

Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NECC502	Mathematics for Communication Theory	3	1	0	4

Course Objective

The objective of the course is to get the students familiarized with the mathematical topics foundational to the modern communication theory

Learning Outcomes

Upon successful completion of this course, students will:

- Learn the core concepts of probability, linear algebra and real analysis which underlie the modern communication theory
- Upon completion of the course, the students will be able to go through research papers in communication theory and consult more advanced topics in communication

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Probability and Random Variables: Foundations of probability theory, basics of random variables and their properties: CDF, PDF, MGF etc, discrete and continuous random variables, transformation of random variables and derivation of distribution functions, Gaussian random variable and its properties, Random vectors, complex random variables and circularity, applications in communication	9L+3T	Get acquainted with fundamental notions of probability and random variables and get familiarity with their usage in communication
2	Random Processes: Different notions of convergence of sequence of random variables: pointwise, almost sure, in probability, in distribution, in mean square, introduction to random processes: stationary, WSS, cyclostationary, white, basic notions of DTMC, Gaussian processes, examples in communication	9L+3T	Understand the concept of random processes and their use in communication
3	Concentration of measure: Markov's and Cramer's inequality, Moment methods, weak law of large numbers, Hoeffding's inequality, Bernstein's inequality, central limit theorem, Berry-Esseen inequality, applications in communication	6L+2T	Understand the concept of concentration inequalities and their usage in communication
4	Linear Algebra: Vector space, basis, linear transformation, dual space, projection, orthogonal complement, inner product, norm, Banach spaces, Hilbert Spaces, matrix norm, operator norm, eigenvalues and eigenvectors, diagonalizability, applications in communication	9L+3T	Understand the concepts of linear algebra and their usage in modern wireless communication
5	Real analysis: Metric space, closed, open sets, limit points, sequence, closure, compactness, continuity of functions, inf, sup, multivariate Taylor's theorem, gradient of a function, convex set, convex function, applications in communication	9L+3T	The students will acquire the basic understanding of notions of analysis to use in communication theory
Total:		42L+14T	

Text Books:

1. Sheldon M. Ross, "Introduction to Probability Models", Academic Press Inc.

Reference Books:

1. Bruce Hajek, "Random Processes for Engineers", Cambridge University Press.
2. Carl D. Meyer, "Matrix Analysis and Applied Linear Algebra", SIAM.
3. Robert G. Bartle, Donald R. Sherbert, "Introduction To Real Analysis", John Wiley & Sons, Inc.
4. Robert G. Gallager, "Principles of Digital Communication", Cambridge University Press.