COURSE TITLE	**DEEP LEARNING**
COURSE CODE	**01CT0628**
COURSE CREDITS	**4**

Objective:

1 This course aims at teaching supervised, unsupervised and reinforcement deep learning methods which helps to develop state-of-the-art artificial intelligence applications. The course will provide an overview of the challenges of vision, the commonly used techniques and the current approaches. This course investigates different transformation operation, depth estimation, feature extraction and shading. This course also includes Generative learnings and topics in Natural Language Processing leading to the seq2seq models leading to the solution of the real-world problems.

Course Outcomes: After completion of this course, student will be able to:

1 Analyze the fundamentals of deep learning based on linear algebra, probability, statistics and machine learning

2 Analyze different supervised, unsupervised, and reinforcement deep learning models and their applications in real world scenarios

3 Build, train, test and evaluate neural networks for different applications and data types.

4 Evaluate and Improve the deep learning mode using error analysis, regularization, hyper parameter tuning.

5 Apply optimization strategies for large scale applications

Pre-requisite of course: Machine learning

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction of Deep Learning** History, AI vs ML vs DL, Deep Learning and its Applications, loss function, cost function, Multilayer perceptron, forward propagation; , Model Training: Backpropagation, Stochastic Gradient Descent and Optimizers: Momentum, RMSProp, Adam; , Deep Learning Experiments: Datasets, training-validation, testing set, evaluation measures: accuracy, precision, recall, f-measure	3
2	**Model Improvement and Regularization** Overfitting vs underfitting, Bias vs Variance, hyper parameter tuning: random, , coarse to fine; Regularization: L1, L2 regularization, , Dropout, Early stopping, Data normalization, Augmentation	3

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Contents : Unit	Topics	Contact Hours
3	**Convolutional Neural Network** Convolutional Neural Networks, NNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); , CNNs for Detection: Background of Object Detection, R-CNN, YOLO, CNNs for Segmentation: FCN, U-Net, Mask-RCNN	9
4	**Recurrent Neural Networks** Time-series data analysis, forward propagation, , Backpropagation Through Time (BPTT), word embedding, , Vanishing-exploding gradients, LSTM, GRU; RNN Se2Seq model,, Encoder-Decoder, Attention Mechanism, , Self-Attention Transformer, BERT, Application: Sentiment analysis, text generation, image captioning, machine translation	10
5	**Generative Learning** Variational Auto-encoders, , Generative Adversarial Neural Networks;, GL Applications: Image generation,, font generation, anime face/celebrity face generation	9
6	**Variants and Applications of Generative Models in Vision** Image Editing,, Super resolution, , 3D Object Generation	4
7	**Cognitive Computing with Machine Learning** Cognitive Computing, The Nature of Cognitive Psychology, , Cognitive architecture, The Cognitive Modeling Paradigms, , Machine learning Techniques for cognitive decision making – Hypothesis Generation and Scoring, , Applications: Cognitive Systems in health care, , Cognitive Assistant for visually impaired – AI for cancer detection	4
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiments** 1. Implement Multi Layer Feed Forward Neural Network, Implement CNN, 3. Implement R-CNN and Masked R-CNN, Implement YOLO, Implement U-Net, Implement RNN and LSTM, Implement Encoder-Decoder Architecture, Implement Transformer and Self-Attention Mechanism, Implement Image Recognition Algorithm, Implement Image Generation system, Implement 3D Object Generation, Implement Text Generation Approach, Implement Image Labelling/Image Captioning System, Implement Machine Translation	28
Total Hours		**28**

Textbook :

1 Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, Springer, 2016

2 Neural Networks and Deep Learning, Michael Nielsen, Wiley, 2016

References:

1 Learning Deep Architectures for AI, Learning Deep Architectures for AI, Yoshua Bengio, nowpublishers, 2009

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
15.00	20.00	30.00	20.00	10.00	5.00

Instructional Method:

1 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.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

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

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

Supplementary Resources:

1 https://www.coursera.org/specializations/deep-learning

2 https://www.edx.org/learn/engineering/purdue-university-introduction-to-deep-learning-2