	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**M.Tech/Ph.D**	Year of Regulation	**2021 – 22**
Department	Electronics and Communication Engineering	Semester	**I**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC 549	**Adaptive and Statistical Signal Processing**	3	0	0	3	50	50	100	200

Course Objectives		Course Outcomes		
	Introducing of digital Wiener filtering for processing signals		CO1	Able to apply concepts of discrete random processes in the processing of non-stationary signals
	Introducing of least mean squares adaptive filters for processing signals		CO2	Able to apply digital Wiener filtering in processing of non-stationary signals
	Introducing of concepts of adaptive equalization processing of non-stationary signals		CO3	Able to develop methods for analysis of non-stationary signals using least mean squares and least squares approaches
			CO4	Able to develop equalization techniques for analysis of non-stationary signals

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	Discrete Random Processes: Random variables, random processes, filtered random processes, ensemble averages, correlation, covariance, power spectrum, cross power spectrum, stationarity, ergodicity, time averages, Wiener-Khinchin theorem, white noise and Gaussian processes.	09	CO1
II	Digital Wiener Filtering: Minimum mean squared error (MMSE) estimation, principle of orthogonality. Wiener filters. Wiener smoothing and prediction filters, application of Wiener filters to noise cancelling, application of Wiener prediction filters. Adaptive equalization.	10	CO2
III	Least Mean Squares Adaptive Filter: Method of steepest descent, convergence speed analysis, choice of step size parameter. LMS adaptive algorithm, performance analysis of LMS adaptive filter, normalized forms, applications to adaptive equalization. Convergence analysis. Method of Least Squares: Windowing, normal equations, Riccati equations, recursive Least Squares (RLS) algorithm, complexity, performance (convergence speed, steady state mean squared error) analysis, applications to channel equalization, convergence analysis.	09	CO3
IV	Kalman Filters: State space description, scalar Kalman filter, innovations process, Riccati equations, apriori and a-posteriori state estimate update, applications of Kalman filters. Adaptive Equalization: Equalization of communication channels, zero-forcing and MMSE equalizers, leading to decision feedback and fractionally spaced equalizers. Detailed simulations for Wiener filter, LMS, RLS and other adaptive estimation methods for channel equalization to understand the working/performance of adaptive estimation.	08	CO4
	Total Hours	36	

Essential Readings

1. Simon O. Haykin, “Adaptive Filter Theory”, Pearson, 5th Edition, 2014.
2. Ali H. Sayed, “Fundamentals of Adaptive Filtering”, Wiley-IEEE Press, 1st Edition, 2003.

Supplementary Readings

1. Bernard Widrow and Samuel D. Stearns, “Adaptive Signal Processing”, Pearson, 1st Edition, 1985.