NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE (Data Science) / MTech CSE
Course Code:	6CS272ME25
Course Title:	Deep Learning Applications
Course Type:	Core / Department Elective-II
Year of Introduction:	2025-26

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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to –

1. identify the strengths and weaknesses of the deep network (BL3)
2. analyse the suitability of different deep networks for problems in various domains (BL4)
3. interpret the functioning and math behind the deep learning architectures (BL5)
4. design and implement deep networks for solving problems pertaining to computer science and interdisciplinary research. (BL6)

Unit	Contents	Teaching Hours (Total 30)
Unit-I	**Fundamentals:** Introduction to AI, Machine Learning and Deep Learning, basics of supervised and unsupervised learning, gradient descent, linear regression, Artificial Neural Networks, forward and backpropagation	05
Unit-II	**Convolutional Neural Networks:** Fundamentals of CNN, model training and inferencing for classification and regression, hyper-parameters tuning, state-of-the-art CNN architectures, Transfer Learning,	10
Unit-III	**Sequence Learning:** Recurrent Neural Networks (RNN), Long short-term memory (LSTM), Gated Recurrent Unit (GRU), Attention and Transformer Networks, Attention Mechanism for Images	06
Unit-IV	**Deep Unsupervised Learning:** Auto-encoders, Generative Adversarial Networks (GAN)	03
Unit-V	**Reinforcement learning:** Markovian Decision Process, Basic Decision problem, Bellman Equation, Q-learning, Deep reinforcement learning.	03
Unit-VI	**Case Studies:** Case studies related to image processing, computer vision, video processing, object detection and tracking	03

Self-Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Zhang, Aston, Dive into deep learning. Cambridge University Press
2. Glassner, Andrew. Deep learning: a visual approach. No Starch Press
3. Prince, Simon JD. Understanding Deep Learning. MIT Press
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press
5. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly
6. Ronald T. Kneusel, Practical Deep Learning, No starch press.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Analysis of Titanic – Machine Learning from Disaster	02
2	Basics of Tensorflow and Keras	02
3	Conventional Feed Forward Neural Network on MNIST. Write code using (a) Sequential Class (b)Model Class API	02
4	Kaggle: Digit Recognizer (Digit Recognizer Kaggle)	02
5	Kaggle: CIFAR-10 - Object Recognition in Images Use transfer learning.	04
6	Image Segmentation & Detection Using Deep Networks	04
7	Auto Encoders for Dimensionality Reduction	02
8	Build a language model using RNN. Write functions to sample novel sentences and find the probability of the input sentence. Also, use Recurrent Neural Network for Sentiment Analysis.	04
9	Recurrent Neural Network for Image Captioning	04
10	GAN for MNIST-like image generation.	04