Approval: 10th Senate Meeting

Course Name: Probability and Random Processes
Course instructor: Dr. Arnav Bhavsar
Course Number: CS-601
Credits: 3-1-0-4
Students intended for: High-level B.Tech / MS / Ph.D.
Prerequisites: N/A
Elective or Compulsory: Elective

Course description:

Unit 1 (6 hours): Set theory and Basic probability: Set operations, Axioms, Properties, Finite sample space, Combinatorics, Union of events, Conditional Probability, Independence of events, Bayes' formula

Unit 2 (5 hours): Introduction to measure theory (Definitions, examples, some theorems): Set sequences and their limits, Borel fields, Sigma fields, Measure space, Additive set functions, Measure, Probability space and probability measure, Random variable

Unit 3: (7 hours): Random Variables: Basic definitions and examples, PDF, CDF, Examples and properties of some standard continuous and discrete random variables

Unit4: (9 hours): Functions of Random variables: Functions of one random variable, Transformation of Random Variables, Expectations, Moments, Moment generating functions, Some inequalities (Chebyshev's, Schwarz, Markov, etc.), Functions of two random variables, Joint distributions, Marginal distributions, Joint moments, Covariance, Correlation, Independence, Central limit theorem, Example applications

Unit 5: (10 hours): Random vectors and random processes: Joint pdf, Multivariate distributions, Expectation vector, Covariance matrix, Diagonalization, Principal components Analysis, Generalization of random vectors to random process, Examples of Random Processes, Auto-and Cross Correlation, Auto- and Cross Covariance, Stationarity, WSS, Random process through a LTI system, Power spectral density, White noise, Example applications.

Unit 6 (5 hours): Overview of some applications (with examples): ML and MAP estimation, Bayesian belief networks

Text Books:
1. H. Stark, J Woods, "***Probability and Random Processes with Applications to Signal Processing***" (3rd Edition), Prentice Hall, 2002
2. A. Papoulis, U. Pillai, "***Probability Random Variables and Stochastic Processes***", 4th edition, McGraw-Hill, 4th Edition, 2002.
3. Sheldon M. Ross, "***Introduction to Probability Models***", Academic Press, (2009).