MIT | Academy of Engineering (An Autonomous Institute Affiliated to Savitribai Phule Pune University)	COURSE SYLLABUS	
SCHOOL OF COMPUTER ENGINEERING	W.E.F	AY: 2023 - 2024 (Rev. 2022)
THIRD YEAR BACHELOR OF TECHNOLOGY COMPUTER ENGG.	COURSE NAME	DEEP LEARNING LAB
	COURSE CODE	2304337L
	COURSE CREDITS	1
RELEASE DATE : 01/07/2024	REVISION NO.	2.0

TEACHING SCHEME (HOURS/WEEK)		EXAMINATION SCHEME AND MARKS					
		THEORY			LABORATORY		TOTAL
LECTURE	PRACTICAL	IA	MSE	ESE	CA	PRACT/DEMO/PRES.	
NIL	2	NIL	NIL	NIL	20	30	50

PREREQUISITE : Statistics and Integral Calculus, Artificial Intelligence and Machine learning

COURSE OBJECTIVES :

2304337L.CEO.1: Develop hands-on skills to implement and train deep learning models using popular frameworks.
2304337L.CEO.2: Identify problems that can be effectively addressed using deep learning solutions.
2304337L.CEO.3: Evaluate the performance of deep learning models using evaluation metrics.
2304337L.CEO.4: Assess the strengths and limitations of different deep learning approaches.

COURSE OUTCOMES :

After successful completion of the course, students will be able to,

2304337L.CO.1: Develop critical thinking skills by solving real-world problems using deep learning algorithm.[L4]
2304337L.CO.2: Investigate strategies for improved model generalization, reducing overfitting, enhancing unseen performance.[L4]
2304337L.CO.3: Optimize models by fine-tuning hyperparameters for task-specific and dataset-specific optimal performance.[L5]
2304337L.CO.4: Discuss results to draw conclusions on problem-solving method effectiveness.[L5]
2304337L.CO.5: Improve collaboration through group discussions, sharing insights, and contributing to DL projects in lab settings. [L5]

COURSE ABSTRACT:

This course explores deep learning in artificial intelligence, covering its principles, methodologies, and practical applications. Students will learn about neural networks, convolutional neural networks, and recurrent neural networks, and their roles in tasks like image classification, object detection, segmentation, natural language processing, and time series analysis. The course combines theoretical understanding with practical implementation through lectures, exercises, and projects. Lab components include hands-on exercises, project-based assignments, experimentation with pre-trained models, and integration with web applications. Students will gain a comprehensive understanding of deep learning principles and methodologies.

PRACTICALS

PRACTICAL NO.01	**Neural Networks design and deployment**	**4 HOURS**

1. Model Development: Design and train the neural network with appropriate architecture, loss function, optimizer, and data handling techniques, ensuring model accuracy and performance through evaluation and hyperparameter tuning.

PRACTICAL NO.02	**Transfer Learning**	**6 HOURS**

1. Transfer Learning Model Development: Fine-tune a pre-trained model on your specific dataset, adjusting the top layers and optimizing hyperparameters to achieve desired performance metrics.

PRACTICAL NO.03	**Object Detection and Multi object classification**	**4 HOURS**

1. Dataset Preparation and Model Design: Select and preprocess a dataset with annotations for object detection, segmentation masks, and class labels. Design a deep learning architecture that integrates object detection, segmentation, and recognition tasks.
2. Model Training and Optimization: Train the multi-task model, experiment with hyperparameters, and fine-tune using transfer learning. Implement optimization techniques to enhance performance.
3. Evaluation and Visualization: Evaluate the model on a test dataset, create visualizations of predictions, and discuss challenges and potential real-world applications.

PRACTICAL NO.04	**Natural Language Processing**	**4 HOURS**

1. Data Preparation: Obtain a dataset with sentiment labels, clean the data using NLP tools, and visualize sentiment distribution.
2. Text Representation and Model Training: Convert text to numerical vectors using TF-IDF or word embeddings, implement a baseline model, and split the dataset into training and testing sets.
3. Evaluation and Conclusion: Evaluate models on the test set using relevant metrics, summarize key findings, suggest improvements, and recommend future research directions.

PRACTICAL NO.05	**Sequence Classification**	**4 HOURS**

1. Development: Design and train a deep sequence model (e.g., RNN, LSTM, GRU, Transformer) using a suitable dataset for sequence classification tasks, ensuring to preprocess the data appropriately and tune hyperparameters for optimal performance.
2. Evaluation: Validate the model's performance on a separate test set, using metrics like accuracy, precision, recall, and F1-score to assess its effectiveness in classifying sequences accurately.

PRACTICAL NO.06	Sequence Generation	6 HOURS

1. Model Design and Training: Construct and train a deep sequential model (e.g., LSTM, GRU, Transformer) on a dataset of sequences, focusing on generating new sequences by learning patterns from the input data.
2. Evaluation and Fine-tuning: Assess the model's ability to generate coherent and relevant sequences by comparing generated sequences against a validation set, and fine-tune the model's parameters to improve generation quality.

PRACTICAL NO.06	Mini Project (Object detection/NLP).	6 HOURS

1. The mini project aims to create a real-time object detection/langauge based web application that uses a pre-trained deep learning model to identify objects in a live webcam feed or dynamic data.
2. The project involves selecting a suitable dataset and model, pre-processing the data, integrating the model, developing the web application, deploying it, and documenting the project.
3. The project will take five weeks, with a maximum of three students participating. The team will prepare a project plan, select a real-time dataset, and select a pre-trained model.
4. The project will also involve data pre-processing, model integration, web application development, deployment, and documentation.
5. Regular communication and collaboration will be maintained throughout the project, with the goal of having a fully functional real-time object detection or NLP web application ready for deployment.

TEXT BOOKS

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville (2016). *Deep Learning.* 1^{st} Edition, The MIT Press . ISBN 978-0262035613.
2. Aurélien Géron(2019) *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition.* 1^{st} Edition,Packt Publishing. ISBN 9781492032649.
3. Aurélien Géron(2019) *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow.* 1^{st} Edition,O'Reilly Media. ISBN 978-149203264.

REFERENCE BOOKS

1. Maxim Lapan.(2018).*Deep Reinforcement Learning Hands-Ons*Packt Publishing. ISBN 978-1788834247
2. Seth Weidman.(2019).*Deep Reinforcement Learning Hands-Ons*Packt Publishing. ISBN 978-1788834247

E-BOOKS/E-CONTENTS LINKS

1. Dive into Deep Learning:ASTON ZHANG, ZACHARY C. LIPTON, MU LI, AND ALEXANDER J.SMOLA(2024)*Dive into Deep Learning*Paperback. ISBN 1009389432. link- https://d2l.ai/d2l-en.pdf
2. https://developer.nvidia.com/deep-learning
3. https://builtin.com/machine-learning/deep-learning
4. https://www.deeplearningbook.org/