

VII Semester

DEEP LEARNING			
Course Code	21CS743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Course Learning Objectives			
CLO 1. Understand the fundamentals of deep learning.			
CLO 2. Know the theory behind Convolutional Neural Networks, Autoencoders, RNN.			
CLO 3. Illustrate the strength and weaknesses of many popular deep learning approaches.			
CLO 4. Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.			
CLO 5. Learn the open issues in deep learning, and have a grasp of the current research directions.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.			
2. Use of Video/Animation to explain functioning of various concepts.			
3. Encourage collaborative (Group Learning) Learning in the class.			
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.			
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.			
6. Introduce Topics in manifold representations.			
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.			
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
Module-1			
Introduction to Deep Learning: Introduction, Deep learning Model, Historical Trends in Deep Learning,			
Machine Learning Basics: Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.			
Textbook 1: Chapter1 – 1.1, 1.2, 5.1,5.7-5.8.			
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning		
Module-2			
Feedforward Networks: Introduction to feedforward neural networks, Gradient-Based Learning, Back-Propagation and Other Differentiation Algorithms. Regularization for Deep Learning,			
Textbook 1: Chapter 6, 7			
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration		
Module-3			
Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm.			

Textbook 1: Chapter: 8.1-8.5	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features- LeNet, AlexNet.	
Textbook 1: Chapter: 9.1-9.9.	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Recurrent and Recursive Neural Networks: Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.	
Applications: Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processing and Other Applications.	
Textbook 1: Chapter: 10.1-10.3, 10.5, 10.6, 10.10, 12.	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes CO1: Understand the fundamental issues and challenges of deep learning data, model selection, model complexity etc., CO2: Describe various knowledge on deep learning and algorithms CO3: Apply CNN and RNN model for real time applications CO4: Identify various challenges involved in designing and implementing deep learning algorithms. CO5: Relate the deep learning algorithms for the given types of learning tasks in varied domain	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy	

as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Textbooks

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference:

1. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009.
2. N.D.Lewis, "Deep Learning Made Easy with R: A Gentle Introduction for Data Science", January 2016.
3. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications.

Weblinks and Video Lectures (e-Resources):

- <https://faculty.iitmandi.ac.in/~aditya/cs671/index.html>
- <https://nptel.ac.in/courses/106/106/106106184/>
- <https://www.youtube.com/watch?v=7x2YZhEj9Dw>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning