Philadelphia University	PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE	**Approval date:**
Faculty of Science		**Issue:**
Department of Math		**Credit hours: 3**
Academic year 2021/2022	**Course Syllabus**	**Bachelor**

Course information

Course#	Course title	Prerequisite
250373	**Linear Programming**	**Linear Algebra 1 250241**

Course type	Class time	Room #
☐ University Requirement ☐ Faculty Requirement ☒ Major Requirement ☐ Elective ☒ Compulsory	ST 12:45-14:15	21009

Instructor Information

Name	Office No.	Phone No.	Office Hours	E-mail
Feras Awad	822	2132	ST 11:15–12:30 MW 09:45–11:00	fawad@philadelphia.edu.jo

Course Delivery Method

Course Delivery Method			
☒ **Physical**	☐ **Online**	☐ **Blended**	
Learning Model			
Precentage	**Synchronous**	**Asynchronous**	**Physical**
	0%	**0%**	**100%**

Course Description

What is a Linear Programming (LP) Problem? Modeling LP Problems. The Graphical Solution of Two-Variable LP Problems. The Idea of the Simplex Method. Converting an LP to Standard Form. Basic Feasible Solutions. The Simplex Algorithm. Representing the Simplex Tableau. Solving Minimization Problem. Artificial Starting Solution and the Big M-Method. Special Cases in the Simplex Method: Degeneracy, Alternative Optima, Unbounded Solutions, Nonexisting (or Infeasible) Solutions. Sensitivity Analysis. Finding the Dual of an LP. The Dual Theorem and its Consequences. Shadow Prices. Duality and Sensitivity Analysis. Complementary Slackness. The Dual-Simplex Method. As a supporting theme, the course will also emphasize the use of mathematical solvers such as LINGO, TORA, MATHEMATICA, and EXCEL.

Course Learning Outcomes

Number	Outcomes	Corresponding Program outcomes
Knowledge		
K1	Define and formulate linear programming problems and determine their limitations.	**K_p1, K_p3**
K2	Apply the simplex and the dual-simplex algorithms for solving linear programming problems.	**K_p3**
Skills		
S1	Use computer software like GeoGebra and TORA to solve problems graphically and analytically.	**S_p4**
S2	Ability to solve real-life mathematical problems.	**S_p3**
Competencies		
C1	Thinking reasonably and the ability to make decisions.	**C_p1**
C2	Work in a team to implement one of the tasks of the course.	**C_p2**

Learning Resources

Course textbook	Feras Awad (2018) Linear Programming (1st ed.). Instructor Lectures and Notes.
Supporting References	• Taha, H. (2018) Operations Research: An Introduction (10th ed.). Pearson. • Winston, W. (2004) Operations Research: Applications and Algorithms (4th ed.). Cengage.
Supporting websites	GeoGebra: https://www.geogebra.org/
Teaching Environment	☒**Classroom** ☐ **laboratory** ☐**Learning platform** ☐**Other**

Meetings and Subjects Timetable

Week	Topic	Learning Methods	Tasks	Learning Material
1	Explanation of the study plan for the course, and what is expected to be accomplished by the students.	Lecture		Course Syllabus
2	**Introduction to Linear Programming:** Operations Research. What is a Linear Programming (LP) Problem?	Lecture		Chapter 1
3	Modeling LP Problems.	Lecture	Homework	Chapter 1
4	Geometric Preliminaries and Solutions: Half-Spaces, Hyperplanes, and Convex Sets	Lecture		Chapter 1
5	The Graphical Solution of Two-Variable LP Problems. The Corner Point Theorem and its Proof. How to use GeoGebra?	Lecture	Computer Task	Chapter 1
6	**The Simplex Method:** The Idea of the Simplex Method. Converting an LP to Standard Form.	Lecture		Chapter 2

7	Basic Feasible Solutions. The Simplex Algorithm: Iterative Nature of the Simplex Method, Computational Details of the Simplex Algorithm, Representing the Simplex Tableau.	Lecture	Quiz	Chapter 2
8	Solving Minimization Problem. How to use TORA?	Lecture	Computer Task	Chapter 2
9	Artificial Starting Solution and the Big M-Method.	Lecture		Chapter 2
10	Special Cases in the Simplex Method: Degeneracy, Alternative Optima, Unbounded Solutions, Nonexisting (or Infeasible) Solutions.	Lecture		Chapter 2
11	Some Important Formulas.	Lecture	Midterm Exam	Chapter 3
12	Sensitivity Analysis. Finding the Dual of an LP.	Lecture		Chapter 3
13	The Dual Theorem and its Consequences.	Lecture	Homework	Chapter 3
14	Shadow Prices. Duality and Sensitivity Analysis.	Lecture		Chapter 3
15	Complementary Slackness. The Dual-Simplex Method.	Lecture	Quiz	Chapter 3
16	Final Exam			

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

Course Contributing to Learner Skill Development

Using Technology
• Use GeoGebra to solve linear programming problems graphically. • Use TORA to solve linear programming problems analytically by the simplex method and the dual-simplex method.
Communication Skills
• Choose a special case linear programming problem and present it to the students and explaining its solution method.
Application of Concepts Learnt
• Formulate a real-life situation using linear programming and completely solve it graphically (if possible) and analytically and make a sensitivity analysis of the model.

Assessment Methods and Grade Distribution

Assessment Methods	Grade Weight	Assessment Time (Week No.)	Link to Course Outcomes
Mid Term Exam	**30%**	**11**	**K1, K2**
Various Assessments *	**30%**	**Continuous**	**S1, S2, C1, C2**
Final Exam	**40%**	**16**	**K1, K2**
Total	**100%**		

* Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Alignment of Course Outcomes with Learning and Assessment Methods

Number	Learning Outcomes	Learning Method*	Assessment Method**
Knowledge			
K1	Define and formulate linear programming problems and determine their limitations.	Lecture	**Exam**
K2	Apply the simplex and the dual-simplex algorithms for solving linear programming problems.	Lecture	**Exam**
Skills			
S1	Use computer software like GeoGebra and TORA to solve problems graphically and analytically.	Case Study	**Computer Project**
S2	Ability to solve real-life mathematical problems.	Case Study	**Homework**
Competencies			
C1	Thinking reasonably and the ability to make decisions.	Discussion	**Quiz**
C2	Work in a team to implement one of the tasks of the course.	Case Study	**Group Project**

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

** Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Course Polices

Policy	Policy Requirements
Passing Grade	The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%).
Missing Exams	• Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment. • A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from an exam or assessment due date. • A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date.
Attendance	The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and seven lectures (S, T, T). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive excuse accepted by the dean of the college, then withdrawal grade will be recorded.
Academic Honesty	Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights.

Program Learning Outcomes to be Assessed in this Course

Number	Learning Outcome	Course Title	Assessment Method	Target Performance level
S_p3	Translating life situations into mathematical models	Linear Programming	Homework	100% of the students get 70% or more on the rubric

Description of Program Learning Outcome Assessment Method

Number	Detailed Description of Assessment
S_p3	The student is given a real-life problem, in the 6^{th} week, that is compatible with linear programming and formulates it into a mathematical model.

Assessment Rubric of the Program Learning Outcome

	Poor (1 pt.**)** Student is very confused and does not understand the topic, nor is able to clearly grasp how to apply it or when to use it.	**Fair (**2 pts**)** Student has a decent grasp of the process but makes some major mistakes.	**Good (**3 pts**)** Student is almost perfect in their understanding of the topic, with some minor confusion or mistakes.	**Excellent (**4 pts**)** Student understands the concept perfectly.
Define Variables Number of variables Clarity of the variables	Incorrect number of variables and no explanation of variables used.	Correct number of variables but it is not clear what variables stand for.	Correct number of variables. Complete sentences are not used but it is clear what variables stand for.	Correct number of variables including description of what variable represents in the problem with complete sentences.
Objective Function Clear and correct with justification	Objective function is totally wrong.	Objective function is not fully correct. Some of the variables or coefficients are incorrect	Objective function is correct without a clearly written justification.	Objective function is correct with a clearly written justification.
Constraints Clear and correct with justification	Includes inequalities for constraints with minor errors.	Includes correct inequalities for constraints with no justification.	Includes correct inequalities for constraints with some justification.	Includes correct inequalities for constraints with justification written.