	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**M.Tech/Ph.D**	Year of Regulation	**2021**
Department	**Electronics and Communication Engineering**	Semester	

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC 531	**Deep Learning**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		
	Introducing of fundamentals of neural networks		CO1	Able to explain mathematical methods in development of neural networks
	Introducing of better training neural networks		CO2	Able to use better training methods in development of deep neural networks
	Introducing of advanced topics such recurrent neural networks, long short term memory cells and convolutional neural networks		CO3	Able to develop advanced neural networks for various applications
			CO4	Able to develop multi-task deep learning networks

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	CO1	2	1	0	0	1	0	0	0	0	0	0	0	2	0	1	0
2	CO2	1	2	2	2	0	0	0	0	0	0	0	1	2	0	2	0
3	CO3	0	2	2	1	2	0	0	0	0	0	0	2	2	2	2	0
4	CO4	0	2	0	1	2	0	0	0	0	0	0	2	2	2	2	0

SYLLABUS

No.	Content	Hours	Cos
I	Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.	08	CO1
II	Difficulty of training deep neural networks, Greedy layerwise training. Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).	10	CO2
III	Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs. Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.	09	CO3
IV	Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning. Applications: Vision, NLP, Speech.	09	CO4
	Total Hours	36	

Essential Readings

I. Goodfellow, Y, Bengio, A. Courville, "Deep Learning", MIT Press, 2016.

Supplementary Readings

1. Raúl Rojas, “Neural Networks: A Systematic Introduction”, Springer, 1996.

2. C.M. Bishop, "Pattern Recognition and Machine Learning", 2nd Edition, Springer, 2011.