Form: Course Syllabus	**Form Number**	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	02/11/2024
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	Number of Pages	07

1.	**Course Title**	**Mathematical Optimization**
2.	**Course Number**	0301371
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	Linear Algebra I (0301241)
5.	**Program Title**	B.Sc. in Mathematics
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Mathematics
9.	**Course Level**	Elective specialization requirement
10.	**Year of Study and Semester (s)**	3rd and 4th years, 1st and 2nd semesters
11.	**Other Department(s) Involved in Teaching the Course**	None
12.	**Main Learning Language**	English
13.	**Learning Types**	☑Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	☐Moodle ☑Microsoft Teams
15.	**Issuing Date**	02/11/2024
16.	**Revision Date**	02/11/2024

17. Course Coordinator:

Name: Prof. Baha Alzalg Contact hours: TBA

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18. Other Instructors:

Name: Contact hours:

Office number: Phone number:

Email:

19. Course Description:

Formulation of linear optimization problems, the graphical method, geometry of linear programming, the simplex method for linear optimization, duality in linear programming, integer programming formulation, the Gomory cutting-plane method, gradient methods for nonlinear optimization, the steepest descent method.

20. Program Student Outcomes (SO's):

SO1. Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline.

SO2. Formulate or design a system, process, procedure or program to meet desired needs.

SO4. Communicate effectively with a range of audiences in oral or written forms and exhibit ethical and professional values.

SO5. Reflect the impact of technical and/or scientific solutions in economic, environmental, and societal contexts.

SO7. Utilize research methods, critical and creative thinking skills to assess and analyze information) to solve problems properly, then draw valid reasoning and logical conclusions leading to true consequences.

SO8. Utilize techniques, skills, and modern scientific tools such as mathematical packages, statistical software, graphing calculators, and online resources necessary for professional practice.

21. Course Intended Learning Outcomes (CLO's):

Upon completion of the course, the student will be able to achieve the following intended learning outcomes.

CLO1. Apply appropriate theories, principles and concepts and select a reasoned argument relevant to mathematical optimization.

CLO2. Formulate real-life problems as linear and integer optimization models and apply the graphical method for solving two-dimensional problems.

CLO3. Learn about the geometry of linear programming and the duality in linear programming.

CLO4. Understand and apply the simplex method for solving linear optimization problems and the Gomory cutting-plane method for soling integer linear optimization problems.

CLO5. tudy and apply the steepest descent gradient method for solving nonlinear optimization problems.

CLO6. Plan and design practical activities using techniques, procedures and algorithms appropriate to solve linear and integer optimization problems.

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
CLO (1)	●	●				
CLO (2)		●	●			
CLO (3)	●	●		●		
CLO (4)		●	●	●	●	
CLO (5)		●	●		●	
CLO (6)		●	●		●	●

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SO's / Course CLO's	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)	SO (6)	SO (7)	SO (8)
CLO (1)	●							
CLO (2)	●				●			●
CLO (3)	●							
CLO (4)		●					●	●
CLO (5)	●	●						
CLO (6)		●		●			●	●

23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types Face to Face (FF) Blended (BL) Fully Online (FO)	Platform Used	Synchronous (S) Asynchronous (A)	Evaluation Methods	Learning Resources
1	1.1	Introduction and syllabus discussion	1	FF	Boards	S		Textbook
	1.2	General form for linear programming (LP) problems, definitions	1	FF	Boards	S		Textbook
2	2.1	LP formulation and examples	2	FF	Boards	S		Textbook
	2.2	LP formulation and examples	2	FF	Boards	S		Textbook
3	3.1	The graphical method for two-dimensional LP	2	FF	Boards	S		Textbook
	3.2	The graphical method and LP cases	2	FF	Boards	S		Textbook
4	4.1	Standard form LP	1	FF	Boards	S		Textbook
	4.2	Linear algebra: Review	1	FF	Boards	S		Textbook
5	5.1	Convexity and polyhedra	1	FF	Boards	S		Textbook
	5.2	Geometry of LP	3	FF	Boards	S		Textbook
6	6.1	Basic feasible solutions	3	FF	Boards	S		Textbook
	6.2	Simplex method for maximization	4	FF	Boards	S		Textbook
7	7.1	Simplex method for maximization	4	FF	Boards	S		Textbook
	7.2	The full tableau method	4	FF	Boards	S		Textbook
8	8.1	**Midterm Exam**		FF		S		
	8.2	Detecting the existence of alternative optimal solutions, detecting unboundedness	4	FF	Boards	S		Textbook
9	9.1	Simplex tableau for minimization	4	FF	Boards	S		Textbook

	9.2	Big-M method	4,6	FF	Boards	S		Textbook
10	10.1	Detecting infeasibility, dealing with anticycling	4	FF	Boards	S		Textbook
	10.2	Duality in LP	3	FF	Boards	S		Textbook
11	11.1	Duality theorems	3	FF	Boards	S		Textbook
	11.2	Dual optimal solution via primal simplex tableau	4	FF	Boards	S		Textbook
12	12.1	Integer LP formulation and examples	1,2	FF	Boards	S		Textbook
	12.2	The Gomory cutting-plane method	4,6	FF	Boards	S		Textbook
13	13.1	**Second exam**		FF	Boards	S		
	13.2	Introduction to nonlinear optimization	1,5	FF	Boards	S		Textbook
14	14.1	Nonlinear programming formulation and examples	5	FF	Boards	S		Textbook
	14.2	Introduction to gradient methods for nonlinear optimization	5	FF	Boards	S		Textbook
15	15.1	The steepest descent method	5	FF	Boards	S		Textbook
	15.2	The steepest descent method	5,6	FF	Boards	S		Textbook
16		**Final Exam**						

24. Evaluation Methods:

Opportunities to demonstrate achievement of the CLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLO/s Linked to the Evaluation activity	Period (Week)	Platform
Midterm exam	% 30	TBA	1-4	TBA	On Campus
Second exam	% 20	TBA	3,4,6	TBA	On Campus
Final exam	% 50	All topics	1-6	TBA	On Campus

25. Course Requirements:

Each student must have:

-Account on Microsoft Teams.

26. Course Policies:

A. Attendance policies: Attendance is absolutely essential to succeed in this course. You are expected to attend every class; please notify your instructor if you know you are going to be absent. All exams must be taken at the scheduled time. Exceptions will be made only in extreme circumstances, by prior arrangement with the instructor.

B. Absences from exams and submitting assignments on time: If a student is absent for more than 10% of lectures without an excuse of sickness or due to other insurmountable difficulty, then he/she shall be barred from the final examination also he/she will get a failing grade in this course.

C. Health and safety procedures: Medical certificates shall be given to the University Physician to be authorized by him. They should be presented to the Dean of the Faculty within two weeks of the student's ceasing to attend classes.

D. Honesty policy regarding cheating, plagiarism, misbehavior: Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on home works.

E. Grading policy: Test papers shall be returned to students after correction. His/her mark is considered final after a lapse of one week following their return.

F. Available university services that support achievement in the course: Math library, Computer lab.

27. References:

A- Required book(s), assigned reading and audio-visuals:

- Dimitris Bertsimas and John N. Tsitsiklis, *Introduction to Linear Optimization*. Athena Scientific.

B- Recommended books, materials, and media:

- Baha Alzalg, *Combinatorial and Algorithmic Mathematics: From Foundation to Optimization,* 1st edition, Wiley, 2024.
- Edwin K. Chong and Stanislaw H. Zak, *An Introduction to Optimization*. 4th edition, Wiley, 2013.
- Laurence A. Wolsey and George L. Nemhauser, *Integer and Combinatorial Optimization*, Wiley Series in Discrete Mathematics and Optimization.

28. Additional information:

Name of the Instructor or the Course Coordinator: **Prof. Baha Alzalg**	Signature: ……	Date: 02/11/2024
Name of the Head of Quality Assurance Committee/ Department of Mathematics: **Prof. Manal Ghanem**	Signature: ……	Date: ……
Name of the Head of Department: **Prof. Baha Alzalg**	Signature: ……	Date: ……
Name of the Head of Quality Assurance Committee/ School of Science: **Prof. Emad A. Abuosba**	Signature: ……	Date: ……
Name of the Dean or the Director: **Prof. Mahmoud I. Jaghoub**	Signature: ……	Date: ……