QF01/0408-4.0E	Course Plan for Bachelor program - Study Plan Development and Updating Procedures/ Department of Mathematics

Study plan No.	**2021/2022**		**University Specialization**	**Bachelor of Mathematics**	
Course No.	**0101376**		**Course name**	**Linear Programming & Game Theory**	
Credit Hours	3		**Prerequisite/ Co-requisite**	**Linear Algebra (1)**	
Course type	☐ MANDATORY UNIVERSITY REQUIREMENT	☐ UNIVERSITY ELECTIVE REQUIREMENTS	☐ FACULTY MANDATORY REQUIREMENT	☐ Support course family requirements	✓ **Mandatory requirements** ☐ Elective requirements
Teaching style	☐ Full online learning		▪ **Blended learning**	☐ Traditional learning	
Teaching model	☐ 1 Synchronous: 1 asynchronous		▪ **1 face to face : 1 asynchronous**	☐ 2 Traditional	

Faculty member and study divisions' information (to be filled in each semester by the subject instructor)

Name	Academic rank	Office No.	Phone No.	E-mail	
Division number	**Time**	**Place**	**Number of students**	**Teaching style**	**Approved model**
1				Blended	

Brief description

Introducing the linear optimization theory and its applications, Modeling of 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, Basic game theory, 2-player games, Mini-max solutions, Zero sum games Nash equilibrium.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	1. An Introduction to Linear Programming and Game Theory, by Paul R. Thie & G. E. Keough, 3rd Ed., 2008.			
Supportive learning resources (Books, databases, periodicals, software, applications, others)	2. Linear Programming, K.G. Murty, John Wiley. 3. Game Theory, by Maschler, M., E. Solan, & S. Zamir, Cambridge University Press, 2013. 4. Linear Programming, G. Hadley, Addison Wesley.			
Supporting websites	https://www.springer.com/gp/book/9780387969312			
The physical environment for teaching	✓ Class room	☐ labs	✓ Virtual educational platform	☐ Others
Necessary equipment and software				
Supporting people with special needs				
For technical support				

Course learning outcomes (S= *Skills, C= Competences K= Knowledge,)*

No.	Course learning outcomes	The associated program learning output code
	Knowledge	
K1	Students will match how to write a linear program in standard form.	**MK 1**
K2	Recognition of the numerous applications of linear programming	**MK 2**
K3	Review basic concepts in game theory	**MK 2**
K4	Describe how to interpret the solutions in terms of the original problems.	**MK 3**
	Skills	
S1	Obtain the ability to apply linear programming techniques on solving and modeling some fundamental decision-making problems arising in the daily business life.	**MS3**
S2	Formulate real-world problems in mathematical terms.	**MS4**
S3	Produce a flavor of realistic applied problems from operations research such as the transportation and the assignment problems.	**MS4**
S4	Describe duality and its implications for the solutions of linear programs.	**MS4**
	Competences	
C1	Reaching the use of applied mathematics for solving real live problems	**MC1**
C2	Cooperate to work effectively in the group assignments.	**MC 1**

Mechanisms for direct evaluation of learning outcomes

Type of assessment / learning style	Fully electronic learning	Blended learning	Traditional Learning (Theory Learning)	Traditional Learning (Practical Learning)
Midterm exam	30%	**30%**	40%	30%
Participation / practical applications	0	**0**	10%	30%
Asynchronous interactive activities	30%	**20%**	0	0
Final exam	40%	**50%**	50%	40%

Schedule of simultaneous / face-to-face encounters and their topics

Week	Subject	learning style	Reference
1	Introduction to Linear Programming: The linear programming problem LPP, feasible solutions set, solving a two-dimensional problem by the use of a graphical method.	Lecture	Ref 1 (1-10)
2	Optimal solutions, unboundedness, transforming to standard form, geometry of linear programming.	Lecture	Ref 1 (11-38)
3	The simplex method: Initialization, detecting optimality, entering and departing variables, canonical form	Lecture	Ref 1 (57-90)
4	Initial BFS, improving current BFS, artificial variables, two phase method	Lecture	Ref 1 (91-110)

5	Unboundedness, degeneracy, fundamental theorem of linear programming	Lecture	Ref 1 (111-126)
6	Introduction to duality, formulation of dual LPP for different models	Lecture	Ref 1 (127-130)
7	Duality theorems and their interpretations, Complementary slackness theorem, Farkas Lemma.	Lecture	Ref 1 (131-157)
8	Economic interpretation & applications of duality, the dual simplex method.	Lecture	Ref 1 (158-190)
9	**Midterm Exam:** Post optimality analysis: the cases of change in the cost coefficients, the cases of addition and deletion of variables and constraints.	Lecture	Ref 1 (191-210)
10	Special LPPs: The transportation programming problem, the assignment problems.	Lecture	Ref 1 (211-230)
11	Some network flow problems.	Blended	Ref 1 (230-244)
12	Game Theory: Introduction to game theory, some principles of decision making in game theory.	Blended	Ref 1 (350-370)
13	Non-cooperative and cooperative games, Matrix games, LPP and matrix game quivalence.	Blended	Ref 1 (371-390)
14	Saddle points, mixed strategies, the fundamental theorem, computational techniques.	Blended	Ref 1 (400-421)
15	Games people play, Two-Person Zero-Sum Games.	Blended	Ref 1 (411-421)
16	**Final Exam**		

Schedule of asynchronous interactive activities (in the case of e-learning and blended learning)

Week	Task / activity	Reference	Expected results
1	Background	Ref 1	Self-reading and Discussion
2	Video 1 Solving exercises	Ref 1	Discussion in the class
3	Home work1: On the basics	Ref 1	Submit a pdf or word sheet
4	Quiz 1	Ref 1	Submitting on the E-learning
5	Assignment 1: On Matlab Operations	Ref 1	Talk
6	Video 2	Ref 1	Discussion in the class
7	Home work 2 On the subjects studied in weeks 4,5 and 6	Ref 1+Ref 3	Submit a pdf or word sheet
8	Assignment 2: On Plotting of functions	Ref 1+Ref 3	Submitted with the mid exam
9	Self-reading	Ref 2+Ref 3	Talk
10	Video3 Solving exercises	Ref 2+Ref 3	Discussion in the class
11	Home work 3: On the subjects studied after the Mid-Exam	Ref 2+Ref 3	Submit a pdf or word sheet
12	Self-reading	Ref 2+Ref 3	Talk
13	Quiz 2	Ref 2+Ref 3	Submitting on the E-learning
14	Presentation of the subject: Matlab for differential equations	Ref 4	Video presentation
15	Video 4 Revision of all the course	Ref 1-4	Self-reading and Discussion
16	**Final Exam**	-	-