ROC curve).
b) Compare model performance on classification and regression tasks

V. TEXTBOOKS:

1. Michael Nielsen, “Neural Networks and Deep Learning”, Weily Publisher, 2020.
2. Daniel A. Roberts, Sho Yaida, “Principles Of Deep Learning Theory”, Cambridge Press, 2022.

VI. REFERENCE BOOKS:

1. Yoshua Bengio, and Aaron Courville, “Deep Learning by Ian Goodfellow”, Pearson Education, 2021.

2. Charu Aggarwal, “Neural Networks and Deep Learning”, Springer 2023.

VII. WEB REFERENCES:

1. https:// A series of courses that cover the fundamentals of deep learning, taught by renowned AI expert Andrew
2. https://www.redhat.com/en/files/resources/en-rhel-whats-new-in-rhel-712030417.pdf
3. http:/www.tutorials point.comneural networks/

VIII. MATERIALS ONLINE

1. Course Content
2. Lab Manual