| Detailed Course Description - Course Plan Development and Updating Procedures/ Mathematics Department | QF01/0408-3.0E |
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| **Faculty** | **Faculty of Science and Information Technology** | Department | **Mathematics** |
| **Course number** | **0101376** | Course title | **Linear Programming & Game Theory** |
| **Number of credit hours** | **3** | Pre-requisite/co-requisite | **Linear Algebra (1) (0101221)** |

| **Brief course description** |
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| This course aims at introducing students into linear optimization theory and its applications. Students will learn how to model real world problems as linear programs, basic theory of Linear programming, simplex algorithm, two phase method, duality, dual simplex method, post optimality analysis, transportation and assignment problems, simple network models, linear integer programming, students will also learn basic game theory, 2-player games: minimax solutions; zero sum games; Nash equilibria. |

| **Course goals and learning outcomes** | |
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| **Goal 1** | **Introduce the student to the fundamental concepts in Linear Programming** |
| **Learning outcomes** | 1.1 State and describe the basic terminology and results concerning linear optimization and linear programming.<br>1.2 Students will know how to write a linear program in standard form.<br>1.3 Describe duality and its implications for the solutions of linear programs.<br>1.4 Use the simplex method to solve linear programs.<br>1.5 Describe duality and understand its importance in the solution of linear programs. |
| **Goal 2** | **Recognition of the numerous applications of linear programming.** |
| **Learning outcomes** | 2.1 Formulate real-world problems in mathematical terms.<br>2.2 Have the ability to apply linear programming techniques for solving and modeling some fundamental decision-making problems arising in the daily business life.<br>2.3 Know how to interpret the solutions in terms of the original problems.<br>2.4 Have a flavor of realistic applied problems from operations research such as the transportation and the assignment problems. |
| **Goal 3** | **Learn basic concepts in game theory** |
| **Learning outcomes** | 3.1 Understand the relation between linear programming and games.<br>3.2 Learn how to solve simple cooperative games. |

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| **Textbook** | An Introduction to Linear Programming and Game Theory, by Paul R. Thie & G. E. Keough, 3rd Ed., 2008. |
| **Supplementary references** | 1. Linear Programming, K.G. Murty, John Wiley.<br>2. Game Theory, by Maschler, M., E. Solan, & S. Zamir, Cambridge University Press, 2013.<br>3. Linear Programming, G. Hadley, Addison Wesley. |

| **Course timeline** |
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| Week | Number of hours | Course topics | Pages (textbook) |
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| 01 | 1<br>1<br>1 | **Introduction to Linear Programming**<br>The linear programming problem LPP, feasible solutions set, solving a two-dimensional problem by the use of a graphical method. | **Later** |
| 02 | 1<br>1<br>1 | Optimal solutions, unboundedness, transforming to standard form, geometry of linear programming. | |
| 03 | 1<br>1<br>1 | **The simplex method** Initialization, detecting optimality, entering and departing variables, canonical form, | |
| 04 | 1<br>1<br>1 | Initial BFS, improving current BFS, artificial variables, two phase method | |
| 05 | 1<br>1<br>1 | Unboundedness, degeneracy, fundamental theorem of linear programming | |
| 06 | 1<br>1<br>1 | **First Exam**<br><br>**Duality** Introduction to duality, formulation of dual LPP for different models. | |
| 07 | 1<br>1<br>1 | Duality theorems and their interpretations, Complementary slackness theorem, Farkas Lemma. | |
| 08 | 1<br>1<br>1 | Economic interpretation & applications of duality, the dual simplex method. | |
| 09 | 1<br>1<br>1 | **Post optimality analysis** the cases of change in the cost coefficients, the cases of addition and deletion of variables and constraints. | |
| 10 | 1<br>1<br>1 | **Special LPPs** the transportation programming problem, the assignment problems. | |
| 11 | 1<br>1<br>1 | **Second Exam**<br><br>Some network flow problems. | |
| 12 | 1<br>1<br>1 | **Game Theory** Introduction to game theory, some principles of decision making in game theory. | |

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| **13** | **1<br>1<br>1** | Non-cooperative and cooperative games, Matrix games, LPP and matrix game equivalence. | |
| **14** | **1<br>1<br>1** | Saddle points, mixed strategies, the fundamental theorem, computational techniques. | |
| **15** | **1<br>1<br>1** | Games people play, Two-Person Zero-Sum Games. | |
| **16** | **1<br>1<br>1** | **Final Exam 50%** | |

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| **Theoretical course evaluation methods and weight** | Participation = 10%<br>First exam 20%<br>Second exam 20%<br>Final exam 50% | **Practical (clinical) course evaluation methods** | Semester students' work = 50%<br>(Reports, research, quizzes, etc.)<br>Final exam = 50% |

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| **Approved by head of department** | Dr. Amjed Zraiqat | **Date of approval** | |

Extra information (to be updated every semester by corresponding faculty member)

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| **Name of teacher** | **Amal H. Al-Saket** | Office Number | **9114** |
| Phone number (extension) | **430** | Email | **amal_saket@zuj.edu.jo** |
| Office hours | | | |