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संगणक विज्ञान एंव अभियांत्रिकी विभाग / DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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No:- Date:

MC470401 *Deep Learning* **L-T-P-Cr: 3-0-2-4**

Pre-requisites:
1. Basic knowledge of machine learning.

Objectives:
1. To impart knowledge on the need and basics of deep learning.
2. To make students proficient in applying deep learning techniques in various research areas of Computer Vision and Pattern Recognition.
3. To make students able to develop various deep learning based systems.

Course Outcomes – After completing this course, students will be able to understand:

Sl. No	Course Outcome (CO)	Mapping to POs
1	Concepts and techniques of deep neural network and training algorithms of neural network	PO1, PO2
2	Need, concepts, and learning algorithms of various associative memories like Hopfield network and Autoencoder	PO1, PO2
3	Need, concepts, and learning algorithms of stochastic machine like Boltzmann machine	PO1, PO2,PO3
4	Need, concepts, and learning algorithms of radial basis function network	PO1, PO2,PO3
5	Need, concepts, and learning algorithms of convolutional neural network	PO1, PO2, PO3, PO4, PO5
6	Need, concepts, and learning algorithms of recurrent neural network	PO1, PO2, PO3, PO4, PO5
7	Need and concepts of various attention mechanisms	PO1, PO2, PO3, PO4, PO5

UNIT I: Neural Network **Lectures: 10**

Brief introduction to neural network. Error Cost Function, Mean-Square Error, Cross-Entropy. Linear vs Non-linear functions: Activation Function – Linear, Sigmoid, Softmax, Relu.

Optimization: Gradient Descent Algorithm, Momentum Based Gradient Descent Algorithm and Nesterov Accelerated Gradient Descent Algorithm.

UNIT II: Feedback Networks **Lectures: 11**

Algorithm for Pattern Association/Reconstruction: Associative memory networks, Hetero Associative Memory neural networks; Auto Associative Memory Networks---Autoencoders: Undercomplete, Regularized; Bi-directional Associative memory networks.

Feedback Networks: Discrete Hopfield Net, Continuous Hopfield Net; Stochastic machine---Boltzmann machine; Radial Basis Function Networks (RBFN): Training algorithm for an RBFN with fixed centres.

UNIT III: Convolutional Neural Network **Lectures: 08**

Architecture, Convolution Operation, Filters, Pooling Operation---Max pooling, Average pooling; Backpropagation algorithm in CNN, Class activation mapping and Global pooling, Dilated CNN.

UNIT IV: Recurrent Neural Network **Lectures: 09**

Recurrent Neural Network: Basic concepts of RNN, Vanishing Gradient problem, Long Short Term Memory (LSTM)---Architecture, Bidirectional Long Short Term Memory (BLSTM)---Architecture, Gated Recurrent Unit (GRU)---Architecture, Backpropagation through Time algorithm, Attention Mechanism.

UNIT V: Attention Mechanism **Lectures: 04**

Need of attention mechanism**,** Self-attention**,** Channel-attention, Multi-headed attention.

Reference Book:

1) *Neural Network* by Simon Haykin, Pearson Education/PHI
2) *Deep Learning, Part II*. Goodfellow, I., Bengio, Y., Courville, A., MIT Press, 2016.

References:

1) *Learning deep architectures for AI.* Bengio, Yoshua. Foundations and trends in Machine Learning 2.1 (2009): 1127.