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

COURSE CONTENT

ARTIFICIAL NEURAL NETWORKS								
VI Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AECD32	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: VLSI Design								

I. COURSE OVERVIEW:

This course provides a comprehensive foundation in **Artificial Neural Networks (ANNs)** by connecting biological inspiration with computational models. It begins with the significance of neural networks, structure of artificial neurons, network topologies, and classical learning laws, along with the historical evolution of neural network research. The course then explores **activation and synaptic dynamics**, focusing on discrete-time and continuous-time models and their mathematical representations. Students study both **feedforward and feedback/recurrent neural architectures**, analyzing their capabilities in pattern mapping, association, classification, and memory storage using concepts like state evolution and energy functions. Finally, the course highlights real-world ANN applications in speech, image, and biomedical signal processing while addressing practical challenges such as data needs, training constraints, and deployment environments. This course equips learners with both theoretical understanding and industry-relevant insights into neural network design and utilization.

II. COURSES OBJECTIVES:

The students will try to learn

I. The motivation, biological inspiration, and fundamental concepts of artificial neural networks.
II. The neuron models, network topologies, and learning laws in both feedforward and feedback structures.
III. The activation and synaptic dynamics using discrete-time and continuous-time mathematical modeling.
IV. The real-world ANN applications in mapping, recognition, classification, and decision-making tasks.

III. COURSE OUTCOMES:

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

CO1 Explain why neural networks are used and describe biological and artificial neuron models.
CO2 Identify and differentiate between basic neural network topologies including feedforward and recurrent architectures.
CO3 Apply fundamental learning laws and compare different ANN learning methods.
CO4 Model and analyze activation and synaptic dynamics using discrete-time and continuous-time representations.
CO5 Evaluate pattern association, classification, and storage capabilities of feedforward and feedback neural networks.
CO6 Describe and justify practical ANN applications in real-world domains such as speech, image, and biomedical signal processing along with deployment challenges.

IV. COURSE CONTENT:

MODULE - I: BASICS OF ARTIFICIAL NEURAL NETWORKS (10)

why neural networks, what a neuron is, basic topologies, basic learning laws, Characteristics of Neural Networks, Historical Development of Neural Network Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws.

MODULE –II: ACTIVATION AND SYNAPTIC DYNAMICS (10)

Introduction, Biological Motivation for Activation & Synaptic Behavior, Mathematical Representation of Neurons and Signals, Activation Dynamics Models Discrete-Time and Continuous-Time Activation Models, Synaptic Dynamics Models, Learning Methods.

MODULE –III: FEEDFORWARD NEURAL NETWORK (9)

Introduction, Overview of Pattern Mapping and Association Tasks, Role of Neural Networks in Representing.

Input–Output Relationships, Characteristics of Associative, Classification, and Mapping Problems, Analysis of Pattern Association Networks, Analysis of Pattern Classification Networks.

MODULE –IV: FEEDBACK NEURAL NETWORKS (10)

Introduction, Characteristics of Feedback Connections and Recurrent Neural Structures, Comparison Between Feedforward and Feedback Network Behaviors, Dynamic System Perspective: State Evolution and Energy Functions, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks**.**

MODULE –V: APPLICATIONS OF ANN (9)

Introduction, Role of Neural Networks in Solving Real-World Mapping, Recognition, and Decision Tasks, Comparison of ANN-Based Solutions with Conventional Algorithmic Approaches, Practical Considerations: Data Requirements, Training Constraints, and Deployment Environments Direct Applications, Pattern Recognition and Classification in Speech, Image, and Biomedical Signals.

V. TEXT BOOKS:

1 B. Yegnanarayana - Artificial neural network PHI Publication.2005
2. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms

VI. REFERENCE BOOKS:

1. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005
2. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press ,1995

VII. ELECTRONICS RESOURCES:

1. https://ocw.mit.edu/courses/9-641j-introduction-to-neural-networks-spring-2005/
2. https://nptel.ac.in/courses/117105084

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations