**EASTERN MEDITERRANEAN UNIVERSITY**

**DEPARTMENT OF INDUSTRIAL ENGINEERING**

**IENG314/ MANE314 OPERATIONS RESEARCH II**

**COURSE OUTLINE**

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| **COURSE CODE** |  IENG314 | **COURSE LEVEL** |  Third Year |
| **COURSE TITLE** |  Operations Research II | **COURSE TYPE** |  **Department Core** |
| **CREDIT VALUE** |  (4, 1, 0) 4 | **ECTS Credit Value** |  6 |
| **PRE-REQUISITE(S)** |  MATH 322 | **CO-REQUISITE(S)** |  IENG313/MANE313  |
| **PREPARED BY** |  Assco. Prof. Dr. Sahand DANESHVAR  | **SEMESTER / ACADEMIC YEAR** | Spring 2023-24 |
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| **LECTURER(S)** |  Assoc. Prof. Dr. Sahand DAENSHVAR |  sahand.daneshvar@emu.edu.tr  |  IE-C109 |  +90 392 630 2773 |
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| **COURSE SCHEDULE** |  Monday 14:30-16:20 (IE-D102); Thursday 10:30-12:20 (IE-D203); Wednesday 14:30-16:20 (except 28 February (class)) (Lab1, (IE-E102));  Office Hour: Monday 13:30-14:20 |
| **COURSE WEB LINK** | <http://staff.emu.edu.tr/sahanddaneshvar/en> |
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| **CATALOG DESCRIPTION**This course introduces uncertainty, risk, and probabilistic approaches to Operations Research. Elementary mathematical models and topics to be covered in this course are : review of probability theory with illustrations from inventory; decision analysis; decision trees and Bayes rule; utility theory approach; Analytic Hierarchy Method; Markov chain models, Chapman-Kolmogorov equations, steady-state probabilities and their computation, and applications; Queuing Theory, M/M/c infinite and finite capacity queuing models and optimization, queuing networks; two-person, constant and non-constant sum games and their analysis and applications. |
| **COURSE OBJECTIVES**The main objectives of this course are:1. Modeling the decision making problems under uncertainty. (Student Outcomes (SO): 1,2,4,6)
2. Solving the problems under uncertainty (Maximin, Maximax, Minimum Regret and Expected Value criterions)(SO: 1,2,6)
3. Utility theory (SO: 1,2,6)
4. Solving the problems under uncertainty by utility function.(SO: 1,2,6)
5. Solving the problems under uncertainty using probability notions (Decision tree method). (SO: 1,6)
6. Applying the Analytic Hierarchy Process (AHP) for decision making. (SO: 1,2,4,6)
7. Markov Chain as a stochastic process. (SO: 1,2,6,)
8. Constructing the transition probability matrix and *n*-step transition probability matrix. (SO: 1,2,6)
9. Classification of the states in Markov Chain. (SO: 1,6)
10. Poisson Process as a stochastic process.(SO: 1,2,6,7)
11. Applying the arrival and service processes in Queuing Theory. (SO: 1,2,6)
12. Birth-Death process. (SO: 1,2,6,7)
13. Modeling constant and non-constant two- person games. (SO: 1,2,6)
14. Using Excel macro’s for solving real life problems and interpreting the results. (SO: 1,2)

Introducing the engineering solutions in global, economic, environmental, and societal contexts and preparing a report (by Department Council decision). (SO:4,7) |
| **COURSE LEARNING OUTCOMES** On successful completion of this course, students are expected to develop **knowledge** and **understanding** of:1. Probabilistic modelling of simple inventory models. (Course Objective (CO): 1,2,5,7,8,10,13)
2. Decision making under uncertainty. (CO: 1,2,3,4,5)
3. Utility theory approach to decision making. (CO: 3,4)
4. Use of decision tree as an optimization tool. (CO: 5)
5. Use of Analytic Hierarchy Method as a decision tool. (CO: 6)
6. Game theory models and their analysis. (CO: 13)
7. Markov chain models as a powerful tool. (CO: 7,8,9)
8. Poisson process models. (CO: 10)
9. Queuing models and optimization. (CO: 11,12)

 On successful completion of this course, students are expected to develop **their skills** in:1. Formulation of probabilistic and stochastic models arising in diverse real-life problems, (CO: 1-5,7-10)
2. Solving queuing theory, analytic hierarchy method, game theory and Markov chain models, (CO: 6-13)
3. Optimal decision making under uncertainty,(CO: 1-5)
4. Using related decision methods effectively,(CO: 2,4,5,6,11)
5. Using Poisson process as a powerful tool, (CO: 10,11)
6. Using MS Excel in numerical problem solving. (CO: 14)

On successful completion of this course, students are expected to develop their appreciation of and respect for **values and attitudes** regarding the issues of:1. Role of stochastic modeling in real-life situations, (CO: 7-12)
2. Impact of uncertainty in optimal decision making, (CO: 1-5)
3. The role of Poisson process & Markov Chains, (CO: 7,10)
4. Impact of computer technology in solving Industrial and Management Engineering problems. (CO: 14)
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| **CONTRIBUTION OF THE COURSE TO MEETING THE REQUIREMENTS OF CRITERION 5**Mathematics and Basic Sciences : - Credit Engineering Topics : 4 CreditsOthers : - Credits**RELATIONSHIP OF COURSE TO STUDENT OUTCOMES**

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| **Student Outcomes** | **Level of Contribution** |
| **No**  | **Moderate** | **High** |
| (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics | 🞏 | 🞏 | 🗹 |
| (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors | 🞏 |  |  |
| (3) an ability to communicate effectively with a range of audiences | 🗹 | 🞏 | 🞏 |
| (4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts | 🞏 | 🗹 | 🞏 |
| (5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives | 🗹 | 🞏 | 🞏 |
| (6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions | 🞏 | 🞏 | 🗹 |
| (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies | 🞏 | 🗹 | 🞏 |

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|  **GRADING CRITERIA****Exams:** All examinations will be based on lectures, tutorials, labs, assigned homeworks and presentations. To pass these exams students will need to study the material well in advance in order to understand the concepts, procedures and techniques. To discourage last minute cramming, the instructor and the assistants will not answer any questions from students on the day of an examination. Exam results will be announced on the notice boards as soon as the exam papers are evaluated. Descriptions of these examinations are as follows: *Quizzes:* There will be four quizzes that will held on: Quiz1: *Wednesday 06 March 2024*, at *14:30-16:20* Quiz2: *Thursday 21 March 2024*, at *10:30-12:20* Quiz3: *Thursday 02 April 2024,* at *10:30-12:20* Quiz4: *Wednesday 22 May 2024*, at *14:30-16:20* *Midterm Exam:* There will be one closed-book/closed-notes midterm examination that covers all the material up to the date of the examination. The midterm exam may consist of two sections: multiple choise questions and problems. It will be scheduled for a day in the designated mid-term exams week. *Final Exam:* The final examination will be a closed-book/closed-notes exam which will cover all the material studied throughout the semester and has the same structure as in the midterm examination. It will also be used to determine letter grades. Like the midterm exam, the final exam will be scheduled for a day in the designated final exams week.*Homeworks:* There will be four homeworks. Two homeworkes before and two homeworks after midterm will be given and the dead line for submission each of them is **one week** after it is presented on course web link.  *Lab Exams:* Two exams as Mid-term And Final Lab Exams will be taken for computing the grade achieved from Lab classes. The date of these exams will be announced by the assistant of the course.*Make-up Exam:*  **No make-up examination will be given to students who miss quizzes, and whose attendance is below 60%.** Make-up examination will only be offered to students who missed the **final, midterm and lab exams** and provided adequate documentations for the reason for their absence within five working days at the latest after the examination date. A student’s illness will only be accepted as a valid excuse if it is supported by a written report from the Health Centers. *Resit Exams:* The resit examination will cover all the material studied throughout the semester and has the same structure as in the midterm and final examinations. This exam will be scheduled for a day in the designated resit exams week.**Note:** The students need a calculator so they should bring their calculators to all lecture/tutorial/lab/exam hours. |
| **RELATIONSHIP WITH OTHER COURSES** It is a complementary course of all the previously taken departmental courses especially for Modelling and Optimization (IEN212) and Operations Research I (IENG313).  |
| **LEARNING / TEACHING METHOD**Teaching will be based on enabling the students to understand the concepts and procedures in each topic section and to be able to apply them. To do this the course will be organized into two modules: Lectures and Tutorials/Laboratory sessions. The students are required to study the related subjects of the week before coming to class. Sometimes four hours of class in a week will be used for lectures according to the perceived need. On the other hand, sometimes 2 hours of class in a week will be organized for lectures, 1 or 2 hours for Tutorials and/or Laboratory sessions.**Lectures:** In lectures the instructor will attempt to summarize and explain only selected important concepts and points as clearly as possible. To be familiar with the material presented in lectures and participate in class discussions, students are expected to read the material covered in the previous lectures prior to the class meeting. Students will then find the lectures more interesting, and will benefit from the discussion if they come well prepared.**Tutorials:** In addition to the regular lectures, there will be tutorial sessions conducted in the classroom by the assistants, according to the perceived need. In these hours the assistants will do extra example problems. Obviously, the best tutorials are those that meet the learning needs of students. The people who best understand your learning needs are you. Please contact the assistants regarding what you would like to see in the tutorials. Tutorial content will then be determined, and the tutorial date will be announced accordingly.**Laboratory Work:** Throughout the semester, there will be several laboratory sessions, which will be conducted by the assistants, to do various computer exercises that require the use of Word, Excel, together with general IE/OR Software available in the laboratory. Laboratory sessions will always be held in the Department’s PC Labs and their dates announced in advance. If you have any problem in these sessions please try to resolve your problem with the assistants first. **Office Hours:** The students’ timetables will be a base for determining appropriate time slots with zero clash (or minimum number of clashes) as much as possible. If students have difficulty in understanding any material after they have tried their best, they should consult their assistants and instructor during their office hours only. However, if you wish to meet the instructor outside of their office hours, please call him by phone or send an e-mail first to make an appointment. |
| **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. Lab Exams 16 %  Quizzes 16 % Homeworks 16 % Mid-term Exam 20 % Final Exam 32 % TOTAL 100 pointsFor the students who apply for Resit Exam, the grade of this exam will be replaced by Mid-term and Final Exams grades, in total grade computation. Note 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.**NG (Nil-grade):** **Conditions that lead to NG (Nil-grade):**1. Not completeing sufficient work that are included in the assessment of the course.
2. Not attending the **Final Exam** or its **Make-up Exam (Resit) without a valid excuse**.
3. Not attending the **Mid-term Exam** or its **Make-up Exam without a valid excuse**.
4. **Having an attendance to lectures/tutorials/labs less than 60%.**

**Objections:** Any form of document concerning work that is to be used by the instructor as the basis of grading will be shown to the student upon request, **within a week following the announcement of the grade**. The objection to any grade must be made to the assistants within that period. If, after an exam has been graded, you think an error was made in grading or you have questions about the grading of the material, please examine the exam solutions first, and then write your questions or comments on a separate sheet of paper and turn this paper to the assistants. |
| **ATTENDANCE AND NG GRADE**Attendance will be taken every Lecture/Tutorial/Lab session. Note that EMU regulations allow instructors to give a grade of **NG** (Nil Grade) to a student whose absenteeism is more than 40% of the Lecture/Tutorial/Lab hours and/or who do not complete sufficient work that are included in the assessment of the course. |
| **TEXTBOOK/S**Students must have the following textbook:* + - * Wayne L. Winston, Operations Research – Applications and Algorithms, Duxbury Press, 4th edition, 2004. ISBN 0-534-20971-8.

**Lecture Notes:** Students are expected to make their own notes. Lecture notes and/or overheads used in class will not be made available for copying. Nessecary other Materials presented in class taken from other than the textbook will be made available on the web page of the course (refer to <http://www.ie.emu.edu.tr> ).**INDICATIVE BASIC READING LIST*** J. K. Sharma, Operations Research – Theory and Applications, Macmillan India Ltd, 3th edition, 2007. ISBN-10 1403-93151-8 ISBN-13 978-1403-93151-1
* Frederick S. Hiller and G. L. Lieberman, Introduction to Operations Research, McGraw-Hill, 9th edition, 2009. ISBN 0072321695
* Hamdy A. Taha, Operations Research: An Introduction, Prentice Hall, 7th edition, 2003. ISBN 0-13-281172-3

**EXTENDED READING LIST**Note that aside from these books, EMU Library has quite a good collection of books on the intermediate and advanced levels in the related fields of industrial and management engineering discipline. |
| **TOPICS COVERED and COURSE SCHEDULE**

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| **WEEK** | **TOPICS** |
| 1 | Review of Probability Theory |
| 2 | Decision Making under Uncertainty |
| 3 | Utility Theory |
| 4 | Utility Function |
| 5 | Decision Trees |
| 6 | Decision Trees |
| 7 | Analytic Hierarchy Process (AHP) |
| 8-9 | Midterm Exam |
| 10 | Markov Chains |
| 11 | Markov Chains |
| 12 | Queuing Models  |
| 13 | Poisson Process |
| 14 | Berth and Death |
| 15 | Game Theory |
| 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!!!**