**EASTERN MEDITERRANEAN UNIVERSITY**

**DEPARTMENT OF INDUSTRIAL ENGINEERING**

**IENG513 Probabilistic Models**

**Course Outline**

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| **COURSE CODE** |  IENG513 | **SEMESTER / ACADEMIC YEAR** |  Spring 2023-24 |
| **COURSE TITLE** |  Probabilistic Models |
| **CREDIT VALUE** |  (3, 0, 0) 3 |
| **LECTURER(S)** |  Asst. Prof. Dr. Sahand DANESHVAR |  sahand.daneshvar@emu.edu.tr  | IE-C109 |  +90 392 630 2773 |
| **COURSE TYPE** | Core Course |
| **PRE-REQUISITE(S)** | Consent of the instructor |
| **DURATION OFCOURSE** | 14 Weeks |
| **COURSE SCHEDULE** | Tuesday 10:30-13:20 IE-E201, |
| **COURSE WEB LINK** | http://staff.emu.edu.tr/sahanddaneshvar/en  |
| **COURSE DESCRIPTION** Axiomatic approach to probability; conditional probability; Random variable. Commonly used discrete and continuous distributions. Expectation of a random variable; jointly distributed random variables; Marginal and conditional distributions; independent random variables. Multinomial and multivariate normal distributions. Functions of random variables, moments, conditional expectation, m.g.f. and p.g.f., Markov inequality, Law of large numbers, Central Limit Theorem. Discrete-time Markov chains, Kolmogorov-Chapman equations, classification of states, steady-state probabilities. Applications from different areas. |
| **AIMS & OBJECTIVES**The main aims/objectives of this course are:* To lay a strong foundation of the basic concepts in probability theory and Markov Chains,
* To think probabilistically,
* To develop the need of probability models in real life problems,
* To improve application skills in probabilistic modelling,
* To highlight applications of probabilistic modelling in engineering and variety of other fields.

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| **GENERAL LEARNING OUTCOMES (COMPETENCES)**On successful completion of this course, all students will have developed **knowledge** and **understanding** of:* Axiomatic framework of probability and important concepts of random variables and expected values,
* Important useful discrete and continuous distributions and their moments/ generating functions,
* Jointly distributed random variables and distributions of functions of random variables,
* Conditional probability and conditional expectation,
* Law of large numbers and inequalities,
* Markov Chains & classification of states,
* Chapman–Kolmogorov equations,
* Steady-state probabilities & their computations,
* Applications of absorbing Markov chains.

 On successful completion of this course, all students will have developed **their skills in**:* Applications of conditioning as a powerful key tool of probability theory,
* Appreciation and applications of central limit theorem as a number one result of probability theory,
* Markov Chains as a powerful modelling tool,
* Probabilistic modelling and analysis of real-life problems in several areas,
* Development of probabilistic arguments,
* Using related software effectively.

On successful completion of this course, all students will have developed their appreciation of and respect for **values and attitudes** regarding the issues of: * Importance of probabilistic modelling and arguments,
* Recognition of random errors in real-life data,
* Appreciation of probabilistic approach design and analysis of real-life problems,
* Impact of modern computation techniques,
* Professional and ethical responsibility.
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| **GRADING CRITERIA****Exams:** All examinations and assignments will be based on the lectures and tutorials. Assignments will be to hone the problem skills of the students. Students will be encouraged to go through their answer scripts and clarify their omissions and mistakes, if any. Descriptions of the examinations are as follows:*Midterm Exam:* There will be one such examination covering all the teaching material up to the 8th week. This exam held on 01 April *2024 (10:30-12:20)* which is not flexible.*Final Exam:* The final examination will cover all the material studied throughout the semester, and has the same structure as the midterm examination. It will also be used to determine letter grades. Final exam held on 10 June *2024 (10:30-12:20)*. *Quizzes:* There will be two quizzes that will held on 11 March *2024 (11:30-12:20)* and 13 May *2024 (11:30-12:20)* respectively which are not felixible.*Assignments:* Six homeworks in the form of assignments will be given to assess students’ problem solving ability. The dead line for submission each of them is **one week** after it is presented on course web link. Late submissions will not be valued.Note: The voluntary paper presentation has (5%) bonus. Topics will be given by the instructor. |
| **LEARNING / TEACHING METHOD**Teaching will enable the students to understand the application of various statistical processes control methods. The function of teaching is to enable students to learn. Therefore students are required to read the chapters of the textbook before coming to class and solve the related homework questions after each lecture. The instructor will lecture in class by writing on the board and some lectures will be given as a MS power point presentation. Also the lectures will be supplemented by tutorial sessions. |
| **READING ASSIGNMENTS**Besides the textbook material, there will be some reading assignments, which will support the lectures. For any type of examination, students are also responsible from studying all assigned readings, even if they might not be discussed in class. |
| **METHOD OF ASSESSMENT**Although the student’s overall grade will be based on the general assessment of the instructor, the following percentages may give an idea about the relative importance of various assessment tools.  Homework 24 % Quizzes 16 % Mid-term Exam 25 % Final Exam 35 % TOTAL 100 pointsNote that the instructor reserves the right to modify these percentages in case he finds it necessary. Letter grade equivalents of numerical performances will be announced by the Registrar’s Office after the last day for the submission of letter grades. |
| **ATTENDANCE**1. Attendance is mandatory. Any student who has poor attendance and/or misses an examination without providing a valid excuse will be given **NG** grade.
2. Students missing just on Midterm Exam should provide a valid excuse within three days following the examination they missed. One make-up examination will be given at the end of the semester after the final examination period.
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| **TEXTBOOK/S**Students must refer the following textbooks:**Text Book**s: * *Ross, Sheldon M., introduction to Probability Models, 9th Ed., Academic Press, 2007.*

 Reference Books: * *Guttorp, P., Stochastic Modelling of Scientific Data, Chapmann & Hall, 1995*
* *Papoulis, Athannasios, Probability, Random Variables, and Stochastic Processes, 3rd Ed., McGraw-Hill, 1991.*
* *Taylor, H.M., & S. Karlin, An Introduction to Stochastic Processes, Academic Press, 1994.*
* *Yao, D., Stochastic Modelling and Analysis of Manufacturing Systems, Springer Verlag, 1994.*
* *S. Ross, A First Course in Probability, Prentice-Hall, 4th Ed., 1994.*

**CONTENT & SCHEDULE**The lecture topics within the semester are as in the following schedule although minor changes are possible:

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| **Week** | **Topics** |
| 1 | Introduction to probability theory |
| 2and 3 | Discrete and continuous random variables, functions of a random variable, expectation of a random variable, jointly distributed random variables |
| 4 | Moment Generating Functions, Limit Theorems, Stochastic processes |
| 5 | Conditional probability and conditional expectation |
| 6 | Applications of conditional probability and conditional expectation |
| 7 | Introduction to Markov chains |
| 8 | **Midterm Exam**  |
| 9 | Chapman-Kolmogorov Equations and Classification of states of Markov chains |
| 10 | Limiting probabilities and Mean First Passage Times |
| 11 | Absorbing Chains |
| 12 | Applications of Markov Chains |
| 13 | Poisson process & exponential distribution |
| 14 | Assorted applications |
| 15 | Student presentations |
| 16 | **Final Exam** |

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| **ACADEMIC HONESTY, PLAGIARISM & CHEATING**This is intentionally failing to give credit to sources used in writing regardless of whether they are published or unpublished. Plagiarism (which also includes any kind of cheating in exams) is a disciplinary offence and will be dealt with accordingly. According to university by laws cheating and plagiarism are serious offences punishable with disciplinary action ranging from simple failure from the exam or project/report, to more serious action (suspension from the university for up to one semester). Disciplinary action is written in student records and may appear in student transcripts. Any act not suitable for a university student will not be tolerated and may lead to formal disciplinary action. Example of this are: getting someone else to take the examinations for you, misrepresentation of your own answer sheet as another’s work, cheating, knowingly assisting other students to cheat, abusing the tolerance or breaking the discipline of the class. |

**PLEASE KEEP THIS COURSE OUTLINE FOR FUTURE REFERENCE AS IT CONTAINS IMPORTANT INFORMATION!!!**