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| **Course Code: CSE3189** | **Course Title: Deep Learning**  **Type of Course: Theory & Integrated Laboratory** | | | | **L- T-P- C** | **2** | **0** | **2** | **3** |
| **Version No.** | 1.0 | | | | | | | | |
| **Course Pre-requisites** | CSE 3001-Artificial Intelligence and Machine Learning | | | | | | | | |
| **Anti-requisites** | NIL | | | | | | | | |
| **Course Description** | This course introduces students to the concepts of deep neural networks and state of the art approaches to develop deep learning models. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. It will help to design and develop an application-specific deep learning models and also provide the practical knowledge handling and analyzing end user realistic applications. Topics include Fundamental concepts of deep neural networks, Convolutional Neural Networks, Recurrent Network structures, Deep Unsupervised Learning, Generative Adversarial Networks and applications in various problem domains. | | | | | | | | |
| **Course Objective** | This course is designed to improve the learners EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques. | | | | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:   1. Learn the Fundamental Principles of Deep Learning. (Remember). 2. Identify the Deep Learning Algorithms for learning tasks in various related domains (Apply). 3. To understand and apply deep generative models. (Understand). 4. Apply deep learning architectures to image and audio data. (Apply) | | | | | | | | |
| **Course Content:** | | | | | | | | | |
| **Module 1** | **Introduction to Deep Learning and Neural Networks** | Assignment |  | | | | | **13[7L+6P]**  **Sessions** | |
| **Topics:**  Fundamentals of Deep Learning, Perceptron, Multilayer Perceptron, Optimizing Perceptions using Activation Functions, Loss Functions, Gradient Descent.  Feedforward Neural Network, Training Neural Network with Back-propagation, Hyper parameters, Regularization, Dropouts, Batch Normalization, Practical Issues in Neural Network Training -The Problem of Overfitting, The Vanishing and Exploding Gradient Problems | | | | | | | | | |
| **Module 2** | **Common Deep Learning Architectures:** | Assignment |  | | | | | **18[8L+10P]**  **Sessions** | |
| **Topics:**  Convolutional Neural Network, Transfer learning Techniques, Variants of CNN: DenseNet, ResNet  Sequence Modelling: Recurrent Neural Network and its variants - Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU) | | | | | | | | | |
| **Module 3** | **Deep Generative Models** | Assignment |  | | | | | **16[8L+8P]**  **Sessions** | |
| Topics:  Generative Adversarial Networks, Kohonen Networks, Autoencoders, Boltzmann Machine, Restricted Boltzmann Machine, Deep Belief Network | | | | | | | | | |
| **Module-4** | **Advanced Deep Learning Architectures** | Assignment | |  | | | | **13[7L+6P]**  **Sessions** | |
| Topics:  Hopfield Network, Probabilistic Neural Network, Deep Reinforcement Learning - The Basic Framework of Reinforcement Learning  Deep Learning applications: Image segmentation, Object detection,Speech Recognition, Video Analytics | | | | | | | | | |
| **Project work/Assignment:** | | | | | | | | | |
| 1. **Assignment 1 on (Module 1 and Module 2 )** 2. **Assignment 2 on (Module 3 and Module 4)** | | | | | | | | | |
| **List of Laboratory Tasks:**  **Lab 1: Working with Deep Learning Frameworks**  Objective: Explore various Deep Learning Frameworks  Tasks: Identify deep learning frameworks (Keras, Tensorflow, Matplotlib, etc)  Activity: Practice with various methods available in DL Frameworks to develop a Model.  **Lab 2: Build a Basic Artificial Neural Network**  Objective: Create a ANN with DL frameworks.  Task: Identify suitable ANN Layers using Keras and Tensorflow.  Activity: Design a basic Artificial Neural Networks using Keras with TensorFlow ( pima-indians-diabetes)  **Lab 3 and Lab 4: Build a MultiLayer Perceptron**  Objective: Create a MLP for classification task.  Task: Identify suitable model for house price prediction.  Activity: Design a MLP for implementing classification and fine-tuning using House price.csv  **Lab 5: Build a Convolutional Neural Network**  Objective: Create a CNN model.  Task: Build CNN architecture for Dog-Cat classification problem.  Activity: Implement a Convolution Neural Network (CNN) for dog/cat classification problem using keras  **Lab 6 and Lab 7: Build a Time-Series Model**  Objective: Create a RNN and LSTM Model  Task: Build RNN/LSTM Model for predicting time series data.  Activity Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes  **Lab 8: Build a Gated Recurrent Unit architecture.**  Objective: Create a Time Series Model.  Task: Build GRU Architecture for predicting time series data.  Activity: Implement a GRU architecture for language translations.  **Lab 9 and Lab 10: Build a Transfer Learning Model.**  Objective: Create a Seq2Seq Model  Task: Create Hugging-face API using Transfer learning model.  Activity: Implement Transfer Learning models for classification problems Exploring Hugging-face API  **Lab 11: Build an Auto-Encoder model**  Objective: Create an Unsupervised Deep Learning Model.  Task: Create AutoEncoder network Output Translations.  Activity: implement an Encoder-Decoder Recurrent neural network model for Neural Machine Translation.  **Lab 12: Build Generative Adversarial Networks.**  Objective: Create an Unsupervised Deep Learning Model.  Task: Design GAN Architecture for Image generations.  Activity: Design a Age Prediction model by Applying Generative Adversarial | | | | | | | | | |
| REFERENCE MATERIALS:  TEXTBOOKS   1. François Chollet, “Deep Learning with Python”, 2nd Edition, Manning Publications, 2022 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.   REFERENCES   1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra , “Deep Learning”, Pearson Publication, 2021. 2. David Foster, “Generative Deep Learning” O’Reilly Publishers, 2020. 3. John D Kellehar, “Deep Learning”, MIT Press, 2020.   **JOURNALS/MAGAZINES**   * + - 1. IEEE Transactions on Neural Networks and Learning Systems   <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385>   * + - 1. IEEE Transactions on Pattern Analysis and Machine Intelligence   https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special\_papers/IT032.pdf   * + - 1. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x   SWAYAM/NPTEL/MOOCs:   * + - 1. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21\_cs35/preview       2. Coursera – Neural Networks and Deep Learning Andrew Ng       3. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera | | | | | | | | | |
| Catalogue prepared by | S.Poornima | | | | | | | | |
| Recommended by the Board of Studies on | BOS NO: | | | | | | | | |
| Date of Approval by the Academic Council | Academic Council Meeting No. | | | | | | | | |