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| **B. Tech III Year–II Sem** | **L** | **T** | **P** | **C** |
| **Subject Code: 21PC6CM05** | **3** | **1** | **0** | **4** |

**Neural Networks and Deep Learning**

**Prerequisite:**

1. Python Programming
2. Machine Learning

**Course Objectives:**

1. Understand the neural network system and its components.
2. Compare Single Layer and Multi-layer perceptron.
3. Explain Convolutional Neural Network, LSTM.
4. Describe Unsupervised Deep Learning models.

**Module-I**

Introduction to biological neurons and their artificial models, Single Layer Perceptron, Multilayer Perceptron, Optimization Techniques: Gradient Descent, Batch Optimization.

Overview of Convolution Neural Network, Recurrent Neural Network, Unsupervised Deep Learning. Real-time examples.

**Module – II**

**Multi-Layer Perceptron:** Learning rules: perceptron rule, Out star learning rule, Hebb's rule, Delta learning rule, Backpropagation.

**Associative Memory Network:** Algorithm for pattern association, Hetero Associative Memory Neural Network, Auto Associative Memory Network, Comparison of Single Layer and Multi-Layer neural network.

**Module - III**

**Convolutional Neural Networks:** History, CNN Architectures: Convolution layer, pooling, Padding, filters, Activation functions, dropout, optimizers.

**Module – IV**

**Recurrent Neural Networks (RNNs):** Sequence modeling using RNNs, Exploding and Vanishing Gradients, Long Short-Term Memory (LSTM), Gated Recurrent Units, Bidirectional LSTMs.

**Module – V**

**Unsupervised Deep Learning:** Autoencoder, Deep Belief Nets, Generative Adversarial Networks.

**Applications:** Applications of Single Layer Perceptron, Multi-Layer neural network, CNN, LSTM.

**Text Books:**

1. **Deep Learning by Ian Goodfellow and Yoshua Bengio and Aaron Courville (MIT press), 2016**
2. **Neural Networks and Learning Machine – by Simon Haykin, Third Edition, Pearson Education, 2014**

**Reference Text Books:**

1. **Chris Bishop's Pattern recognition and machine learning, Springer, 2010**
2. **Deep Learning Methods and Applications by Deng & Yu's monograph, now publishers Inc, 2014.**
3. **Deep Learning for Natural Language Processing, Develop Deep Learning Models for Natural Language in Python, Jason Brownlee, 2017.**

**Web Resources & E-Books:**

1. **http://cs231n.stanford.edu/**
2. **https://machinelearningmastery.com/what-is-deep-learning.**

**MOOC’s Courses:**

1. **“Deep Learning”, NPTEL.**
2. **“Deep Learning: Convolutional Neural Networks in Python”, Udemy.**

**Course Outcomes:**

Upon completing this course, the student will be able to

1. Explain the concept of the Neural Network and different optimization techniques.
2. Demonstrate the multi-layer neural network and Associative Memory Neural Network for solving the given problem.
3. Comprehend Convolutional Neural Network, LSTM and its hyperparameter.
4. Describe Unsupervised Deep Learning models.

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| **CO-PO/PSO Mapping Chart**  **(3/2/1 indicates strength of correlation)**  **3 – High; 2 – Medium; 1 - Low** | | | | | | | | | | | | | | | |
| **Course Outcomes (COs)** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes\*** | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | **2** |  |  |  |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO2** | **3** | **2** |  |  |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO3** | **2** |  |  |  |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO4** | **2** |  |  |  |  |  |  |  |  |  |  |  | **2** |  |  |

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| **B. Tech III Year–II Sem** | **L** | **T** | **P** | **C** |
| **Subject Code: 21PC6CM08** | **0** | **0** | **3** | **1.5** |

**Neural Networks and Deep Learning Lab**

**Prerequisite:**

1. Python Programming
2. Machine Learning

**Course Objectives:**

1. Design an ANN Model.
2. Develop a Convolutional Neural Network model for classification.
3. Study the impact of Hyperparameters on the model’s performance.
4. Evaluate the performance of the models.

**Lab Programs:**

1. Develop ANN model for the given dataset (csv format) when the value of learning rate, epoch, no of hidden layer and neurons of hidden layer change in ANN.
2. Analyze the performance of the ANN Model.
3. Study the impact of learning rate.
4. Similarly, change the value of epoch, no of hidden layer and neurons of hidden layer and evaluate the performance.
5. Analyse the performance of ANN regression on the Boston housing dataset.
6. Compare the performance of ANN with Decision Tree on the dataset using following metrics:
7. Confusion Matrix, Accuracy, Precision, Recall, F1 Score.
8. Error Metrics: MSE, RMSE and MAE.
9. Analyse the performance of Classification models - ANN on FashionMNIST dataset (in image format).
10. Load the dataset as input.
11. Normalize the given range of pixel values and show the training images along with class labels.
12. Analyze its performance.
13. Analyse the performance of CNN model on MNIST dataset (in image format).
14. Load the dataset.
15. Normalize the given range of pixel values and show the training images along with class labels.
16. Evaluate the model by using metrics – classification accuracy and Cross Entropy Loss.
17. Study the impact of filter size and activation function on the performance of CNN model.
18. Load the dataset.
19. Change the hyper-parameters (Varying filter size, activation function) and compare the model’s performance.
20. Study the impact of number of convolutional layers and pooling layer (Average pooling, Max pooling).
21. Load the dataset.
22. Change the hyper-parameters (number of convolutional layers and pooling layer) and compare the model’s performance.
23. Perform the time series prediction (Airline Passengers dataset) using LSTM.
24. Load the dataset.
25. Pre-process the dataset.
26. Evaluate the model and plot the graph.
27. Train a sentiment analysis model on the IMDB dataset, use RNN layers with LSTM/GRU notes.
28. Compare the performance of CNN and RNN model using a given dataset.

**Text Books:**

1. Deep Learning: A Practical Approach,by Rajiv Chopra, Second edition.
2. Learn Keras for Deep Neural Networks: A Fast-Track Approach to Modern Deep Learning with Python, 2019.

**Reference Text Books:**

1. Hands-On Deep Learning for Images with TensorFlow: Build intelligent computer vision applications using TensorFlow and Keras, 2018, by Will Ballard
2. Deep Learning by Ian Goodfellow and Yoshua Bengio and Aaron Courville (MIT Press), 2016.

**Web Resources & E-Books:**

1. https://playground.tensorflow.org/
2. https://matlab.mathworks.com/

**MOOC’s Courses:**

1. “Deep Learning”, NPTEL.
2. “Deep Learning: Convolutional Neural Networks in Python”, Udemy.

**Course Outcomes:**

Upon completing this course, the student will be able to

1. Develop an ANN Model for classification and regression.
2. Develop a Convolutional Neural Network model for classification.
3. Analyze the Model’s performance by varying Hyperparameters.
4. Evaluate the performance of the models.

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| **CO-PO/PSO Mapping Chart**  **(3/2/1 indicates strength of correlation)**  **3 – High; 2 – Medium; 1 - Low** | | | | | | | | | | | | | | | |
| **Course Outcomes (COs)** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes\*** | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | **3** | **3** | **3** |  | **3** |  |  |  |  |  |  |  | **2** |  | **2** |
| **CO2** | **3** | **3** | **3** |  | **3** |  |  |  |  |  |  |  | **2** |  | **2** |
| **CO3** | **3** | **3** | **3** |  | **3** |  |  |  |  |  |  |  | **2** |  | **2** |
| **CO4** | **3** | **3** | **3** |  | **3** |  |  |  |  |  |  |  | **2** |  | **2** |