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| **Lecture Hours** | **TOPICS** |
| **Unit – I** | |
| 1-2 | Introduction to Neural Networks – Biological NN Vs ANN |
| 3-4 | Computational Models in NN, Neurons Interconnection, ANN Architecture |
| 4-5 | Activation functions & ANN, Perceptron -Single Layer Perceptron and Multi Layer Perceptron |
| 6-8 | Forward and Back propagation, Training Neural Network |
| **Unit – II** | |
| 1 | Improving NN- Hyperparameter Tuning, Overfitting and Underfitting |
| 2 | Regularization and Optimization |
| 3-4 | Dropout, Batch Normalization |
| 5-7 | Data Augmentation |
| **Unit – III** | |
| 1-3 | Introduction to Convolution Neural Networks (CNNs), Mathematical Intuitions, Terminology, Activation Functions in CNNs, Training Aspects of CNNs , Overview of CNN architecture |
| 4-5 | Image Classification (Ex: LeNet, AlexNet, VGG, GoogleNet, ResNet) |
| 5-6 | Common challenges in training deep CNNs (vanishing gradients, overfitting) |
| **Unit - IV** | |
| 1 | Introduction to Sequential Data and Deep Learning |
| 2-3 | Recurrent Neural Networks (RNNs)- Overview of RNNs, RNN architecture- Recurrent layers, hidden states, and loops, Limitations of vanilla RNNs: Vanishing and exploding gradient problems, |
| 4-7 | Introduction to LSTMs, LSTM architecture: Forget gate, input gate, and output gate , Training RNNs and LSTMs, Gated Recurrent Units (GRU), Unsupervised Learning: Auto-encoders |
| **Unit – V** | |
| 1-7 | Applications of Deep Learning- Time Series Forecasting, Natural Language Processing (NLP), Speech Recognition, Video Processing, Computer Vision for Object detection(Faster R-CNN, YOLO, SSD), Instance Segmentation, Semantic Segmentation (Mask RCNN, DeepLabV3) ,Emerging Trends in Deep Learning |

**Textbooks**

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville,“ Deep Learning “ , MIT Press , 2017
2. Charu. C. Aggarwal, “Neural Networks and Deep Learning”, Springer, Second Edition, 2023
3. Nikhil Buduma and Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, (1st. ed.), O'Reilly Media, Inc 2017

**References**

1. Christopher M. Bishop, “Neural Networks for Pattern Recognition”, Oxford Press,2008
2. R. J. Schalkoff,Artificial Neural Networks,McGraw Hill Education, New York, USA, 2011. ISBN 12-5900-237-3.
3. B.Yegnanarayana,Artificial Neural Networks,Prentice Hall India Learning Private Limited publishers,Mumbai, India,1998. ISBN81-2031-253-8.