SEMESTER – IV

Course Code	UDS21401J	Course Name	*DEEP LEARNING FOR ENTERPRISE*	Course Category	C	Professional Core Course	L	T	P	C
							4	0	2	5

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Applications		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	To make the participants comfortable with the fundamentals of some of the advanced deep learning concepts, their working principles, and their functions in a business scenario.			
CLR-2 :	To make the participants comfortable with the fundamentals of different deep learning approaches, and ways to implement them using the suitable libraries and deep learning models.			
CLR-3 :	To make the participants understand the methods of teaching machines in performing cognitive works just as humans do using neural networks.			
CLR-4 :	To build intelligent and automated real-world deep learning applications and use cases spanning healthcare, retail, energy verticals by intelligently Analyzing different datasets collected from diverse data sources.			
CLR-5 :	To provide the participants with a sound understanding of a basic neural network including the concepts of neurons, weight, bias etc along with the mathematical concepts used in calculating the error function, enhancing model performance etc.			
CLR-6 :	To bring the learners to an alignment, apply their learning to a real-world business problem, and then performs research, design, development, and delivers an end-to-end deep learning solution for a given industry problem. The students will be working either in a group or individually.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	Have a strong control over the fundamental concepts of advanced deep learning including ability to have a strong foundational grasp the advanced mathematical concepts.	2	85	80	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H
CLO-2 :	Have a strong control over the fundamental concepts of all the deep learning approaches, techniques for selecting the right features and the models involved in predictive analytics.	3	85	80	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H
CLO-3 :	Use all the their cognitive skills and knowledge in applying the right set of deep learning techniques for the problem in hand	3	85	80	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H
CLO-4 :	Gain hands-on solid skills, knowledge and expertise of real-world situations the applicability of tools and techniques in extracting valuable insights from the data of different formats on time.	3	85	80	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H
CLO-5 :	Get Hands-on Skills, knowledge, and expertise on the architectural components of a basic neural network that facilitates them with the flexibility to go ahead and implement a basic neural network.	3	85	80	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H
CLO-6 :	Able build a full scale working convolutional neural networks, including variations such as residual networks.	3	85	80															

Note: All our curriculum, study materials, assignments, quizzes, lab works, and learning resources are personalized and dynamically generated using machine learning models based on the learner's learning ability. Users can review our learning curriculum only through our intelligent learning management platform (iLMSP), and our learning resources and lab infrastructures are available only in the digital form on our cloud infrastructures.

Duration (hour)		18	18	18	18	18
S-1	SLO-1	**Unit 1: Deep Learning - Deep Dive**	Backpropagation	Cost Function	Improving Activation Maximization with an expert	Eigen Vectors, Eigen Value, Single Value Decomposition
	SLO-2	Optimization for Deep Learning	Gradient Descent	Gradient Descent	Performing Activation Maximization in a code space	**Unit 13: Generative Adversarial Networks (GAN)**
S-2	SLO-1	Aggregated Residual Transformations for Deep Neural Networks	**Unit 4: Deep Learning in Real World Applications**	Stochastic Gradient Descent	Explaining DNN Decisions	Generative Adversarial Models Overview, Discriminative vs Generative Modelling, Examples of Generative models
	SLO-2	Spatial Transformer Networks	Deep learning in Healthcare	Learning Rate	Backward Propagation Techniques	Generative Adversarial Networks Overview, The Generator Model, GAN's and CNN's
S-3	SLO-1	End-to-end Optimized Image Compression	Deep learning in Retail	Batches, Epochs and Iteration	**Unit 9: Deep Neural Net optimization, Tuning**	Conditional GAN's, Why Generative Adversarial Networks, Generative Adversarial Networks Training, Loss Functions
	SLO-2	Generative Adversarial Nets	Deep learning in Energy	**Unit 7: Deep Neural Networks and Tools**	Optimizers overview, Gradient Descent, Stochastic Gradient Descent (SGD), Mini Batch Stochastic Gradient Descent (MB-SGD),SGD with momentum	**Unit 14: Backpropagation, Regularization and Batch Normalization**
S-4	SLO-1	Improved Techniques for Training GANs	Deep learning in Oil & Gas	Deep Neural Network overview	Nesterov Accelerated Gradient (NAG), Adaptive Gradient (AdaGrad)	Back Propagation Overview, Working of Back Propagation algorithm, Need of Back Propagation algorithm, Types of Back Propagation algorithms
	SLO-2	**Unit 2: Deep Learning Approaches**	Deep learning in Automobile	Difference between neural network and deep neural network	Tuning the layers, Hyperparameter Tuning	Feed Forward Networks Overview, Batch Normalization Overview, Working of Batch Normalization
S-5 & S-6	SLO-1 SLO-2	Lab 1 :	Lab 4 :	Lab 7:	Lab 10 :	Lab 13:
S-7	SLO-1	Learning Algorithms	**Unit 5: Challenges of Deep Learning**	Deep Learning Neural Network overview	learning rate, Momentum β, for RMSprop, etc, Mini-batch size, Number of hidden layers, learning rate decay, Regularization λ	Need of Batch Normalization algorithm, Regularization overview, How does Regularization reduce overfitting

	SLO-2	Supervised Learning	Data Issues	Deep Convolutional Neural Network overview	**Unit 10: Convolutional Neural Network**	Types of Regularization techniques ✓ L2 and L1 regularization ✓ Dropout ✓ Data augmentation ✓ Early stopping
S-8	SLO-1	Unsupervised Learning	Overfitting in neural networks	Improving accuracy of the neural networks	Convolution , ReLU layer, Pooling, Padding, Flattening	**Unit 15: Backpropagation, Regularization and Batch Normalization**
	SLO-2	How to select a Deep Learning Algorithm	Hyperparameter optimization	The problem of explainability	Full Conversion Layer, Softmax, Cross-Entropy	Overview of Gradient descent optimization, Overview of Adagrad Gradient descent algorithm
S-9	SLO-1	Deep Learning Workflow and applications	High Performance Hardware	**Unit 8: Interpretability of Neural Networks**	**Unit 11: Recurrent Neural Network**	Gradient descent with Adagrad ✓ Two-Dimensional Test Problem ✓ Gradient Descent Optimization With AdaGrad ✓ Visualization of AdaGrad
	SLO-2	Challenges and Vision for the future	Neural network is a Black Box	Learned features	RNN intuition, Vanishing Gradient Problem, Tackling Vanishing Gradient Problem	Overview of Adadelta Gradient descent algorithm, Gradient descent with Adadelta
S-10	SLO-1	Analysis of Deep Learning applications	Lack of Flexibility	Feature visualization	Exploding Gradient Problem, Tackling Exploding Gradient Problem	Overview of RMSProp Gradient descent algorithm, Gradient descent with RMSProp
	SLO-2	**Unit 3: Deep Learning Techniques**	Multitasking	Feature Visualization through Optimization	Long Short-Term Memory, Applications of Recurrent Neural Networks	Overview of Adam Gradient descent algorithm, Gradient descent with Adam
S-11 & S-12	SLO-1 SLO-2	Lab 2 :	Lab 5 :	Lab 8:	Lab 11:	Lab 14:
S-13	SLO-1	Classic Neural Networks	Deep Learning Security	Connection to Adversarial Examples	**Unit 12: Auto Encoders and dimensionality reduction in networks**	**Unit 16: Deep Learning Hands On Lab Work 2- Build, Test and Deploy ML Models (Health - 3)**
	SLO-2	Convolutional Neural Networks	**Unit 6: Artificial Neural Networks**	Text and Tabular Data	Autoencoders overview	Patient Segmentation
S-14	SLO-1	Recurrent Neural Networks (RNNs)	Neuron	Network Dissection	Types of Autoencoders ✓ Deep Autoencoder ✓ Sparse Autoencoder	Problem statement, Problem type

					✓ Under complete Autoencoder ✓ Variational Autoencoder ✓ LSTM Autoencoders ✓ Hyperparameters of Autoencoders	
	SLO-2	Generative Adversarial Networks	Weight	Network Dissection Algorithm	Applications of Autoencoders ✓ Dimensionality reduction ✓ Anomaly detection ✓ Image denoising ✓ Image compression ✓ Image generation	Data engineering, Data pipeline
S-15	SLO-1	Self-Organizing Maps	Bias	Experiments	Dimensionality Reduction with PCA	Model selection, Model engineering
	SLO-2	Boltzmann Machines	Activation Function	Advantages of Feature visualization	The Curse of Dimensionality	Mode outcome, analysis, and optimization
S-16	SLO-1	Deep Reinforcement Learning	Forward Propagation	Disadvantages of Feature visualization	Principal component analysis	Model pipeline
	SLO-2	Autoencoders	Backward Propagation	Activation Maximization	Eigen Value Decomposition	Data visualization, User interface
S-17 & S-18	SLO-1 SLO-2	Lab 3:	Lab 6:	Lab 9:	Lab 12:	Lab 15:

Learning Resources	1. Machine Learning at Enterprise Scale by Piero Cinquegrana, Matheen Raza Released July 2019, Publisher(s): O'Reilly Media, Inc.	2. Deep Learning for Business Managers Artificial Intelligence Prithwis Mukerjee

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	15%	20%	15%	20%	15%	20%	15%	20%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	15%	10%	15%	10%	15%	10%	15%	10%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr.Jothi, Periyasamy , Chief AI Architect DeepSphere.AI, CA, USA	Dr.S.Gopinathan, Associate Professor, University of Madras, Chennai	Mrs.M.Ramla, SRMIST