CSE 209: PROBABILITY METHODS IN ENGINEERING

Credit Hours: 3

Contact Hours: 3

Grading: As per UET rules

1. COURSE OUTLINE:

Probability Methods in Engineering (PME) course provides an introduction to Probability theory and underlying concepts. Axioms of probability and counting methods are taught with illustrations. Probability concepts like conditional probability, total probability, Bayes’ rule are covered with examples of practical importance.

The main focus of this course is the notion of Random Variables and its relevance in state-of-the-art research. Related concepts like expected value, standard deviation, functions, transforms and entropy of Random Variables are also part of this course. Students are also trained to generate Random Variable based values using software tools like MATLAB or Python codes.

1. WEEKLY COURSE OUTLINE:

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| Week | Contents |
| Week 1 | Statistics, Descriptive Statistics and Inferential Statistics, Applications of Statistics, Sample and Population |
| Week 2 | Introduction to Mathematical Models, Deterministic Models, Probabilistic Models  Basic Concepts of Probability, Axioms of Probability |
| Week 3 | Computing Probabilities using Counting Methods, Conditional Probability |
| Week 4 | Law on Total Probability, Bayes’ Rule |
| Week 5 | Independence of Events, Sequential Experiments |
| Week 6 | Binomial Probability Law, Geometric Probability Law |
| Week 7 | Sequences of Dependent Experiments, Random Variables, Notation of a Random Variable |
| Week 8 | Types of Random Variable, Probability Mass Function |
| **Midterm Examination** | |
| Week 9 | Discrete Random Variables |
| Week 10 | Expected Value, Variance, Standard Deviation |
| Week 11 | Functions of a Random Variable, Expected Value of Function of Random Variables |
| Week 12 | Entropy, Continuous Random Variables |
| Week 13 | CDF, PDF, Memoryless Property |
| Week 14 | Multiple Random Variables, Joint CDF and PDF, Conditional CDF and PDF, CCDF |
| Week 15 | MATLAB or Python codes for Generation of Pseudo Random Variables |
| Week 16 | Course Revision |
| **Final Term Examination** | |

1. MAPPING OF CLOS WITH PLOS:

After completing this course, students will be able to

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| CLO # | Course Learning Outcomes (CLOs) | Level of Learning (Bloom's Taxonomy) | Program Learning Outcomes (PLOs) |
| 1 | Use essential concepts of probability and apply analytical methods for solving engineering problems. | Cog-3 (Application) | PLO1 (Engineering Knowledge) |
| 2 | Use the concepts of random variables and solve mathematical problems related to stochastic systems. | Cog-3 (Application) | PLO3 (Design/Development of Solutions) |
| 3 | Apply mathematical skills and demonstrate the use of software tools for implementation of probabilistic models. | Cog-3 (Application) | PLO5 (Modern Tool Usage) |

1. MAPPING OF CLOs WITH COURSE ASSESSMENT TOOLS:

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| --- | --- | --- | --- |
| Course Assessment Tools | CLO1 | CLO2 | CLO3 |
| Assignment | ✓ | ✓ | ✓ |
| Quiz | ✓ | ✓ | ✓ |
| Mid Term | ✓ |  |  |
| Final Term |  | ✓ | ✓ |

1. RESOURCES:

* TEXT BOOK
  + Alberto Leon-Garcia, “Probability and Random Processes for Electrical Engineering”, 3rd Edition, Pearson Prentice Hall, 2008
* REFERENCE BOOKS
  + Dimitri Bertsekas and John N. Tsitsiklis, “Introduction to Probability”, 2nd Edition, Athena Scientific, 2008
  + Hossein Pishro-Nik, “Introduction to Probability, Statistics, and Random Processes”, Kappa Research, 2014