MTH 6031: Probability & Statistics

Programme: B.Tech. (ECE, CCE, CSE), M. Sc. Math Year: 2nd Year Semester: Even
Course : Core/Math Credits : 4 Hours : 40L+14T

Course Context and Overview: This course has been designed as a compulsory course for ECE, CCE and CSE discipline and M.Sc. Mathematics students. The main objective of this course is to provide a foundation in the theory and applications of probability theory and statistics. The emphasis in this course is to teach the basic theoretical concepts and techniques to solve probabilistic and statistical problems arise in engineering and applied science.

Prerequisites Courses: Mathematics-I

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 Be familiar to the fundamentals of probability theory, random variables and random processes
C02 Be understand the mathematical concepts related to probability theory and random processes.
C03 Be analyze the given probabilistic model of the problem.
C04 Be familiar with applications of Probability theory and random processes in science and engineering problems occurred in real world phenomena
C05 Be prepare students for a wide range of courses in communications, signal processing, control and other areas of engineering in which randomness has an important role.

Course Topics:

Topics	**Lecture Hours**	
UNIT - I **1. Topic** Introduction to Probability Theory		

1.1 Introduction, Review of set theory, countable and uncountable sets, Sample Space; Events; Definition of Probability function, Properties of Probability function, continuity of probability function. 1.2 Conditional Probability; Total Probability Theorem; Bayes' Theorem, Independent Events; counting: permutation and combination		7
UNIT - II **2. Topic** The Concept of random variable, Function(s) of random variable(s)		13
2.1 Random Variable; Events generated by random variables, 2.2 Distribution function, probability density function (pdf), probability mass functions (pmf). Discrete uniform, Binomial, Poisson, Geometric, Normal, Exponential, Continuous uniform random variables. 2.3 Function of a random variable, distributions, pdf and pmf of function of random variable. 2.4 Expectation, Variance; Moments, 2.5 Joint distribution and joint density function, Function of two random variables. 2.6 Expected value and variance of function of random variables, Covariance, Correlation coefficient, Covariance matrix and its properties, 2.7 Conditional distributions, Conditional expectation,		
UNIT – III **3. Topic** Probabilistic Inequalities, Characteristic Function, Limit Theorems		5
Jensen's Inequality, Markov's Inequality, Chebyshev's Inequality; Characteristic Function and it's properties. Weak and strong law of large numbers, central limit theorem;		
UNIT - IV **4. Topic:** Estimation		15
Unbiased Estimates, minimum-variance unbiased estimators, Maximum likelihood estimation, confidence intervals, Testing Hypotheses, Neyman-Pearson Lemma, Likelihood Ratio Tests, Students's t-distribution. Parametric test based on Chi-square, normal, t, F distributions. Simple Linear regression.		

Text Book:

1. Sheldon M. Ross: A First Course in Probability, Pearson Education India; 9 edition (2013)
2. Papoulis & S.U. Pillai, Probability, Random Variables and Stochastic Processes, Mc Graw Hill, 4th Edition, 2002.
3. Introduction to Probability, Statistics, and Random Processes by Hossein Pishro-Nik.(available free on net: https://www.probabilitycourse.com/)

Other Refernce books:

1. Sheldon M. Ross, Introduction to Probability Models, Academic Press, 10th Edition, 2010
2. Sheldon M. Ross, Introduction to Probability & Statistics for Engineers and Scientists, Academic Press, 4th Edition, 2009
3. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, Wiley; Second edition (2008).

Additional Resources:

1. MIT Open Course on Introduction to Probability and Statistics by Jeremy Orloff\\ (https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/)
2. NPTEL Lectures on Probability and Statistics by Prof. Somesh Kumar (IIT Kharagpur) \\ (http://nptel.ac.in/courses/111105041/1)

Evaluation Methods:

Item	Weightage
Quiz1	20%
Quiz2	
Attendance	5%
Midterm	25%
Final Examination	50%

Attendance Policy:

Students should attend all the lectures and tutorials. There are total **5 Marks for attendance** as per the following distribution:

Attendance %	Marks
91-100	5
81-90	4
71-80	3
61-70	2
51-60	1

Following are guiled-lines for counting the attendance %.

1. In case student have medical reason (with certificate duly issued by Institute RMO) , representing institute in sports, cultural or various competitions (with due permissions from institute authorities), student will be granted leave. Attendance % will be counted from the lectures/tutorial days without leave.

2. In case of death/very serious medical condition (with genuine evidence) in the immediate family, a students will be granted leave. Attendance % will be counted from the lectures/tutorial days without leave.

3. In case of wedding (with genuine evidence) in the immediate family, a students will be granted leave. Attendance % will be counted from the lectures/tutorial days without leave.

4. Attendance % will be rounded up. (Roundup would mean all digits between, for instance, 1.001 to 1.999 will rounded up to 2)

Grading:

Grading will be relative as per Institute guidelines. Please refer the Appendix-1 in attached document.

Instructors: Dr. Vikas Gupta, Dr. Sunil Kumar Gauttam, Dr. Somnath Maiti and Dr. Dheerendra Mishra