Course Code	21CSE558T	Course Name	DEEP NEURAL NETWORK ARCHITECTURES	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
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Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*School of Computing*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand the fundamental concepts and basic tools of deep neural networks*
CLR-2:	*recognize and appreciate the functionalities of various layers in deep neural networks*
CLR-3:	*explorer the application of deep neural networks in image processing*
CLR-4:	*comprehend convolutional neural networks and its layer wise functionality*
CLR-5:	*getting familiar with transfer learning techniques*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*create a simple deep neural network and explain its functions*	3	-	1
CO-2:	*building neural networks with multiple layers with appropriate activations*	1	2	-
CO-3:	*application of deep neural networks in Image processing problems*	-	2	1
CO-4:	*implementation of convolutional neural networks*	2	-	1
CO-5:	*determine the application of appropriate transfer learning techniques*	1	3	-

Module-1 - Introduction to Deep Learning	***9 Hour***
Fundamentals Of Deep Learning Architecture, Motivation: Biological Neurons, Perceptron Model-AND-OR Models, Multilayer Perceptron -X-OR Problem, Basics of Tensor Flow-Data Structures In Tensorflow, Need and Use Of Activation Functions-Types Of Activation Functions, Layers In Neural Networks, Mathematical Model Of Feedforward Neural Network, Back Propagation In Neural Networks, Loss Functions And It's Types *T1: Getting Familiar with Tensor Flow Environment* *T2: Working With Tensors* *T3: Building Programs to Perform Basic Operations in Tensors*	
Module-2 - Optimization And Regularization in Deep Neural Networks	***9 Hour***
Optimization Algorithms-Gradient Descent Algorithm, Stochastic Gradient Descent, Mini Batch Gradient Descent, Batch Gradient Descent, Unit Saturation- Vanishing And Exploding Gradient, Underfitting, Overfitting. Hyper Parameter Tuning, Learning Rate, Regularization Techniques In Neural Networks-LASSO Regression, Ridge Regression, Dropouts, Early Stopping, Normalization In Neural Networks -Batch Normalization, Group Normalization, Instance Normalization. *T4: Building basic neural network in Python* *T5: Building neural network using Keras* *T6: Building programs to optimize the neural network using gradient descent*	
Module-3 - Image Processing And Deep Neural Networks	***9 Hour***
Fundamentals Of Image Processing- Image Enhancement, Noise Removal Techniques, Edge Detection Techniques, Image Segmentation, ROI Segmentation, Morphological Processing, Feature Extraction from Images-Shape, Colour and Texture, Unstructured Image Structural Data, Image Classification from Extracted Features, Various Applications of Computer Vision *T7: Building Programs on Image Processing Using Open CV*	

T8: Building Programs to Perform Image Segmentation Using Open CV *T9: Building Programs to Extract Features from Image Using Open CV*
Module-4 - Convolutional Neural Network and Transfer Learnings ***9 Hour***
Biological Motivation for Convolutional Neural Networks, 1D, 2D And 3D CNN, Layered Architecture Of CNN- Convolution Operation, Pooling Layer, Types of Pooling, Fully Connected Layer, Regularization In CNN, Applications in Computer Vision, Stride Convolutions, Introduction To Transfer Learning, Image Net, Pre Trained Network Architectures-Alexnet, VGG, Resnet, Mobilenet, Fine Tuning Transfer Learning. *T10: Building Programs to Perform Classification Using CNN In Keras* *T11: Building Programs to Perform Multiclass Classification with Data Augmentation* *T12: Building Programme to Develop A LSTM Model*
Module-5 - Object Localization and Detection Models ***9 Hour***
Object localization and object detection models, Single shot approaches (YOLO/ SSD), Two stage approaches (RCNN family), RCNN, Fast RCNN, Faster RCNN, IOU, MAP, non-maximal Suppression. *T13: Building programs to implement prediction using pre-trained model* *T14: Building programs to implement transfer learning with fine tuning* *T15: Building programs to implement object detection using RCNN*

Learning Resources	1. *Chollet F. Deep learning with Python. Simon and Schuster; 2021 Dec 7.* 2. *Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2017 (available at http://www.deeplearningbook.org)* 3. *Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012*	4. *Brownlee J. Deep learning with Python: develop deep learning models on Theano and TensorFlow using Keras. Machine Learning Mastery; 2016 May 13.* 5. *Weidman S. Deep learning from scratch: Building with python from first principles. O'Reilly Media; 2019 Sep 9.* 6. *Gulli A, Kapoor A. TensorFlow 1. x Deep Learning Cookbook: Over 90 unique recipes to solve artificial-intelligence driven problems with Python. Packt Publishing Ltd; 2017 Dec 12.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	20%	-	20%	-	20%	-
Level 2	*Understand*	20%	-	20%	-	20%	-
Level 3	*Apply*	30%	-	30%	-	30%	-
Level 4	*Analyze*	20%	-	20%	-	20%	-
Level 5	*Evaluate*	5%	-	5%	-	5%	-
Level 6	*Create*	5%	-	5%	-	5%	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
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2. Dr Srabashi Basu, Senior Faculty, GreatLearning		*2. Dr. S. Sharanya, SRMIST*