School of Science | Department of Mathematics
Nonlinear Optimization | Course outline

Course code: 0301772
Course name: Nonlinear Optimization
Credit hours: 3
Prerequisite: None
Teaching Language: English

Instructor Name	Dr. Baha Alzalg
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Course description:

Theory and algorithms for **unconstrained nonlinear optimization** problems, including line search, trust region, conjugate gradient, Newton and quasi-Newton methods.

Course aims and outcomes:

A- Aims:

1. Develop a fundamental understanding of nonlinear unconstrained optimization.
2. Provide a detailed treatment of the theory of nonlinear unconstrained.
3. Learn Newton's methods solving for nonlinear unconstrained optimization.
4. Describe applications of nonlinear 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 nonlinear unconstrained optimization.

A2) Identify the steps required to carry out a piece of research on a topic with in the field of nonlinear unconstrained optimization.

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

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

B2) Assess the literature within nonlinear unconstrained optimization

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

C. Subject- Specific Skills: Student will be able to

C1) Plan and design applications using techniques and procedures appropriate to unconstrained optimization.

C2) Plan and design a piece of independent research using nonlinear optimization algorithms.

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

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

D2) Solve problems relevant to unconstrained programming 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.

Tests & evaluations:

Grades of this course will be calculated from two exams and a final exam. Grade distribution as follows:

Evaluation	Percentage	Time
Homework	20 %	---
Med-term Exam	40 %	After the first 8 weeks of classes
Final Exam	40 %	To be announced later

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	Week(s)
Chapter 1. Introduction	---
Chapter 2. Fundamentals of unconstrained optimization	---
Chapters 3-6. Algorithms for unconstrained minimization	----
Chapter 12. Theory of constrained optimization (provided that time allows)	----

Text book:

J. Nocedal and S. J. Wright. *Numerical Optimization*. Second Edition, Springer, 2006

References:

1. D. P. Bertsekas. *Nonlinear Programming*. Second Edition, Athena Scientific, Belmont, MA, 1999
2. Ruszczynski. *Nonlinear Optimization*. Princeton University Press, 2006
3. Stephen Boyd and Lieven Vandenberghe. *Convex Optimization*. Cambridge University Press

Important regulations:

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 questions and marks will be announced at the course webpage.
6. Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on homework.