Approval: 22nd Senate Meeting

Course Number : EE 534
Course Name : Probability and Random Processes
Credits : 3-0-0-3 (L-T-P-C)
Prerequisites : Linear algebra (MA512 or IC 111) and IC 252 or equivalent of both (MA512 and IC252)
Intended for : UG /MS/MTech (CSP)/PhD/M.Sc(Maths)
Distribution : Core for Mtech (CSP), Elective for B.Tech. III/IV year, MS, Ph.D, M.Sc(Maths).
Semester : Odd

Preamble

Knowledge of random variables and random processes is essential in the following fields – signal processing, communications and machine learning. Starting with a review of basic concepts in probability the course aims to prepare a student to think in terms of random variables and processes. By the end of the course the student should be able to identify the type of process or variable involved and analyze a problem accordingly and obtain reasonable conclusions from the analysis. The course is oriented towards engineering applications rather than a mathematical one based on measure theory.

Course modules with Quantitative lecture hours:

Sigma field. Review of - axiomatic probability, conditional probability and independence.

(2 lectures)

Recap of random variables and functions of random variables.

(3 lectures)

Probability generating function, moment generating function and characteristic functions – properties and applications.

(3 lectures)

Markov chains, classification of states and chains, stationary distribution and limit theorem, Poisson process.

(5 lectures)

Convergence of random variables – basic results, inequalities (Markov and Chebyshev), law of large numbers (weak and strong), central limit theorem.

(5 lectures)

Concentration inequalities – Chernoff's bound, Hoeffding's inequality, Bennett's inequality, Bernstien's inequality and Efron-Stein inequality.

(8 lectures)

Random vectors and covariance matrix. Random processes – stationarity, WSS. Autocorrelation, cross correlation, power spectral density. Filtering of WSS processes. Basic notion of ergodicity. Wiener processes, Markov processes.

(10 lectures)

Queueing models - Little's law, M/M/1, M/M/m, M/M/m/m, M/G/1 queuing systems, priority queuing

(6 lectures)

Textbook:

1. Probability and Random Processes, Grimmett and Stirzaker, Oxford University Press, 2001.

Reference books:

(1) Erhan Cinlar, Introduction to Stochastic Processes, Dover Books on Mathematics, 2013

(2) R. G. Gallager, Stochastic Processes: Theory for applications, Cambridge University Press; 1 edition (February 17, 2014)

(3) S. M. Ross, Stochastic processes, 2nd Edition, 1996, John Wiley, New York

(4) J. R. Norris, Markov chains, 1999, Cambridge University Press, Cambridge

(5) Papoulis and Pillai, Probability, Random variables and Stochastic processes, McGraw-Hill Europe; 4th edition (January 1, 2002).

Similarity Content Declaration with Existing Courses:

Sr. No.	Course code and Title	Similarity content	Approx. % of content	Remarks
1	MA 524	Introductory material	5 lectures (12%)	
2	IC 252	Introductory material	5 lectures (12%)	
3	CS 601	Introduction and some parts of Random processes	At most 10 lectures (24%)	

Justification for new course proposal if cumulative similarity content is > 30%: This course is meant to replace CS 601 so the 24% similarity goes away. The remaining similarity is only due to the introductory material.