مؤسسة قطر
Qatar Foundation

جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY

Course Syllabus

Course Information:			
Course Title:	Advanced Systems Optimization	**Course Code:**	CSE 507
Pre/Co-requisite(s):	CSE 507	**Credit Hours:**	3
Class Time:	Mondays 4:30-7:30pm	**Class Room:**	LAS Lecture Hall B
Instructor Information:			
Name:	Islam Safak Bayram	**Office:**	CP4 Room 9
E-mail:	ibayram@qf.org.qa	**Office Hours:**	Mondays 3:15-4:15pm, Thursdays 8:45-10:30am
Course Descriptions: (as in Catalog)			
This course aims to give students the tools and training to recognize and solve optimization problems related to scientific and engineering applications. It will cover theoretical, numerical and programming/algorithm foundations, with a focus on tools and modeling aspects that are useful for engineering applications. Students will complete hands-on exercises using high-level software such as IBM CPLEX, Microsoft Excel Solver, and MATLAB.			
Textbook(s):	Shu-Cheng Fang and Sarat Puthenpura, *Linear Optimization and Extensions*, First Edition, Wiley (ISBN: 978-0139152658)		
Other Reading Material(s):	(1)Dimitri Bertsekas and John Tsitsiklis, *Introduction to Linear Optimization,* Third Edition, Athena Scientific, ISBN-13: 978-1886529199 (2)Frederick Hillier, Introduction to Operations Research, 10th Edition, McGraw-Hill Education, 978-1259162985(3) Roy Kwon, *Introduction to Linear Optimization and Extensions with Matlab, ISBN-13: 978-1439862636, CRC Press*		
Course Objectives:			

- Students will understand and apply fundamental principles, generalizations, or theories of optimization methods
- Students will examine classifications, methods and terminology of linear programming
- Students explore potential real life applications for the theories they learn

Student Learning Outcomes: **Upon successful completion of this course, students should be able to:**	
SLO 1	Identify linearity and analyze real-life problems through the use of mathematical modeling techniques.
SLO 2	State and apply important results from set theory and geometry of optimization, with the ability to provide proof-based arguments of the related results
SLO 3	Analyze algorithms for optimization problems and evaluate their computational complexities.
SLO 4	Perform algebraic operations to solve small-scale optimization and develop basic coding techniques to solve large-scale problems with scientific computing tools.
SLO 5	Interpret the economical aspect of the optimization problems and perform sensitivity analysis.
SLO 6	Analyze and solve network optimization problems including the Max-Flow, the Min-Cost, and routing problems.
SLO 7	
SLO 8	

Weekly Schedule of Course Topics and Out of Class Assignments:

Week	**Topics**
Week 1	Introduction to Optimization, Reading Assignments on History of optimization, the role of optimization in business and science.
Week 2	Overview of linear algebra, matrix theory, linearity. In-class problem solving and homework assignment-1.
Week 3	Standard form of linear programming, modelling classical optimization problems. In-class problem solving. Homework assignment -2
Week 4	Geometry of linear programming. Hyperplanes, halfspaces, convex and affine sets. Solving problems with graphical method. Homework assignment-3

Week 5	Optimal solution set, extreme points, degeneracy/nondegeneracy, Resolution and Fundamental Theorem of Linear Programming with proofs. Homework assignment-4
Week 6	Introduction to Simplex method, tabular method. Solving problems with MATLAB, Microsoft Excel, IBM CPLEX. In-class problem solving. Software assignment-1
Week 7	In-class mid-term-1.
Week 8	Algebra of Simplex method. Iterations and checking for optimality, pivoting process. Two phase method. Homework assignment-5
Week 9	Big-M method, preventing cycling, revised simplex Method. Computation complexity. In-class problem solving. Homework assignment-6
Week 10	Dual linear program. Duality Theory. Karmarkar's form. Weak duality theorem, strong duality theorem. In-class problems. Homework assignment-7.
Week 11	In-class mid-term 2
Week 12	Sensitivity analysis, dual simplex method, Sherman-Morrison-Woodbury formula, Klee-Minty
Week 13	Network flow problems and applications.
Week 14	Integer programming formulations, cutting plane methods, dynamic programming, branch and bound
Week 15	Final Exam

Grading Plan and Assessments:	
Methods	**Weights**
Homework assignments	30%
2 Midterm and 1 Final	60%
Software assignments	10%

Program Outcomes:

Program Learning Outcomes (PLOs)

MS/PhD Sustainable Environment

Learning Outcomes – the graduate can

- Expertly apply knowledge and skills to multi-disciplinary aspects of environmental sustainability.
- Develop products/solutions for environmental sustainability providing economic, social and technological impact.
- Analyze, interpret, and communicate findings from a research project related to environmental sustainability to relevant audiences.
- Independently analyze complex environmental research problems, addressing multi-disciplinary facets.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes leadership, social consciousness, integrity and professionalism.

MS/PhD Sustainable Energy

Learning Outcomes – the graduate can

- Expertly apply knowledge and skills to multi-disciplinary aspects of energy efficient generation, storage, distribution as well as energy policy to address significant national and regional energy security and economic development issues.
- Develop technical products/solutions for efficient renewable energy production, transmission, and distribution with economic and social impact.
- Analyze, interpret, and communicate findings from a research project related to energy technology and policy to relevant audiences.
- Independently analyze complex energy-related research problems, crossing various disciplines.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

PhD in Computer Science and Engineering

Learning Outcomes – the graduate can

- Critically apply theories, methodologies and tools to address fundamental as well as applied research in computer science and engineering.
- Creatively solve research problems in the related discipline or for a multidisciplinary project by demonstrating intellectual/engineering work of significance.
- Analyze, interpret, and communicate findings from a research project to relevant audiences.
- Lead entrepreneurial efforts, thereby contributing to national strategies and goals.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

MS in Data Science and Engineering

Learning Outcomes – the graduate can

- Extract knowledge and insights from big data obtained from various sources.
- Design novel tools, methods and systems for big data collection, storage, processing and mining.
- Devise advanced and effective strategies and policies for business success.
- Analyze, interpret, and communicate findings from a research project to relevant audiences.
- Lead entrepreneurial efforts, thereby contributing to national strategies and goals.
- Collaborate with researchers/scientists and other professionals from industry and government, exhibiting the attributes of leadership, social consciousness, integrity and professionalism.

Correlation Matrix between the course and the PLOs

Courses	Program Outcome 1	Program Outcome 2	Program Outcome 3	Program Outcome 4	Program Outcome 5
SENR	x		x	x	
SENV	x		x	x	
CPEG	x	x	x		
DATA	x			x	

Course Policies

Grading Policy

University course work is measured in terms of quantity and quality. A credit normally represents one hour per week of lecture or recitation or not fewer than two hours per week of independent or laboratory work throughout a semester. The number of credits is a measure of quantity. The grade is a measure of quality. The university system for graduate course grading is as follows:

Letter Grade	Grade Points	Explanation of letter grades
A	4.00	Demonstrates a superior understanding of the subject matter
A-	3.67	Demonstrates exceptional understanding of the subject matter, a foundation of extensive knowledge, and a skillful use of concepts and/or materials.

B+	3.33	Demonstrates capacity to use the appropriate concepts, a good understanding of the subject matter, and an ability to handle the problems and materials encountered in the subject.
B	3.00	
B-	2.67	Demonstrates partial familiarity with the subject matter and some capacity to deal with relatively simple problems, but also demonstrating deficiencies serious enough to make it inadvisable to proceed further in the field without additional work. **Note**: No graduate student can graduate with a CGPA below 3.0.
C+	2.33	
C	2.00	
C-	1.67	
F	0.00	Means a student did not meet course requirements and must repeat the class.

Refer to the grading policy for more details.

Academic Integrity

The Honor Code is an integral part of university life. Students are responsible, therefore, for understanding the code's provisions. Cheating and attempted cheating, plagiarism, lying, and stealing of academic work and related materials constitute Honor Code violations. To maintain an academic community according to these standards, students and faculty must report all alleged violations.

HBKU expects its students to uphold high standards of academic integrity and conduct. In particular, students are required to:

- Attend classes regularly and punctually.
- Be actively involved in class discussions and other course related classroom activities.
- Complete assignments on time.
- Meet the requirements for course and program completion.
- Abide by high standards of academic integrity, ethics, and honesty.
- Refrain from cheating on homework and examinations, plagiarizing other people's work by submitting it as their own, or any other forms of academic dishonesty.
- Adhere to the published test or examination rules and regulations.
- Make every effort to maintain good academic standing.

Given the internet and easy access to information and knowledge sources, the University is committed to students' learning in an ethical manner. For all academic assignments, project work, and presentations, students need to ensure that due acknowledgement is given to the source of any information, which they incorporate in their work. The following are some examples of academic misconduct:

- Cheating/using unfair means in examinations.
- Significant paraphrasing in written academic work that is unacknowledged.
- Unacknowledged use of information or ideas.
- Citing sources which student has not read or referred to.
- Breaching the word limit of assignments and mentioning wrong word count.
- Plagiarism.

Plagiarism: Plagiarism is a serious academic offense. Plagiarism is the use of someone else's ideas, words, projects, artwork, phrasing, sentence structure or other work without properly acknowledging the ownership (source) of the property (item). Plagiarism is dishonest because it misrepresents the work of someone else as one's own. It is intellectual theft as it robs others of credit for their work. Plagiarism takes many forms including:

- Using someone else's words without putting those words in quotation marks and providing full information about their source, sufficient information so that another person could easily locate the words that are being quoted, whether it is in an article, a book, or on the web.
- Using unique, original ideas, phrases, sentences, paragraphs, or other materials, etc. from a single source or a variety of sources such as a text, journal, web page, electronic source, design, artwork, etc. in one's work without citing all sources. For a student found plagiarizing, the punishment will be a failing grade in the assignment without the right to redo the assignment up to a failing grade in the course.

Examples of Cheating: Acts of cheating include, but are not limited to:

1. Copying from another student's paper during an exam, or allowing or encouraging another student to copy from your paper during an exam.
2. Having someone else take your exam in your place, or taking an exam for someone else.
3. Obtaining unauthorized access to exams and accepting exams obtained by unauthorized access.

Examples of Plagiarism. Acts of plagiarism include, but are not limited to, the following:

1. Handing in as 'original', work prepared by someone else or preparing/completing someone else's work.
2. Copying from a book or other publication without citing sources.
3. Using the same work to satisfy the requirements of two or more courses (during the same or different terms).
4. Having someone else rewrite a rough draft or rewriting a rough draft that is not your own work.

Violations of plagiarism are subject to evaluation according to the criterion of "reasonable doubt". The student's right to appeal and the procedures to be followed in carrying out the appeal of the University's decision is clearly stated in the *Student Handbook*.

Any violations of the University's academic rules, regulations or directives are reported to the University and may result in disciplinary measures as outlined in the *Student Handbook*.

Please refer to the relevant section in the *Student Handbook* and ensure a clear understanding of the provisions of the University honor code and honor system in order to avoid infringement of the policy and attendant penalization.

Electronic Devices: Laptops in the classroom must be used for academic purposes only. Silence your mobile phones before class starts.

Classroom Etiquette: Everyone is expected to behave politely and considerately. You should respect each other and your teacher by arriving on time, not chatting with your seat mates while the teacher is talking, and not leaving the classroom once class starts. Leaving the classroom during class is especially disruptive and disturbing and should be done only for restroom emergencies.

Concerns about grades or other course matters: Students are responsible for their learning experiences. If you are concerned about a class matter, first discuss it with the instructor. If the matter is not resolved, the next step is to meet with the Program Coordinator. If you still have a concern, meet with the Dean. The matter is likely to be resolved before it reaches that point, but if it is not, then the following positions are next on the organization chart: the Associate Provost for Academic Affairs, and, finally, the Provost. Students who decide to "jump to the top" will be referred back to the appropriate next step.

Assignments: University policy is that assignments are due on the date assigned. Instructors may refuse to accept late assignments or lower the grade that would be otherwise given.

Attendance: Absences have a direct negative effect on your grade! In the event that you miss a class, you are responsible for the material covered in that class (announcements, handouts, assignments, etc.) and for preparation for the following class. It is your responsibility to find out what assignments were missed. It is important that you attend all classes. If you are ill or have a valid reason for your absence, you must supply an excuse to submit missed or late work without penalty. Excessive absences will be penalized with a grade reduction.