Vivekanand Education Society's
Institute of Technology
Approved by AICTE & Affiliated to University of Mumbai

AI and Data Science Department

Lecture Plan

Year: 2023-24 (Odd)

Lab Code : ADC 701	**Year/ Semester : B.E.(AI and DS)/ Sem III**
Name Of the Lab : Deep Learning	**Class : D16AD**
Lab Teacher : Sangeeta oswal	**Subject Teacher : Sangeeta oswal**
Email id : sangeeta.oswal@ves.ac.in	**Email id:** sangeeta.oswal@ves.ac.in

		Teaching Scheme (Contact Hours)			**Credits Assigned**			
Subject Code	**Subject Name**	**Theory**	**Practical**	**Tutorial**	**Theory**	**Practical/ Oral**	**Tutorial**	**Total**
ADC 701	Deep Learning	3 hrs	2 hrs	--	3	1	--	03

Course Code	**Course Name**	**Examination Scheme**						
		Theory				**Term Work**	**Pract**	**Total**
		Internal Assessment		**End Sem Exam**	**Exam. Duration (in Hrs)**			
		Mid Term	**CA**					
ADC701	Deep Learning	20	20	60	2	25	25	150

Program Outcomes (PO):

PO1) Engineering knowledge: Apply knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2) Problem Analysis: identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3) Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

PO4) Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1) Professional Skills: Understand, analyze and develop essential proficiency in the areas related to artificial intelligence and data science like mathematics, computational methods and statistics.

PSO2) Successful Career: Ability to design and implement novel solutions using state of the art Artificial Intelligence and Data Science techniques such as Machine Learning, Reinforcement and Deep Learning, Natural Language Processing leading to successful careers.

Programme Educational Objectives (PEOs)

PEO1: To inculcate the fundamentals of science and engineering concepts essential for solving real world problems in the field of Artificial Intelligence and Data Science.

PEO2: To empower students with knowledge and expertise to accomplish Socially Innovative Project with ethical practices in the area of Artificial Intelligence and Data Science.

PEO3: To enable graduates to participate in lifelong learning, innovative research and product development in the area of Artificial Intelligence and Data Science

Prerequisite: Basic mathematics and Statistical concepts, Linear algebra, Machine Learning	
Course Objectives:	
1	To learn the fundamentals of Neural Network.
2	To gain an in-depth understanding of training Deep Neural Networks.
3	To acquire knowledge of advanced concepts of Convolution Neural Networks, Auto encoders and Recurrent Neural Networks.
4	Students should be familiar with the recent trends in Deep Learning.
Course Outcomes:	
1	Gain basic knowledge of Neural Networks.
2	Acquire in depth understanding of training Deep Neural Networks.
3	Design appropriate DNN model for supervised, unsupervised and sequence learning applications.
4	Gain familiarity with recent trends and applications of Deep Learning.

CO-PO-PSO Mapping :

Course Outcomes (COs)	**Program Outcomes(POs)**							**Program SPecific Objectives (PSO)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	2	1	1
CO2	3	3	3	3	3	1	3	1	1
CO3	3	3	3	3	3	3	3	1	2
CO4	3	2	2	2	2	1	1	1	1

Course Plan

Week	Contents to be covered	Reference	Methodology used	Mapping to CO
1	**Fundamentals of Neural Network: Biological** neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron, Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes. Deep Networks: Fundamentals, Brief History, Three Classes of Deep, Learning Basic Terminologies of Deep Learning	T1,T2,T3	PPT Black Board	CO1,CO2
2,3,4	**Training, Optimization and Regularization of Deep Neural Network:** **Training Feedforward DNN** Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function **Optimization** Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov GD, AdaGrad, Adam, RMSProp **Regularization** Overview of Overfitting, Types of biases, Bias Variance Trade-off Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output	T1,T3,T4,R1	PPT Black Board	CO1,CO2
5,6	**Auto encoders: Unsupervised Learning**: Introduction, Linear Auto encoder, Under complete Auto encoder, Over complete Auto encoders, Regularization in Auto encoders Denoising Auto encoders, Sparse Auto encoders, Contractive Auto encoders Application of Auto encoders: Image Compression	T1,T4,R1	PPT Black Board	CO3,CO4
8,9	**Convolutional Neural Networks (CNN): Supervised Learning** :Convolution operation,	T1,T2,T3	PPT Black Board	CO3,CO4

	Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture			
10,11,12	**Recurrent Neural Networks (RNN)** : Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit	T1,T2,T3	PPT Black Board	CO3,CO4
13,14	**Recent Trends and Applications**: Generative Adversarial Network (GAN): Architecture Applications: Image Generation, Deep Fake	T1,T2,T3	PPT Black Board	CO3,CO4

Bloom's Taxonomy:-

Level	Descriptor	Level of Attainment
1	Remembering	Recalling from memory of previously learned material
2	Understanding	Explaining ideas or concepts
3	Applying	Using information in another familiar situation
4	Analyzing	Breaking information into part to explore understandings and relationships
5	Evaluating	Justifying decision or course of actions
6	Creating	Generating new ideas, products or new ways of viewing things

1. **Textbooks:**

T1: Ian Goodfellow, Yoshua Bengio, Aaron Courville. ―Deep Learning‖, MIT Press Ltd, 2016

T2: Li Deng and Dong Yu, ―Deep Learning Methods and Applications‖, Publishers Inc.

T3: Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.

T4: JM Zurada ―Introduction to Artificial Neural Systems‖, Jaico Publishing House

T5: M. J. Kochenderfer, Tim A. Wheeler. ―Algorithms for Optimization‖, MIt Press.

2. **Reference books:**

R1 : Buduma, N. and Locascio, N., ―Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc.".

R2: François Chollet. ―Deep learning with Python ―(Vol. 361). 2018 New York: Manning
R3 : Douwe Osinga. ―Deep Learning Cookbook‖, O'REILLY, SPD Publishers, Delhi.

R4: Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc

R5: S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India

3. Web Resources

- http://www.cse.iitm.ac.in/~miteshk/CS6910.html
- https://nptel.ac.in/courses/106/106/106106184/
- https://nptel.ac. https://deeplearning.cs.cmu.edu/S21/index.html
- https://www.deeplearningbook.org/

Test Syllabus:

Internal Assessment Test 1 Syllabus **Marks(20)**

COs mapped: CO1,CO3,CO4

Test	**Contents**	
I	1	Module 1:Fundamentals of Neural Network
	2	Module 2: Training, Optimization and Regularization of Deep Neural Network
	3	Module 3: Autoencoders: Unsupervised Learning

Evaluation

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr.no	**Rubrics**	**Marks**

1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Content beyond syllabus presentation	10 marks
3.	Creating Proof of concept	10 marks
4.	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5.	Multiple Choice Questions (Quiz)	5 marks
6.	GATE Based Assignment /Tutorials etc	10 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

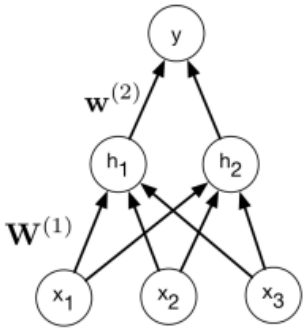
CO Mapping (Assessment)

Sr. No	Rubrics	CO1	CO2	CO3	CO4
1	Multiple Choice Questions (Quiz)	3	3	3	3
2	Content beyond syllabus presentation/ creating proof of concept	3	3	3	3

Assignment 1 :

D.O.P :30.08.2023 **D.O.S :15.09.2023**

Sr.No	Questions	Course Objective
I	Consider a convolution layer. The input consists of 6 feature maps of size 20×20. The output consists of 8 feature maps, and the filters are of size 5 × 5. The convolution is done with a stride of 2 and zero padding, so the output feature maps are of size 10 × 10. For both parts, you can leave your expression as a product of integers; you do not need to	CO3,CO4

	actually compute the product. You do not need to show your work, but doing so can help you receive partial credit. a) Determine the number of weights in this convolution layer b) Now suppose we made this a fully connected layer, but where the number of input and output units are kept the same as in the network described above. Determine the number of weights in this layer	
2	Your job is to design a multilayer perceptron which receives three binary-valued (i.e. 0 or 1) inputs x1, x2, x3, and outputs 1 if exactly two of the inputs are 1, and outputs 0 otherwise. All of the units use a hard threshold activation function: z = 1 if z ≥ 0 0 if z < 0 Specify weights and biases which correctly implement this function. You do not need to explain your solution. Hint: one of the hidden units should activate if 2 or more inputs are on, and the other should activate if all of the inputs are on. $\mathbf{W}^{(1)} = \underbrace{(\quad)}_{2\times 3 \text{ matrix}}$ $\mathbf{b}^{(1)} = (\quad)$ $\mathbf{w}^{(2)} = (\quad)$ $b^{(2)} =$ 	CO1,CO2
3	we saw that using squared error loss C = (y − t) 2 with a logistic output unit can make optimization difficult because the unit can saturate, leading to a small gradient. Cross-entropy loss doesn't have this problem. Suppose that we instead use the absolute loss C = |y−t| (but keep the logistic output unit). Does this have the same problem with saturation that squared error does? Justify your answer algebraically and/or by drawing a figure.	CO2,CO3

Subject teacher Signature with date:

Group Advisor Signature with date: