

Branch Name:	IMCA
Program Code:	CS301
Course Code	1CS3010802P
Course Title	Advanced Machine Learning Practical
Pre-requisite Course:	It is Essential to have solid foundation in programming, mathematics 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	
	-	3	3	-	-	25	25	50

Suggested Practical / Lab Work (Deep Learning)

1. **Python Environment Setup**
Install and configure Python libraries such as NumPy, Pandas, Matplotlib, TensorFlow, and PyTorch.
2. **Implementation of Perceptron Model**
Develop a simple perceptron algorithm for binary classification.
3. **Multi-Layer Perceptron (MLP)**
Implement a feedforward neural network for classification using TensorFlow or PyTorch.
4. **Activation Functions Visualization**
Plot and analyze Sigmoid, Tanh, ReLU, and Softmax activation functions.
5. **Backpropagation Algorithm**
Implement backpropagation for training a neural network on a small dataset.
6. **Hyperparameter Tuning**
Train a neural network by adjusting parameters such as learning rate, batch size, and epochs.
7. **Regularization Techniques**
Apply Dropout and L1/L2 regularization to reduce overfitting in deep neural networks.
8. **Convolutional Neural Network (CNN) Implementation**
Build a CNN model for image classification using a dataset such as MNIST or CIFAR-10.
9. **Image Feature Extraction using CNN**
Visualize feature maps and convolution layers.
10. **Transfer Learning**
Use a pre-trained model (e.g., ResNet or VGG) for image classification.
11. **Recurrent Neural Network (RNN)**
Implement an RNN model for sequential data prediction.
12. **LSTM Network for Sentiment Analysis**
Train an LSTM model for sentiment classification on text data.
13. **Word Embedding Techniques**
Implement Word2Vec or use pre-trained embeddings for NLP tasks.
14. **Attention Mechanism and Transformer Model**
Implement a basic Transformer model for text classification.

15. Autoencoder Implementation

Implement an Autoencoder for dimensionality reduction or image reconstruction.

16. Generative Adversarial Network (GAN)

Implement a basic GAN to generate synthetic images.

17. Explainable AI Techniques

Apply visualization techniques such as Grad-CAM or SHAP for model interpretability.

18. Model Evaluation

Compute performance metrics such as accuracy, precision, recall, F1-score, and confusion matrix.

19. Deployment of Deep Learning Model

Deploy a trained deep learning model using a web framework such as Streamlit.

20. Mini Project

Develop a deep learning application such as sentiment analysis, image classification, or recommendation system.

Recommended Tools:

- Python
- TensorFlow
- PyTorch
- Keras
- Jupyter Notebook

Text Book

- Chollet, F., *Deep Learning with Python*, Manning Publications.

Reference Books

1. Géron, A., *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow*, O'Reilly Media.
2. Goodfellow, I., Bengio, Y., Courville, A., *Deep Learning*, MIT Press.
3. Zhang, A., Lipton, Z., Li, M., Smola, A., *Dive into Deep Learning*.
4. Nielsen, M., *Neural Networks and Deep Learning*.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand fundamental concepts of neural networks and deep learning architectures.	2.Understand
CLO2	Apply optimization and training techniques for deep neural networks.	3.Apply
CLO3	Analyze convolutional neural networks for computer vision applications.	4.Analyze
CLO4	Implement sequence models such as RNN, LSTM, and Transformer for NLP tasks.	3.Apply
CLO5	Evaluate advanced deep learning techniques such as GANs and Autoencoders for real-world AI problems.	5.Evaluate

Mapping of CLOs with POs & PSOs

Course Learning Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CLO1	H	M	-	-	L	-	L	-	-	-	-	-	L	-
CLO2	H	H	M	M	M	-	L	-	-	-	-	-	M	L
CLO3	H	H	H	M	M	-	L	-	-	-	L	L	M	L
CLO4	H	H	H	M	M	-	L	-	-	L	L	M	H	M
CLO5	H	H	H	H	M	L	M	L	L	L	M	M	H	H
CLO6	H	M	-	-	L	-	L	-	-	-	-	-	L	-

H:High, M:Medium, L:Low