



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

NEURAL COMPUTING AND DEEP LEARNING								
<b>V Semester: CSE   IT</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
ACSE21	Core	3	0	0	3	40	60	100
<b>Contact Classes: 48</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: Nil</b>			<b>Total Classes: 48</b>			
<b>Prerequisites: Machine Learning</b>								

### I. COURSE OVERVIEW:

This course provides an in-depth introduction to the principles and practices of neural networks and deep learning, which form the core of modern artificial intelligence and machine learning applications. It focuses on building both theoretical understanding and practical skills to design, train, and evaluate deep learning models.

### II. COURSE OBJECTIVES:

The students will try to learn:

- I The fundamentals of Artificial Neural Networks, including learning paradigms, architectures, and training algorithms such as Perceptron, Back-Propagation, BAM, and Hopfield models.
- II The unsupervised and competitive neural networks, including SOM, LVQ, Counter-Propagation, ART, and other special-purpose networks.
- III The evolution and core principles of Deep Learning, differentiating it from Machine Learning, and challenges.
- IV The optimization strategies for training deep neural models, including dropout, dataset augmentation, early stopping, adaptive learning rate techniques, and second-order optimization methods across vision, speech, and NLP domains.

### III. COURSE OUTCOMES:

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

- CO1 Explain the fundamental concepts, models, and learning mechanisms of Artificial Neural Networks including perceptron and back-propagation architectures.
- CO2 Demonstrate supervised associative memory models such as BAM and Hopfield networks and interpret their training algorithms for pattern association.
- CO3 Analyze fixed-weight competitive and self-organizing neural models including SOM and LVQ for clustering and feature mapping tasks.
- CO4 Summarize the evolution, types, applications, and historical trends of deep learning while distinguishing it from classical machine learning approaches.
- CO5 Apply regularization techniques such as dropout, data augmentation, early stopping, and adversarial training to improve model generalization.
- CO6 Implement and evaluate neural network optimization strategies including adaptive learning rate, parameter initialization, and approximate second-order methods for deep model training.

#### **IV. COURSE CONTENT:**

##### **MODULE-I: INTRODUCTION: ARTIFICIAL NEURAL NETWORKS (9)**

Basic models of ANN, important terminologies, supervised learning networks, perceptron networks, adaptive linear neuron, back-propagation network. associative memory networks. training algorithms for pattern association, BAM and Hopfield networks.

##### **MODULE-II: UNSUPERVISED LEARNING NETWORK (10)**

Fixed weight competitive nets, maxent, hamming network, kohonen self-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory networks. special networks-introduction to various networks.

##### **MODULE-III: INTRODUCTION TO DEEP LEARNING, (10)**

Evolution of AI, Machine Learning vs Deep Learning, Deep Learning types, Stages in ML/DL project, Applications of Deep Learning, Challenges motivating deep learning.

Historical trends in deep learning, deep feed - forward networks gradient-based learning hidden units architecture design back-propagation and other differentiation algorithms

##### **MODULE-IV: REGULARIZATION FOR DEEP LEARNING (10)**

Parameter norm penalties, norm penalties as constrained optimization, regularization and under-constrained problems, dataset augmentation, noise robustness, semi-supervised learning, multi-task learning, early stopping, parameter typing and parameter sharing, sparse representations, bagging and other ensemble methods, dropout, adversarial training, tangent distance, tangent prop and manifold, tangent classifier

##### **MODULE-V: OPTIMIZATION FOR TRAIN DEEP MODELS (9)**

challenges in neural network optimization, basic algorithms, parameter initialization strategies, algorithms with adaptive learning rates, approximate second- order methods, optimization strategies and meta-algorithms, Applications: Large-scale deep learning, computer vision, speech recognition, natural language processing.

#### **V. TEXTBOOKS:**

1. Deep Learning: An MIT Press Book by Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press,2016.
2. Neural Networks and Learning Machines, Simon Haykin, 3<sup>rd</sup> Edition, Pearson Prentice Hall.

#### **VI. REFERENCEBOOKS:**

1. John C Martin, "Introduction to Languages and Automata Theory", Tata McGraw-Hill, 3<sup>rd</sup> edition, 2017.
2. Daniel I.A. Cohen, "Introduction to Computer Theory", John Wiley & Sons, 2<sup>nd</sup> Edition, 2004.

#### **VII. ELECTRONICSRESOURCES:**

1. <https://www.coursera.org/learn/neural-networks-deep-learning>
2. <https://www.iitp.ac.in/~shad.pcs15/data/NN-DL.pdf>

#### **VIII. MATERIALS ONLINE:**

1. Course outline description
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Open ended experiments
6. Assignments
7. Model question paper - I
8. Model question paper - II
9. Lecture notes
10. Power Point Presentation
11. Early learning readiness videos (ELRV)