The University of Jordan

Department of Mathematics

Course Syllabus

Course Name:

Modern Convex Optimization

1	Course title	Modern Convex Optimization
2	Course number	0301972
3	Credit hours (theory, practical)	3
	Contact hours (theory, practical)	3
4	Prerequisites/corequisites	None
5	Program title	Ph.D. in Mathematics
6	Program code	
7	Awarding institution	The University of Jordan
8	Faculty	Science
9	Department	Mathematics
10	Level of course	Doctorate
11	Year of study and semester (s)	2017/2018
12	Final Qualification	Ph.D. in Mathematics
13	Other department (s) involved in teaching the course	
14	Language of Instruction	English
15	Date of production/revision	December 10, 2017

16. Course Coordinator:

Course coordinator: Dr. Baha Alzalg
Office number: Mathematics Building 306
Office hours: T.B.D.
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Course website: http://sites.ju.edu.jo/sites/Alzalg/Pages/972.aspx

17. Other instructors:

None.

18. Course Description:

Theory and algorithms for **constrained convex optimization** including optimality conditions, duality theory, applications, interior-point methods, penalty and barrier methods.

19. Course aims and outcomes:

A- Aims:
1. Develop a fundamental understanding of convex and conic optimization models.
2. Able to develop a convex optimization model from a problem description.
3. Provide a detailed treatment of the theory of convex optimization.
4. Learn interior-point algorithms solving for convex optimization.
5. Describe applications of convex optimization.

B- Intended Learning Outcomes (ILOs):
Successful completion of the course should lead to the following outcomes:

A. Knowledge and Understanding Skills: Student will be able to

A1) State the theories and concepts used in convex optimization.
A2) Identify the steps required to carry out a piece of research on a topic with in the field of convex optimization.
A3) Recognize the contribution and impacts of convex optimization in scientifically, economic and engineering terms.

B. Intellectual Analytical and Cognitive Skills: Student will be able to

B1) Apply appropriate theories, principles and concepts relevant to convex optimization.

B2) Assess the literature within convex optimization.

B3) Demonstrate a reasoned argument to the solution of problems relevant to convex optimization.

C. Subject- Specific Skills: Student will be able to
C1) Plan and design applications using techniques and procedures appropriate to convex optimization.
C2) Plan and design a piece of independent research using convex optimization algorithms.

D. Creativity /Transferable Key Skills/Evaluation: Student will be able to

D1) Deal with an appropriate effective data relevant to convex optimization.

D2) Solve problems relevant to convex optimization using ideas and techniques some of which are at the forefront of the discipline.

Teaching methods:

In order to succeed in this course, each student needs to be an active participant in learning – both in class and out of class.
- The instructor will spend most of the class time on presenting the new material as well as on discussing homework problems.
- Group work in this class is encouraged.
- To actively participate in class, you need to prepare by reading the textbook and to do all assigned problems before class. (Problems will be assigned each class period, then to be discussed the following period).
- You should be prepared to discuss your homework at each class meeting.
- You are encouraged to work together with other students and to ask questions and seek help from your professor, both in and out of class.
- Students are also encouraged to use graphing calculators extensively and to use computer software supplements.

20. Topic Outline and Schedule:

The following is a rough plan. As the course progresses, I may include new topics and/or delete some of the ones listed here.

Topic	Achieved ILOs	Weeks
Chapter 1. Introduction		1
Chapter 2 & 3. Convex sets and convex functions		1 & 2
Chapter 4. Convex optimization problems		3 & 4
Duality for linear optimization: An overview		5 & 6
Chapter 5. Duality for convex optimization		7 & 8
Interior-point algorithms for linear optimization: An overview The primal path-following algorithm & the primal-dual path following algorithm		9 & 10
Chapter 9. Unconstrained minimization		11 & 12
Chapter 10. Equality constrained minimization		13 & 14
Chapter 11. Interior-point algorithms for convex optimization		15 & 16

21. Teaching Methods and Assignments:

Development of ILOs is promoted through the following <u>teaching and learning methods</u>:

1. The instructor will spend most of the class time on presenting the new material as well as on discussing the new ideas and techniques with the students.
2. To actively participate in class, students need to prepare before class by reading the textbook and doing all assigned problems before class.
3. Students should be prepared to discuss their homework at each class meeting.
4. Students are encouraged to work together with other students and to ask questions and seek help from their professor, both in and out of class.

22. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following <u>assessment methods and requirements</u>:

ILO/s	Learning Methods	Evaluation Methods	Related ILO/s to the program
	Lectures	Exams and Assignments	To develop the necessary skills to do independent and original research

23. Course Policies:

1. 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.

2. 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.

3. 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.

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

5. Solutions for the exams will be posted at the teaching webpage of the instructor.

6. Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on home works.

24. Required equipment:

Data Show.

25. References:

 A-   Required book (s), assigned reading and audio-visuals:
       Stephen Boyd and Lieven Vandenberghe. *Convex Optimization*. Cambridge University Press

 B-   Recommended books, materials, and media:
       D. Bertsimas and J. Tsitsiklis. *Introduction to Linear Optimization*. Athena Scientific Series in Optimization and Neural Computation.
       Aharon Ben-Tal and Arkadi Nemirovski. *Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications.* MOS-SIAM Series on Optimization. ISBN: 978-0-89871-491-3
       Dimitri P. Bertsekas. *Convex Optimization Theory.* Athena Scientific. ISBN: 1-886529-31-0, 978-1-886529-31-1

26. Additional information:

NA

                                             Date: Decemebr 10, 2017

Name of Course Coordinator: Dr. Baha Alzalg.   Signature: --------------------------------

Head of curriculum committee/Dept.: Prof. Emad Abuosba.   Signature: --------------------------------

Head of Department: Dr. Baha Alzalg.   Signature: --------------------------------

Head of curriculum committee/Faculty: Prof. Amal Al-Aboudi. Signature: --------------------------------

Dean: Prof. Sami Mahmoud.   Signature: --------------------------------

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                                             Head of Department
                                             Assistant Dean for Quality Assurance
                                             Course File