Course Code	Course Title	L	T	P	C
MCSE603L	**Deep Learning**	2	**0**	**0**	2
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. Introduce major deep neural network frameworks and issues in basic neural networks
2. To solve real-world applications using Deep learning
3. Providing insight into recent Deep Learning architectures

Course Outcomes

At the end of this course, students will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and improve Hyper parameters for better Deep Network Performance
3. To understand and visualize Convolutional Neural Network for real-world applications
4. To demonstrate the use of Recurrent Neural Networks and Transformer based for language modeling
5. To distinguish different types of Advanced Neural Networks

Module:1	**Neural Networks**	**3 hours**

The Neuron –Expressing Linear Perceptrons as Neurons – Feed-Forward Neural Networks – Linear Neurons and their Limitations – Sigmoid, Tanh and Relu Functions – Softmax Output Layers

Module:2	**Neural Learning**	**4 hours**

Measuring Errors - Gradient Descent – Delta Rule and Learning Rate – Backpropagation – Stochastic and Minibatch Gradient – Test Sets, Validation Sets and Overfitting – Preventing Overfitting in Deep Neural Networks – Other Optimization Algorithms: Adagrad, RMSProp, Adadelta, Adam

Module:3	**Convolution Neural Networks**	**5 hours**

Neurons in Human Vision – Shortcomings of Feature Selection –Scaling Problem in Vanilla Deep Neural Networks – Filters and Feature Maps – Description of Convolutional Layer – Maxpooling – Convolution Network Architecture – Image Classification

Module:4	**Pre-Trained Models**	**3 hours**

Self-Supervised Pretraining, AlexNet, VGG, NiN, GoogleNet, Residual Network (ResNet), DenseNet, Region-Based CNNs (R-CNNs) – Transfer Learning - FSL

Module:5	**Recurrent Neural Networks**	**6 hours**

Sequence-to-Sequence Modeling – Embedding - Recurrent Neural Networks - Bidirectional RNNs, Analyzing Variable Length Inputs – Tackling seq2seq Problem – Beam Search and Global Normalization – Recurrent Neural Networks (RNN)– Hidden States – Perplexity – Character-level Language Models –Modern RNNs: Gated Recurrent Units (GRU), Long Short Term Memory (LSTM), Bidirectional Long Short Term Memory (BLSTM), Deep Recurrent Neural Network, Bidirectional RNN

Module:6	**Attention Models and Transformers**	**4 hours**

Attention Mechanism: Attention Cues, Attention Pooling, Scoring Functions, Self-Attention and Positional Encoding;–Bidirectional Encoder Representations from Transformers (BERT) – Generative Pre-trained Transformers

Module:7	**Advanced Neural Networks**	**4 hours**

Generative Adversarial Networks – Generator, Discriminator, Training, GAN variants; Autoencoder: Architecture, Denoising and Sparcity; DALL-E, DALL-E 2 and IMAGEN

Module:8	**Contemporary Issues**	**1 hour**
	Total Lecture hours:	**30 Hours**

Text Book(s)	
1.	Fundamentals of Deep Learning, Nikhil Buduma and Nicholas Locasio, O-Reilly, 2017
2.	Dive into Deep Learning, Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Amazon Senior Scientists – Open source and Free Book, March 2022
Reference Books	
1.	Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017
2.	Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017

Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
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