هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Optimization theory**
Course Code:	**2024111-3**
Program:	Bachelor in Mathematics
Department:	Mathematics and Statistics Department
College:	**Faculty of Sciences**
Institution:	**Taif University**
Version:	**1**
Last Revision Date:	**20/05/2023**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (3,0,0)					
2. Course type					
A.	☐University	☐College	☒ Department	☐ Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 7 / Third Year					
4. Course general Description:					
This course introduces students to the fundamentals of linear and nonlinear optimization theory and methods. Topics include unconstrained and constrained optimization, The course is divided into five main parts: linear programming (simplex method, duality theory, stativity analysis), unconstrained nonlinear programming (optimality conditions, descent algorithms and convergence theorems), constrained nonlinear programming (Lagrange multipliers, Karush-Kuhn-Tucker conditions,), Dynamic programming and an Integer programming. Students will also use MATLAB's optimization toolbox to obtain practical experience with the material.					
5. Pre-requirements for this course (if any):					
2022201-4 (Ordinary Differential Equations) **2022204-3 (Linear Algebra)**					
6. Co-requirements for this course (if any):					
None					
7. Course Main Objective(s):					
• **Introducing the concepts and importance of optimality theory.** • **Describing basic optimization models and methods for optimality theory.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**3Hr /Week**	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	NA
3.	**Field**	NA
4.	**Tutorial**	NA
5.	**Others (specify)**	NA
Total		**45**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Recognize the existence and uniqueness of solutions to a given optimization problem.	K1	• Lectures • Group discussions `	• Quizzes • Assignments
1.2	Memorize the rate of convergence and complexity requirements of various optimization algorithms.	K1	• Lectures • Group discussions	• Exams • Assignments
2.0	**Skills**			
2.1	Use various electronic resources, analytical and mathematical techniques for data analysis and problem solving.	S3	• Interactive classes • Group discussions	• Quizzes • Assignments
2.2	Design optimization algorithms on a computer	S4	• Lectures • Group discussions	• Exams • Quizzes
2.3	Develop performance of different optimization models and methods from both theoretical and numerical perspectives.	S4	• Lectures • Self-learning through the website	• Exams • Quizzes • Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively within groups and independently.	V1	• Interactive classes • Give students tasks of duties	• Assessment of design projects that have elements of

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
				interpersonal skills
3.2	Articulate ethical behavior associated with institutional Guidelines in classroom, and in Lab.	V3	• Lectures • Group discussions	• Exams • Quizzes

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to modeling, solving linear programming using graphical and simplex method.	3
2.	The simplex method.	3
3.	Duality and Sensitivity Analysis.	3
4.	Transportation Problems.	3
5.	Assignment Problems	3
6	**First Midterm exam**	3
7.	Network Optimization	3
8.	Nonlinear programming: Constrained optimization: theory of Lagrange, KKT condition.	3
9	**Second Midterm exam**	3
10.	Nonlinear programming: Convexity and optimization: Implications for Unconstrained and Constrained Optimization.	6
11.	Dynamic programming and Integer programming.	9
12	Multicriteria optimization, MATLAB or Tora optimization toolbox.	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	Continuous Evaluation	10 %
2.	Assignments, report	Continuous Evaluation	10 %
3.	Midterm 1 Exam	8-9	15%
4.	Midterm 2 Exam	12-13	15%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
5.	Final Exam	15-16	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	S. S. Rao, Engineering Optimization: Theory and Practice, 4th Edition, john willy, 2009. ISBN: 9780470183526
Supportive References	H. A. Taha, "Operations Research: An Introduction," 9th Edition, Pearson, 2011, ISBN-10: 013255593X ISBN-13: 978-0132555937
Electronic Materials	Lectures available in Blackboard
Other Learning Materials	**None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (projector, smart board, software)	Data show, Blackboard
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Program Leader	Direct & Indirect
Effectiveness of student's assessment	Faculty, Program Leader	Direct
Quality of learning resources	Students, Faculty	Indirect
The extent to which CLOs have been achieved	Faculty	Direct & Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Department Council
REFERENCE NO.	4
DATE	October 2023

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