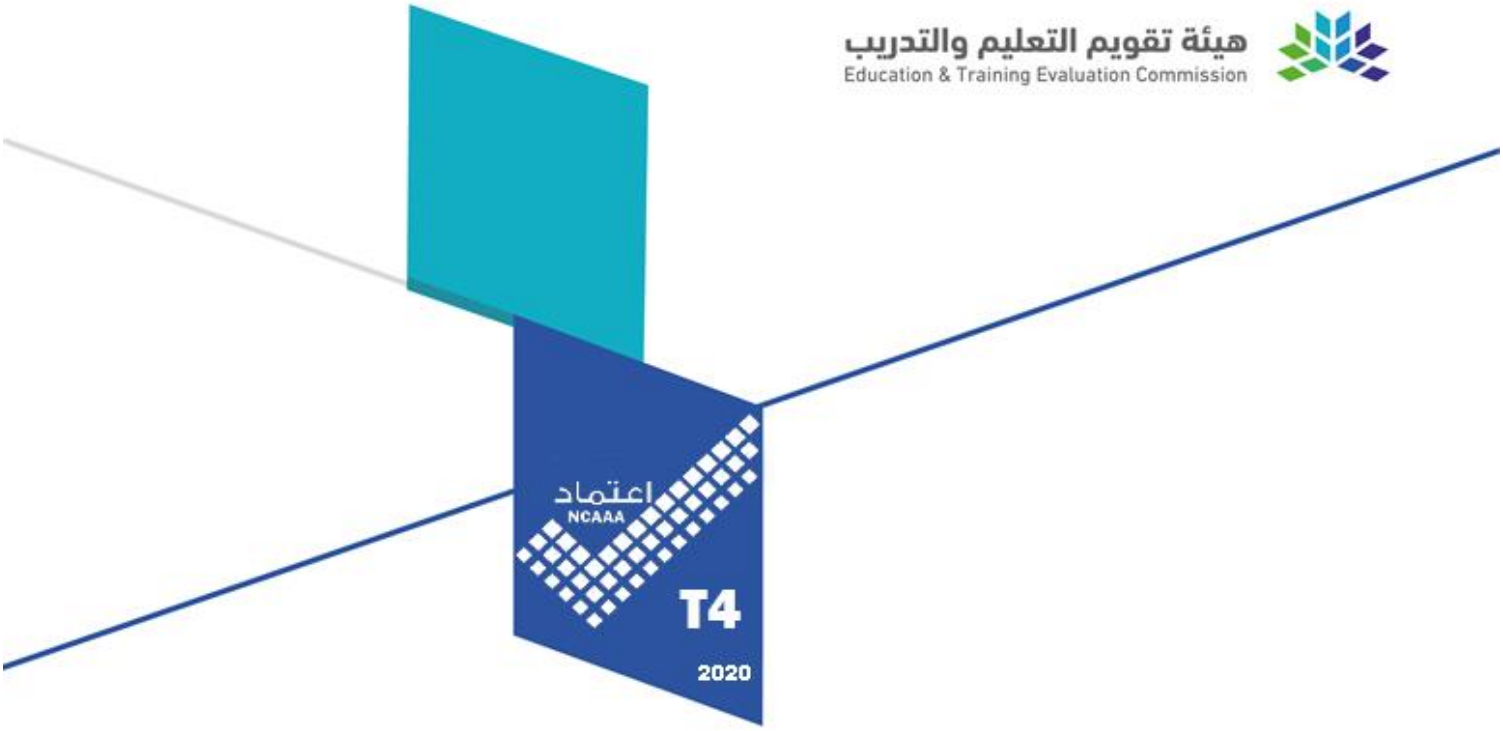
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	OPTIMIZATION
Course Code:	MATH 4530
Program:	BACHELOR OF SCIENCE IN MATHEMATICS
Department:	**Mathematics**
College:	College of Science and Humanities Al Kharj
Institution:	PRINCE SATTAM BIN ABDUALZIZ UNIVERSITY

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A. Course Identification

1. Credit hours: 4
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☐ Elective ☑
3. Level/year at which this course is offered: Elective
4. Pre-requisites for this course (if any)**:** **Math 3330, Math 3320**
5. Co-requisites for this course (if any)**:** **None**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	Weekly 04 hours	100
2	**Blended**		-
3	**E-learning**		
4	**Distance learning**		-
5	**Other**		-

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**48**
2	**Laboratory/Studio**	
3	**Tutorial**	**00**
4	**Others** (specify) – 5 office hours a week	**60**
	Total	**108**

B. Course Objectives and Learning Outcomes

1. Course Description

Linear Optimization – Introduction – The Geometry of Linear Optimization – The Simplex Method – Duality Theory I – Duality Theory II – Sensitivity Analysis – Robust Optimization – Large Scale Optimization – Network Flows – Network Optimization – Introduction and Applications – Network Optimization – The Network Simplex Algorithm – Discrete Optimization – Exact Methods for IP – Lagrangian Methods – Heuristic Methods – Dynamic Optimization – Dynamic Programming – Nonlinear Optimization – Applications of Nonlinear Optimization – Optimality Conditions and Gradient Methods for Unconstrained Optimization – Line Searches and Newton's Method – The Conjugate Gradient Algorithm Optimality Conditions for Constrained Optimization – The Affine Scaling Algorithm – Barrier Interior Point Algorithms – Semidefinite Optimization.

2. Course Main Objective

- The objective is to make the students gain knowledge about various Optimization techniques with constrained and unconstrained, linear and nonlinear optimization methods and their applications
- Students will be familiars with linear Optimization methods.

- For nonlinear optimization problems using Lagrange and KT condition will be used for the optimization problems.
- We will also use multivariable unconstrained optimization methods.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Acquire knowledge to develop algorithms for linear and nonlinear constrained and unconstrained problems using both direct and indirect search methods.	K1
1.2	Become familiar with the concept of Optimal control theory for constrained and unconstrained problems with higer number of variables.	K3
2	**Skills :**	
2.1	Develop models of linear programs for real world problems- i.e. converting physical problem into mathematical model	S2
2.2	Be able to solve practical problems of large scale LPP using various techniques such as simplex method, duality theories and unconstrained problems with higher number of variables.	S3
3	**Values:**	
3.1	Make interpretations	V2

C. Course Content

No	List of Topics	Contact Hours
1	Linear Optimization – Geometry of Linear Optimization	4
2	Simplex Method – Duality Theory I and II	6
3	Sensitivity Analysis – Robust Optimization	4
4	Large Scale Optimization – Network Optimization	3
5	Network Simplex Algorithm – Discrete Optimization	4
6	Solutions of IP – Lagrangian Method – Heuristic Method	4
7	Dynamic Programming – Non Linear Programming & Applications	6
8	Unconstrained Optimization-Optimality conditions and Gradient Method	4
9	Conjugate Gradient Algorithm	4
10	Constrained Optimization- The Affine Scaling Algorithm	3
11	Barrier Interior Point Algorithms	3
12	Semidefinite Optimization	3
...		
Total		48

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	Acquire knowledge to develop algorithms for linear and nonlinear constrained and unconstrained	1.Class Room Lectures 2. Interactive sessions	1. Two Internal Exams 2. At least two Quiz

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	problems using both direct and indirect search methods.	3. Exclusive Office Hours for clearing doubts in small groups	3. End Semester Exam
1.2	Become familiar with the concept of Optimal control theory for constrained and unconstrained problems with higer number of variables.		
2.0	**Skills**		
2.1	Develop models of linear programs for real world problems- i.e. converting physical problem into mathematical model	Application oriented exercises during tutorial session. Homework to improve the analytical skills	• Home works • Assignments Quizzes
2.2	Be able to solve practical problems of large scale LPP using various techniques such as simplex method, duality theories and unconstrained problems with higher number of variables.		
…			
3.0	**Values**		
3.1	Make Interpretations	Group Discussion during lectures and Interactive Session	Homework to be given so that the students discuss among themselves or refer materials from textbook to find solution

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Mid Term Exam I	**6**	**20%**
2	Quiz	**4 & 10**	**5%**
3	Mid Term Exam II	**13**	**20%**
4	Continuous Assessment – Homework, Assignment, Attendance etc.	**--**	**5%**
5	End Semester Exam (Practical 10%, Theory 40%)	**15**	**50%**

***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 :

1. Exclusive Office Hours – 5 Hours per week
2. Academic Advising for Students – Hour per week

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Bertsimas Dimitris and John Tsitsiklis, "Introduction to Linear Optimization", Belmont – MA: Athena Scientific Press, ISBN: 9781886529199. • A First Course in Optimization Theory by Rangarajan K. Sundaram (Jun 13, 1996) • Engineering Optimization: Theory and Practice by S. S. Rao (Jul 20, 2009)
Essential References Materials	NIL
Electronic Materials	Soft copies for study
Other Learning Materials	Online study links to help the students

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classrooms with Smart boards with seating facilities for at least 30 students
Technology Resources (AV, data show, Smart Board, software, etc.)	Smartboard, Internet Connection for Blackboard
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Library

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of Teaching	Students, Graduates	Course Evaluation and Program Evaluation Survey (Indirect)
	Program Leaders	Peer Review (Direct)
Achievement of CLOs	Faculty and Quality Personnel	Direct (Tests and Quiz) and Review of Course Report
Quality of Learning Resources	Students	Course Evaluation (Indirect)
	Graduates	Program Evaluation(Indirect)

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Facilities	Students / Graduates	Course and Program Evaluation (Indirect)
	Faculty	Faculty Survey (Indirect), Course Reports (Direct)

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	
Reference No.	
Date	