Course Syllabus
Gyanmanjari College of Computer Application
Semester-3 (MCA)

Subject: Deep Learning - MCAAI13519

Type of course: Minor-Stream

Prerequisite: Mathematics, Machine Learning Concepts.

Rationale:

Deep learning has emerged as a dominant force in artificial intelligence due to its remarkable ability to automatically learn feature hierarchies from raw data. This representation learning aspect is particularly advantageous in scenarios where manual feature engineering is difficult or impractical.

Furthermore, deep learning models exhibit scalability, enabling them to handle large datasets effectively, which is essential in fields like computer vision, natural language processing, and speech recognition. Their flexibility allows adaptation to diverse data types and tasks, from image classification to machine translation, leading to state-of-the-art performance in many domains.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
3	0	2	4	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**Introduction to Deep Learning:** • Overview of deep learning and its applications • History and evolution of deep learning • Basics of artificial neural networks (ANNs)	5	15

	• Key concepts: neurons, layers, activation functions		
2	**Fundamentals of Neural Networks:** • Building blocks of neural networks: perceptions, weights, biases • Forward propagation: how data moves through a neural network • Backpropagation: understanding gradient descent and optimization algorithms	10	20
3	**Convolutional Neural Networks:** • Introduction to CNNs and their architecture • Convolutional layers, pooling layers, and fully connected layers • Applications of CNNs: image recognition, object detection, and more • Transfer learning and pre-trained models	12	25
4	**Recurrent Neural Networks:** • Understanding sequential data and the need for RNNs • Basics of RNNs, including architectures like LSTM and GRU • Applications of RNNs: sequence prediction, text generation, language translation	12	25
5	**Advanced Topics in Deep Learning:** • Introduction to advanced topics such as generative adversarial networks (GANs), reinforcement learning, and attention mechanisms • Case studies and applications of advanced deep learning techniques • Ethical considerations and challenges in deep learning	6	15

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	**Study Synopsis :** Students have to explore different industries, domains, and contexts where deep learning is applied to solve problems. Make predictions, automate tasks, or gain insights from data. Students have to prepare document file and upload it on GMIU web portal.	10
2	**Idea Revolve:** Students have to identify potential domains or contexts where deep learning is not currently applied but could offer valuable solutions or improvements. Students have to prepare document file and upload it on GMIU web portal.	10
3	**Skill-Building Task:** Skill-Building Task: Mini project definition will be given Students have	10

	to upload the task on GMIU web portal. Perform this activity in group.(group of five)	
Total		30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	25%	30%	25%	10%	10%	0

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand deep learning principles, including its applications, history, and evolution. They will grasp the basics of artificial neural networks (ANNs), including key concepts such as neurons, layers, and activation functions.
CO2	Develop skills in the building blocks of neural networks, including perceptrons, weights, biases, and the processes of forward propagation and backpropagation for training neural networks.
CO3	Explore CNN applications such as image recognition and object detection, as well as techniques like transfer learning and utilizing pre-trained models.
CO4	Comprehend the importance of RNNs for sequential data processing and understand architectures like LSTM and GRU, sequence prediction, text generation, and language translation.
CO5	Enhance proficiency in advanced topics in deep learning, including generative adversarial networks (GANs), reinforcement learning, and attention mechanisms.

List of Practical

Sr. No.	Descriptions	Unit No.	Hrs
1.	Implement a basic image classification model using a simple neural network architecture to classify images from the CIFAR-10 dataset.	1	2
2.	Develop a simple deep neural network to recognize handwritten digits from the MNIST dataset.	1	4

3.	Perform sentiment analysis on a small dataset of Twitter data to classify tweets as positive, negative, or neutral.	**1**	**2**
4.	Create a simple neural network model to classify images of flowers into different species, using a dataset such as the Flower Recognition Dataset.	**1**	**2**
5.	Develop a deep learning model to detect the ripeness of fruits from images, categorizing them as ripe, unripe, or overripe.	**1**	**2**
6.	Implement the perceptron algorithm from scratch using Python and NumPy to classify linearly separable datasets.	**2**	**2**
7.	Create a simple feedforward neural network to solve the XOR gate problem, demonstrating the ability of neural networks to learn nonlinear relationships.	**2**	**2**
8.	Develop a neural network using a library like TensorFlow or PyTorch and train it on a synthetic dataset, experimenting with different gradient descent optimization algorithms such as stochastic gradient descent (SGD), mini-batch SGD, and Adam.	**2**	**2**
9.	Use grid search or random search techniques to optimize hyperparameters (e.g., learning rate, number of hidden units, batch size) of a neural network model on a benchmark dataset like MNIST or CIFAR-10	**2**	**2**
10.	Create a CNN model to classify images as either cats or dogs using the famous Kaggle dataset.	**3**	**4**
11.	Build a CNN model to classify images of different fruits (e.g., apples, oranges, bananas) using a small dataset collected from the internet.	**3**	**2**
12.	Train a simple RNN model to generate text resembling Shakespearean literature.	**4**	**2**
13	Develop a basic RNN model to perform named entity recognition on text data, identifying entities like names, organizations, and locations.	**4**	**2**

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal
[2] "Recurrent Neural Networks and LSTM: Deep Learning and Natural Language Processing" by Rohit Kumar Passi

[3] "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani
[4] "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
[5] "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster