

Year: B. Tech III (Semester VI)

Subject Name: Deep Learning

Subject Code: BTEA19622

Type of course: Honors (Group: Artificial Intelligence and Machine Learning)

Prerequisite (if any): Probability and Statistics, Machine Learning and applications

Rationale: Deep learning has varied applications in today's world ranging from Object detection to Natural Language Processing. This course aims to give a detailed insight into Artificial Neural Networks, Deep Neural Networks and its types. The course gives an in-depth exploration of Convolutional Neural Networks, Recurrent Neural Networks, Generative Adversarial Networks and their applications and Transfer Learning.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
4	0	2	5	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Contents	Total Hrs
1	Introduction to Artificial Neural Network : ANN, Multilayer Basic building block of neural network, Learning representation from data, Perceptron, Multilayer Perceptrons (MLPs), Feedforward Neural Networks, Gradient Descent (GD), Backpropagation, Loss functions.	10
2	Deep Neural Network : Deep Learning and its Architectures, Activation Functions and Hyper parameter Tuning	7
3	Convolutional Neural Network (CNN) and its Variants: Foundations of CNN- Convolution, Striding, Padding, Pooling,, Understanding and visualizing CNNs. LeNet, AlexNet, VGGNet, GoogleNet, ResNet, MobileNet; Case Study - Image Classification	15
4	Improving Deep Neural Network: Bias vs Variance Tradeoff, Saddle point problem in neural networks, Regularization: L1 regularization, L2 regularization, Batch Normalization, Early stopping, Dropout, Pruning; Optimization Techniques - Batch Optimization, Momentum Based GD, Stochastic GD, RMSProp, Adam Optimizer	8
5	Transfer Learning: Pre-trained layers, freezing the layers, fine tuning layers; Case Study - Face Recognition	5
6	Recurrent Neural Network (RNN) : Sequence modeling using RNN, Long Short Term Memory (LSTM), Bidirectional LSTMs, Case study: Sentiment Analysis	8

Suggested Specification table with Marks (Theory): (For B. Tech. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	25	15	5	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

Sr No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication /Publication Edition
1.	Fundamentals of Deep Learning	Nikhil Buduma	O-Reilly	Latest Edition
2.	Deep Learning	Goodfellow, I., Bengio, Y., Courville, A.	MIT Press,	
3.	Neural Networks - A Classroom Approach	Satish Kumar	Tata McGraw-Hill	
4.	Neural Networks and Learning Machines	Simon. Haykin	Prentice Hall of India	
5.	Deep Learning Using Python	S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka	Wiley	

Note: Students should refer to the latest editions of books

Course Outcomes:

Sr. No.	CO statements	Marks % weightage
CO-1	Discuss the basic building blocks of ANN to construct models	15%
CO-2	Select appropriate deep learning algorithms for various types of learning tasks	15%
CO-3	Demonstrate Convolutional Neural Network models for real world applications	25%
CO-4	Analyzing various optimization techniques for improving deep neural networks	18%
CO-5	Implement sequence models for text analysis	15%
CO-6	Apply deep generative models for various applications	12%

List of Open learning website:

- Deep Learning Part 1 (IITM) by Prof. Sudarshan Iyengar & Prof. Mitesh M. Khapra | IIT Madras
https://onlinecourses.nptel.ac.in/noc19_cs85
- <https://www.udemy.com/course/deeplearning/>
- <https://www.coursera.org/specializations/deep-learning>



List of Open Source Software:

- Python
- Tensorflow
- Keras
- OpenCV
- Pytorch
- Theano
- Caffe

FOR LAB SESSIONS:

List of Suggestive Experiments:

Sr No.	Practicals
1.	Write a program to generate various logic functions (AND,OR,NOT, NOR, XOR) using McCulloch-Pitts neuron and appropriate values for weights, bias and threshold.
2.	Build a neural network with one hidden layer, using forward propagation and backpropagation.
3.	Implement image classification on MNIST using CNN and understand new best-practices for the deep learning era of how to set up train/dev/test sets and analyze bias/variance.
4.	Implement and apply a variety of optimization algorithms, such as Mini-batch Gradient Descent, Momentum, RMSprop, Adam, and hyper-parameter tuning and check for their convergence on MNIST Dataset.
5.	Apply pre-trained Deep Neural Network models for binary/multiclass image classification problems.
6.	Implement transfer learning using pre-trained CNN for face recognition.
7.	Build a Generative Adversarial Network for CIFAR Dataset
8.	Detect and classify positive and negative reviews using a sequence model.
9.	Implement various data augmentation techniques.

