

Branch Name:	M.Sc. (Artificial Intelligence & Data Science)
Program Code:	ET214
Course Title:	Deep Learning
Course Code:	1ET2140204
Pre-requisite Course:	Proficiency in intermediate Python and linear algebra, calculus and probability/statistics.

Course Objectives:

1. To understand theoretical foundations and architectures of deep neural networks.
2. To design and train deep learning models including CNNs, RNNs, and autoencoders.
3. To apply deep learning frameworks and optimization techniques for real-world problems.
4. To explore generative models and modern deep learning advancements.
5. To develop practical applications using deep learning in computer vision, NLP, and speech processing

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	04	50	50	25	25	150

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Introduction to Deep Learning: Machine learning vs deep learning, applications of deep learning, feature engineering, deep learning frameworks (TensorFlow/PyTorch), bias-variance tradeoff, regularization techniques	5	10%
2	Neural Network Fundamentals: Artificial neuron models, activation functions, loss functions, single layer and multilayer perceptrons, forward and backward propagation, optimization and gradient descent	5	25%
3	Convolutional Neural Networks (CNNs): Convolution and pooling operations, deep CNN architectures (LeNet, AlexNet, VGG, Inception), hyperparameter tuning, transfer learning, visualization and interpretation of CNNs, CNN applications	10	25%
4	Recurrent Neural Networks (RNNs): Sequence modeling, vanishing gradient problem, LSTM, GRU, bidirectional RNNs, autoencoders and sequence learning applications	8	10%
5	Generative Deep Learning Models: Restricted Boltzmann Machines (RBM), Deep Belief Networks (DBN), Generative Adversarial Networks (GAN), generative modeling applications	7	10%
6	Applications of Deep Learning: Computer vision tasks (image classification, object detection), speech processing, natural language processing applications, end-to-end deep learning systems	5	20%

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – *Deep Learning*, MIT Press.
2. Umberto Michelucci – *Applied Deep Learning*, Apress.
3. François Chollet – *Deep Learning with Python*, Manning.

Reference Books:

1. Josh Patterson & Adam Gibson – *Deep Learning: A Practitioner's Approach*, O'Reilly.
2. Aurélien Géron – *Hands-On Machine Learning*, O'Reilly.
3. Zhang et al. – *Dive into Deep Learning*, Cambridge University Press.
4. Bishop – *Neural Networks for Pattern Recognition*, Oxford.

List Of Experiments / Practicals

1. Study of RoboFlow framework and dataset annotation workflow.
2. Loading and pre-processing datasets using Python (NumPy, Pandas, TensorFlow/Keras).
3. Implementation of a multi-layer perceptron (MLP) for classification tasks.
4. Handwritten digit recognition using pretrained CNN models (MNIST dataset).
5. Design and training of a custom CNN architecture for image classification.
6. Object detection using CNN-based deep learning models.
7. Implementation of LSTM network for sequence prediction problems.
8. Implementation of GRU model for time-series or sequential dataset.
9. Implementation of autoencoder for dimensionality reduction or denoising.
10. Study and experimentation with Generative Adversarial Networks (GANs).
11. Mini Project: Development of a deep learning application (CV/NLP/Speech) using real-world dataset.

Course Learning Outcomes (CLO):

COs	Statements	Bloom's Level
CO1	Understand theoretical foundations and characteristics of deep learning models	L2 – Understand
CO2	Apply deep neural network architectures to develop learning models	L3 – Apply
CO3	Analyze and select appropriate deep learning algorithms for different data types	L4 – Analyze
CO4	Evaluate challenges and optimization strategies in deep learning model design	L5 – Evaluate
CO5	Develop deep learning-based applications for computer vision, speech, and NLP problems	L6 – Create

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	L	–	M	–	–	–	–	–	–	–	H	M	–	–
CLO2	H	H	M	M	H	–	–	–	–	–	–	–	H	H	M	–
CLO3	H	H	H	M	H	–	–	–	–	–	–	–	H	H	M	–
CLO4	M	H	H	H	H	–	–	–	–	–	–	–	H	H	M	M
CLO5	H	H	H	M	H	–	–	–	–	–	–	–	H	H	H	M

H:High, M:Medium, L:Low