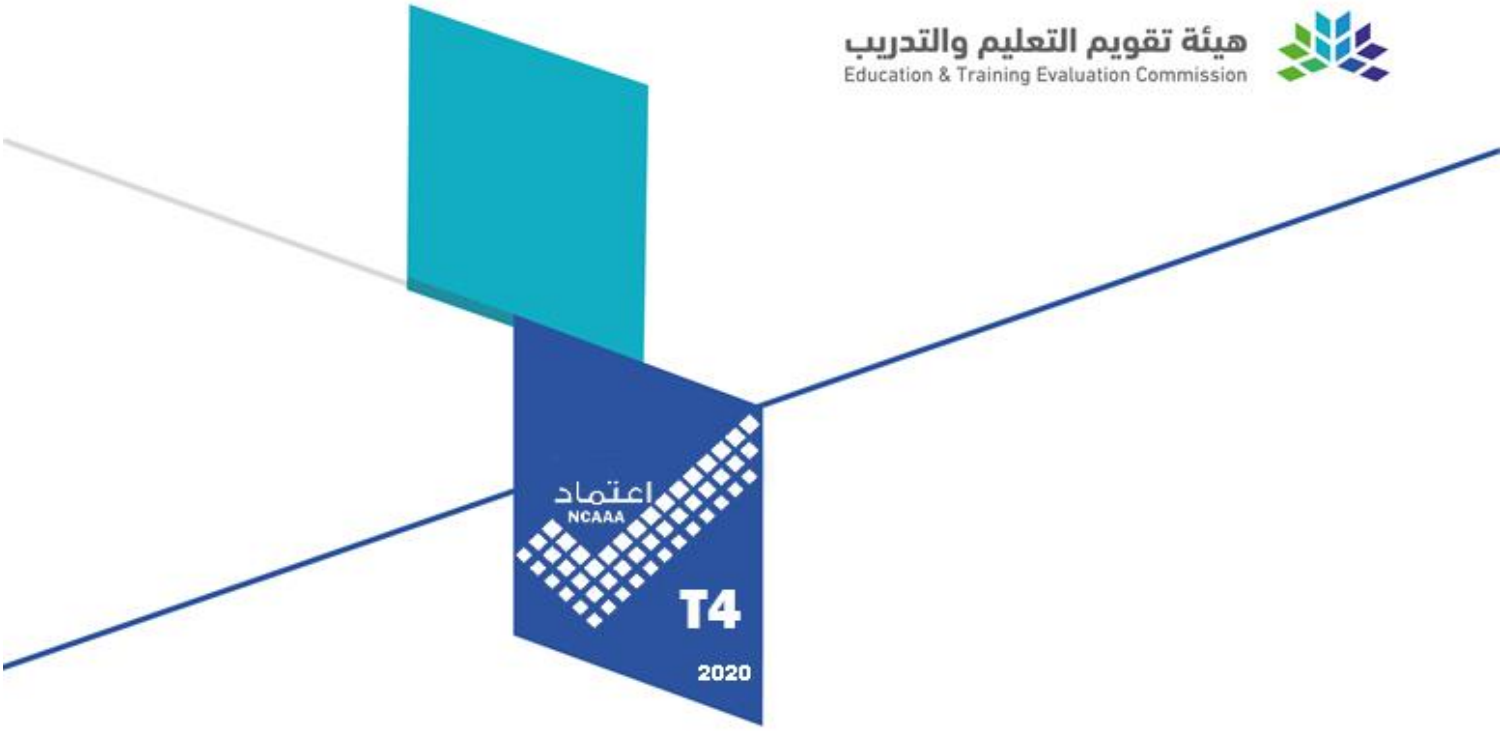
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Optimization technique**
Course Code:	**MTH 454**
Program:	**B. Sc in Mathematics**
Department:	**Mathematics Department**
College:	**College of Science**
Institution:	**College of Science**

Table of Contents

A. Course Identification

1. Credit hours: 3(2+1)
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☐ Elective ☑
3. Level/year at which this course is offered: Third Level/Second year
4. Pre-requisites for this course (if any)**: MTH 203 +MTH 352**
5. Co-requisites for this course (if any)**: N/A**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	30	67 %
2	**Blended**	0	0 %
3	**E-learning**	0	0 %
4	**Distance learning**	0	0 %
5	**Other**	15	33%

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	15
	Total	45

B. Course Objectives and Learning Outcomes

1. Course Description

This course covers the fundamental concepts in Optimization. So the topics to will be covered are:

-Basic concepts for optimality- Convex and concave functions- Quadratic Forms

- Optimality of unconstrained nonlinear functions in one or several variables- Hessian matrix

- Optimality of nonlinear functions with equality constraints- Direct substitution method- Lagrangian multipliers method

- Optimality of nonlinear functions with inequality constraints – Kuhn –Tucker conditions- Quadratic Programming

2. Course Main Objective

This course aims to give students the basic concepts of optimization and different ways to treat optimization restricted and unrestricted and the possibility of the practical application of these concepts such as:

- Recognizing the basic concepts of optimization functions convex and concave functions and the quadratic formulas.
- Solving the optimization of non-linear programming in one variable or multiple variables and how to use the Hessian matrix for it.
- Recognizing on methods for solving the optimization problem of non-linear programming with constrained equations (substitution direct method - Lagrange multiplier method)
- Recognizing the methods of solving optimization problem with inequality constraints
- Recognizing the Kuhn-Tucker and Fritz –John conditions for solving the optimization problem

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Recognizing the basic concepts of optimization functions convex and concave functions and the quadratic formulas.	K3
1.2	Recognizing on methods for solving the optimization problem of non-linear programming with constrained equations (substitution direct method - Lagrange multiplier method)	K3
1.3	Recognizing the methods of solving optimization problem with inequality constraints	K3
1.4	Recognizing the Kuhn-Tucker and Fritz –John conditions for solving the optimization problem	
2	**Skills :**	
2.1	The students will be able to analyze the general knowledge of optimality.	S3
2.2	The students will solve and interpret a general optimality problem by using different mathods.	S3
2.3	The students will be able to apply several techniques of solving the optimization of non-linear programming in one variable or multiple variables and how to use the Hessian matrix for it.	S3
2...		
3	**Values:**	
3.1	The students should be able to develop optimality problem solving skills that require basic linear programming with constrained equations.	C2
3.2	Solving optimization problem with inequality constraints	C2
3.3		
3...		

C. Course Content

No	List of Topics	Contact Hours
1	Basic concepts of optimization functions convex and concave functions and the quadratic formulas.	**8**
2	Quadratic formulas and Hessian matrix.	**8**
3	Methods for solving the optimization problem of non-linear programming with constrained equations (substitution direct method)	**8**
4	Methods for solving the optimization problem of non-linear programming with constrained equations (Lagrange multiplier method)	**8**
5	Optimization problem with inequality constraints	**8**
6	Kuhn-Tucker and Fritz –John conditions for solving the optimization problem	**5**
Total		**45**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	Having the knowledge of the convex and concave functions	• Lectures/Presentations • Media Lectures • Tutorials	• Homework • Quiz • Exam • Final Exams • E-exam • Oral Exam
1.2	Knowledge of quadratic formulas and Hessian matrix.	• Lectures/Presentations • Media Lectures • Tutorials	
2.0	**Skills**		
2.1	The students will be able to solve the optimization problem of non-linear programming with constrained equations.	• Lectures/Presentations • Media Lectures • Tutorials	• Homework • Quiz • Exam • Final Exam
2.2	The students will be able to solve problem of optimization problem with inequality constraints	• Lectures/Presentations • Media Lectures • Tutorials	• Homework • Quiz • Exam • Final Exam
2.3	The students will explain and interpret a general knowledge of the main technical tools of optimality problem.	• Lectures/Presentations • Media Lectures • Tutorials	• Homework • Quiz • Exam • Final Exam
3.0	**Values**		
3.1	Solving optimization problem with inequality constraints	• Lectures/Presentations • Media Lectures • Tutorials	• Homework • Quiz

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
			• Exam • Final Exam
3.2	Methods for solving the optimization problem of non-linear programming.	• Lectures/Presentations • Media Lectures • Tutorials	

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	7th week	20 %
2	Midterm 2	14th week	20 %
3	Homework	Through of semester	5 %
4	Quizzes	Through of semester	5 %
5	Electronic Test	13th week	5 %
6	Presentation	Through of semester	5%
7	Final exam	End of semester	40 %

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

Department of mathematics has "**Student Academic Advisory Committee**". This committee is responsible for students counseling and advising works in synchronization and collaboration with the Deanship of Admissions and Registration and Student Affairs. Department of mathematics Alzulfi has a continuous and standardized procedure that be associated with the student's progress until completion of degree and includes psychological, social and behavioral guidance. This advisory committee also maintain the student's files. The students with GPA below than 50 % in Mid 1 and Mid 2 are stayed under serious observation and continuous consultations with respective course instructor about their performing. The course teacher will commit to a minimum scheduled time for student consultation equivalent to **2 HOURS PER WEEK**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Nonlinear Programming: Theory and Algorithms, Mokhtar S. Bazaraa, John Wiley and Sons Ltd 10-0-471-48600-0 13:978-0471. • Introduction to the Theory of Nonlinear Optimization, Jahn, Johannes Springer 978-3-540-49379-2.

Essential References Materials	1. Introduction to the Theory of Nonlinear Optimization, Jahn, Johannes Springer 978-3-540-49379-2. •
Electronic Materials	https://www.khanacademy.org/math/multivariable-calculus/applications-of-multivariable-derivatives/constrained-optimization/a/lagrange-multipliers-single-constraint
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	- Classroom with capacity of 30-students. - Computer Lab of Mathematics Department
Technology Resources (AV, data show, Smart Board, software, etc.)	Mathematical software packages like MATHEMATICA
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	https://www.edx.org/learn/probability

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students/ internal committee	Direct (Students evaluation electronically organized by Deanship of registration and admission)/ Verification of students' papers
Extent of achievement of course learning outcomes	Staff members (Peer Reviewer)	Indirect (Frequent meetings consultation among the teaching staffs)
Quality of learning resources.	Staff members (course coordinators)	Direct (Meeting between course coordinators and the tutors)

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Mathematics Department

Reference No.	27
Date	8/8/1442 H -21/3/2021 G

Head of Department

Dr. Muqrin Almuqrin