

Branch Name:	IMCA
Program Code:	CS301
Course Code	1CS3010802T
Course Title	Advanced Machine Learning
Pre-requisite Course:	It is Essential to have solid foundation in programming, mathamatics and basic machine learning concept.

Course Objective:

1. To understand the fundamentals of neural networks and deep learning models.
2. To analyze different deep learning architectures used in real-world AI applications.
3. To develop deep learning models for image, text, and sequential data analysis.
4. To apply modern deep learning techniques including transformers and generative models.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
4	-	-	4	60	40	-	-	100

Course Contents:

Unit No	Topics	Total Hours	Weightage (%)
1	Foundations of Deep Learning • Introduction to Artificial Intelligence, Machine Learning, and Deep Learning • Biological neuron vs Artificial neuron • Perceptron and Multi-Layer Perceptron (MLP) • Feedforward Neural Networks • Activation functions (Sigmoid, Tanh, ReLU, Softmax) • Loss functions and cost optimization • Introduction to automatic differentiation and computational graphs	5	10
2	Neural Networks • Gradient Descent algorithms (Batch, Stochastic, Mini-batch) • Backpropagation algorithm • Optimization techniques (Adam, RMSProp, AdaGrad) • Weight initialization methods • Regularization techniques (Dropout, Batch Normalization, L1/L2) • Hyperparameter tuning and early stopping • Model evaluation and performance metrics	10	20

3	Neural Networks (CNN) • CNN architecture and working principle • Convolution operation and feature maps • Padding and stride • Pooling layers (Max pooling, Average pooling) • Popular CNN architectures (LeNet, AlexNet, VGG, ResNet) • Applications in Computer Vision - o Image classification - o Object detection - o Image segmentation	10	20
4	Sequence Models and Natural Language Processing • Recurrent Neural Networks (RNN) • Backpropagation Through Time (BPTT) • Long Short-Term Memory (LSTM) networks • Gated Recurrent Units (GRU) • Word embeddings (Word2Vec, GloVe) • Attention mechanism • Transformer architecture and applications in NLP	11	25
5	Advanced Deep Learning and Generative AI • Autoencoders and Variational Autoencoders (VAE) • Generative Adversarial Networks (GANs) • Self-supervised and few-shot learning • Transformer-based foundation models • Explainable AI (XAI) in deep learning • Deep Reinforcement Learning • Applications of Deep Learning in: - o Natural Language Processing - o Healthcare - o Social media analytics - o Autonomous systems	12	25

Text Book

- Goodfellow, I., Bengio, Y., & Courville, A., Deep Learning, MIT Press, 2016.

Reference Books

1. Nielsen, M., Neural Networks and Deep Learning, Determination Press.
2. Chollet, F., Deep Learning with Python, Manning Publications.
3. Géron, A., Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, O'Reilly.
4. Zhang, A., Lipton, Z., Li, M., Smola, A., Dive into Deep Learning, Cambridge University Press.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:



H:High, M:Medium, L:Low