Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7012	Deep Learning	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECCDLO 7012	Deep Learning	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. ECC 604-Artificial Neural Networks and Fuzzy logic

Course Objectives:

At the end of the course, the students will be expected to:

1. Learn how to use TensorFlow for building and testing Deep Learning models
2. Compare various CNN architectures
3. Know the importance of Regularisation and Optimization techniques in Deep Learning networks
4. Learn Deep Learning models for working with sequential data
5. Understand motivation and functioning of the most common types of Autoencoders and apply such mechanisms to various learning problems.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand the fundamentals of Deep Learning
2. Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
3. Improve deep learning models using Regularization and Optimization techniques
4. Compare the Convolution Neural Network architectures and use them as per the application
5. Design and implement Sequence Neural Network systems and solve real-world problems
6. Illustrate the working of Autoencoders and use them for real-life applications

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Deep learning**	**03**
	1.1	History of Deep Learning- A Probabilistic Theory of Deep Learning	
	1.2	Introduction to Deep Feedforward Networks, Gradient Based Learning, Hidden Units	
	1.3	Architecture Design, Backpropagation Algorithm	
2.0		**TensorFlow for Deep learning**	**06**
	2.1	Introduction to TensorFlow using Python: Computational Graph, Key Highlights, Creating a Graph	
	2.2	Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables, Keras	
	2.3	Preprocessing and Data Augmentation of Images and Datasets using TensorFlow	
3.0		**Regularization and Optimization Techniques**	**06**
	3.1	**Regularization:** Need of Regularization, L2 Regularization, L1 Regularization, Early Stopping and Dropout	
	3.2	**Optimization:** Challenges in NN Optimization, Gradient Descent Approaches, Parameter Initialization Approach, Adaptive Approaches - AdaGrad, RMSProp and Adam	
	3.2	Introduction to Batch Normalization	
4.0		**Evolution of CNN in Deep Learning**	**08**
	4.1	Review of CNN Architecture, Introduction of various CNN Architectures: LeNet, AlexNet, VGG, GoogleNet, ResNet and UNet	
	4.2	Comparison of CNN Architectures, Evaluation Parameters	
	4.3	Applications of CNN in Image Classification and Object Detection	
5.0		**Sequence Modeling**	**08**
	5.1	Recurrent and Recursive Nets: Recurrent Neural Networks, Bidirectional RNN, Encoder Decoder Architectures	
	5.2	Introduction to Long Short-Term Memory (LSTM) and Temporal Dependencies	
	5.3	Gated Recurrent Units (GRUs)	
	5.4	Applications of RNN in Real World- Image Captioning and Time Series Forecasting and Prediction	
6.0		**Encoder Decoder Models**	**08**
	6.1	Autoencoder: Encoder-Decoder Model, Training & Learning Manifold Space	
	6.2	Regularized Autoencoders: Sparse, De-noising and Contractive	
	6.3	Deep Autoencoder: Architecture and Working	
	6.4	Variational Autoencoders: Limitations of Autoencoders, Loss Function, Re-parameterization Trick, Latent Space Visualization	

	6.5	Applications of Autoencoders and Variational Autoencoders-Dimensionality Reduction , Image De-noising and Compression	
		Total	**39**
Self-learning Topics*:** Deep learning applications in Object Localization, Video Classification, Content based Image Retrieval, Recommender System, End-to-End Speech Recognition and Machine Translation *** No questions to be asked in exams.			

Text Books:

1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing, 2018.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference books

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer-Verlag, 2006.
2. Duda, Richard, Peter Hart, and David Stork, Pattern Classification, 2nd edition, Wiley-Interscience, 2000.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
4. Reza Zadeh, Bharath Ramsundar, TensorFlow for Deep Learning, 1st edition, O'Reilly Media Inc, 2018.
5. Zaccone, Giancarlo, Deep Learning with TensorFlow, 2nd edition, Packt Publishing, 2018.

NPTEL / Swayam Courses:

1. NPTEL course on Deep learning by Prof. Sudarshan Iyengar, IIT Ropar. https://nptel.ac.in/courses/106/106/106106184/
2. NPTEL course on Deep learning by Prof. Prabir Kumar Biswas, IIT Kharagpur. https://nptel.ac.in/courses/106/105/106105215/
3. NPTEL Course on Practical Machine Learning with TensorFlow by Prof. Balaraman Ravindran, IIT Chennai. https://nptel.ac.in/courses/106/106/106106213/

Online Resources:

1. https://www.tensorflow.org/tutorials/images/data_augmentation
2. https://towardsai.net/p/machine-learning/improving-artificial-neural-network-with-regularization-and-optimization
3. https://towardsdatascience.com/regularization-techniques-for-neural-networks-e55f295f2866
4. https://www.kaggle.com/sid321axn/regularization-techniques-in-deep-learning
5. https://medium.com/@minions.k/optimization-techniques-popularly-used-in-deep-learning-3c219ec8e0cc
6. https://www.jeremyjordan.me/variational-autoencoders/