Indraprastha College for Women

University of Delhi

Work Plan for ODD SEMESTER – 2025

Course Name:	B.SC.(HONS.) COMPUTER SCIENCE (DSE)
Paper Title:	DEEP LEARNING
Unique Paper Code:	2342012304
Semester:	VII
Faculty(s):	Dr. SHIKHA AGARWAL
Year:	2025 – 26

Work Plan

Unit No.	Learning Objective	Lecture No.	Topics to be Covered
I	Describe the structure and mathematical model of an artificial neuron.	1	Artificial neurons, perceptron
I	Illustrate how computational models simulate neural behavior.	2	computational models of neurons, Structure of neural networks,
I	Identify layers (input, hidden, output) and connections in neural networks.	3	Multilayer feedforward neural networks (MLFFNN)
I	Explain the mathematical foundation and steps of the backpropagation algorithm.	4	Backpropagation learning
I	Define empirical risk and its role in supervised learning.	5	Empirical risk minimization
I	Explain how ERM is used to train models by minimizing training error.	6	Empirical risk minimization
I	Understand the need for regularization techniques to prevent overfitting.	7	Bias-Variance trade-off, Regularization
I	Compare different output activation functions (linear, softmax) and their use cases.	8	output units: linear, softmax, hidden units: tanh, RELU
II	Explain why deep neural	9	Difficulty of training DNNs

	networks are challenging to train.		
II	Explain how layer-wise training mitigates vanishing gradients and improves convergence.	10	Greedy layer wise training
II	Analyse the role of optimization algorithms in training deep networks.	11	Optimization for training DNN's

II	Explain the working principle of AdaGrad and how it adjusts learning rates.	12	Newer optimization methods for neural networks (AdaGrad)
II	Describe how RMSProp resolves AdaGrad's issue of aggressive learning rate decay.	13	Newer optimization methods for neural networks (RMSProp)
II	Explain the Adam optimizer's use of momentum and adaptive learning rates.	14	Newer optimization methods for neural networks (Adam)
II	Understand the concept and mechanism of dropout and dropconnect as regularization techniques.	15	Regularization methods (dropout, drop connect)
II	Explain the purpose and mechanism of batch normalization.	16	Regularization methods (batch normalization)
III	Explain the role of convolution and pooling in feature extraction.	17	Introduction to CNN - convolution, pooling
III	Describe the architectures and historical significance of LeNet and AlexNet.	18	Deep CNNs - LeNet, AlexNet
III	Outline the key steps involved in training a CNN, including forward pass, loss computation, and backpropagation.	19	Training CNNs
III	Analyze how proper initialization helps mitigate vanishing or exploding gradients in CNNs.	20	Weights initialization
III	Discuss how batch normalization accelerates training and provides regularization benefits.	21	Batch normalization

III	Identify key CNN hyperparameters (e.g., learning rate, batch size, kernel size, number of filters).	22	Hyperparameter optimization
III	Interpret intermediate feature maps and activation outputs in a CNN.	23	Understanding and visualizing CNNs
III	Describe the concept and advantages of transfer learning using pre-trained CNNs.	24	Using a pre-trained convnet
IV	Understand the architecture and working principle of recurrent neural networks.	25	Sequence modelling using RNNs
IV	Explain how BPTT extends standard backpropagation to RNNs.	26	Backpropagation through time
IV	Describe the internal architecture of LSTM units and their gating mechanisms.	27	Long Short Term Memory Networks (LSTM)
IV		28	Long Short Term Memory Networks (LSTM)
IV	Explain the concept of bi-directional RNNs and their role in sequence modeling.	29	Bi-directional RNN
IV		30	Bi-directional RNN
IV	Understand the structure and advantages of combining bi directional processing with LSTM units.	31	Bi-directional LSTM
IV		32	Bi-directional LSTM

V	Understand the architecture and functioning of autoencoders, including encoder and decoder components.	33	Autoencoders
V		34	Autoencoders (contd.)
V		35	Autoencoders (contd.)
V		36	Autoencoders (contd.)
V	Describe the architecture of GANs, including generator and discriminator networks.	37	Generative Adversarial Networks
V		38	Generative Adversarial Networks (contd.)
V		39	Generative Adversarial Networks (contd.)
V		40	Generative Adversarial Networks (contd.)

VI	Explain the role of deep learning in solving computer vision tasks like classification, object detection, and segmentation.	41	Computer Vision
VI	Describe how RNNs, LSTMs, and attention mechanisms are used to model temporal audio data.	42	Speech Recognition
VI	Implement sequence models like RNNs, LSTMs, and Transformers for text understanding.	43	NLP
VI	Revision	44	Revision
VI	Revision	45	Revision

Unit	Contents/Syllabus
I	**Introduction to Neural Networks:** Artificial neurons, perceptron, computational models of neurons, Structure of neural networks, Multilayer feedforward neural networks (MLFFNN), Backpropagation learning, Empirical risk minimization, bias-variance trade-off, Regularization, output units: linear, softmax, hidden units:tanh, RELU
II	**Deep Neural Networks:** Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNN's, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Regularization methods (dropout, drop connect, batch normalization).
III	**Convolution neural networks (CNNs):** Introduction to CNN - convolution, pooling, Deep CNNs - LeNet, AlexNet. Training CNNs, weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs, Using a pre-trained convnet
IV	**Recurrent Neural Networks (RNNs):** Sequence modeling using RNNs, Backpropagation through time, Long Short Term Memory Networks (LSTM), Bi-directional RNN, Bi-directional LSTM
V	**Unsupervised Deep Learning:** Autoencoders, Generative Adversarial Networks
VI	**Applications:** Computer Vision, Speech Recognition and NLP.

S. No.	Name of Authors/Books/Publishers
1.	Ian Goodfellow, Yodhua Bengio and Aaron Courville, Deep Learning, MIT Press Book, 2016.

2.	Bunduma, N., Fundamentals of Deep Learning, 1st edition, O'reilly Books, 2017.
3.	Francois Chollet, Deep Learning with python, 2nd edition, Meaning Publications Co, 2021.(Can be used for Practicals)

	Paper Components		
Credits	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**
4	**03**	**0**	**01**
Assessment Scheme			
S.No.	**Component**	**Marking Scheme**	**Total Marks**
1.	Internal Assessment		30
	• Assignment/Quiz/Project/ Presentation	12	
	• Class Test	12	
	• Attendance	6	
2.	Continuous Assessment	NA	NIL
	(**Tutorial)**• Activity 1	NA	
	• Activity 2	NA	
	• Attendance	NA	
3.	Practical		40
	• Continuous Assessment	10	
	• End Term Written/Practical Exam	20	
	• Viva	10	
4.	End Semester Examination		90