ISYE 3133 ENGINEERING OPTIMIZATION

Required

Credit: 3-0-3 in summer, 2-3-3 in spring and fall

Prepared Profs. Boland, Dey, Nemhauser, Summer 2018

Prerequisite(s): MATH 2603 or MATH 2602, ISYE 2027, CS 2316 or CS 1322 or equivalent.

Catalog Description:
Topics include mathematical modeling of engineering applications; network and graphical interpretations; linear, nonlinear, and integer programming; general solution strategies; and utilization of modeling languages and solvers for computer solution.

Course description:
This course provides an introduction to optimization methods used to solve decision-making problems that arise in industrial engineering, operations research, and other fields of engineering, business and management.

References
Introduction to Mathematical Programming by W. Winston and M. Venkataramann, 4th edition, Chapters 1 – 9, and part of Chapters 10, 12, 13 and 14.
The book is out of print, but students can buy or rent a used copy. The same material is in Chapters 1-9 of Operations Research: Algorithms and Applications by Winston. It is a larger and more expensive book.

Objective
The objective of this course is to introduce students to the modeling of constrained decision-making problems and optimization. This includes techniques of mathematical modeling, optimization, and sensitivity analysis, as well as the use of commercial software tools.

Participation
Attendance in recitation sessions: 5%
Participation in recitation sessions: 5%

Grading:
Quizzes: 3 – 5, 20 – 40%
Midterms: 1 or 2, 20 – 40%
Final: 25 – 40%

Assignment policy: Some assignments may be team tasks.

Regrade policy:

Return the regrade request within two weeks of obtaining graded item. Attach a note clearly stating your claim. Regrade will not take place on the spot nor will be considered face-to-face. The instructor keep the prerogative of performing a complete regrade of the item when you request the regrade of any of its parts. You can ask for a regrade every time you feel it is appropriate. Be aware that if the person who graded misunderstood your answer during the first grading, it was probably not clear. Explaining what you meant afterwards will not earn you any points.

Georgia Tech Honor Code and Student-Faculty Expectations
http://osi.gatech.edu/content/honor-code
http://www.catalog.gatech.edu/rules/22/

Topical Outline

Topics	Weeks
Intro to Operations Research and Optimization	1
Formulating Models: examples, applications and computer modeling languages	2
Linear Optimization: models, simplex algorithm, sensitivity analysis, duality	4
Network Optimization: spanning trees, shortest path, max flow, assignment and transportation problems	4
Discrete Optimization: brand-and-bound, cutting planes	3
Total	14

Outcomes and their relationships to ISyE Program Outcomes

At the end of this course, students will be able to:

1. Formulate deterministic mathematical programs in various practical systems
2. Understand basic optimization techniques
3. Be able to interpret the results of a model and present the insights (sensitivity, duality)
4. Know the limitations of different solution methodology
5. Use software to solve problems

Course outcome \ Program Outcomes	**1. identify, formulate solve engg prob by engg, sci & Math**	**2. produce solutions consider public health, safety, welfare, global, cultural, social, environ & economic**	**3 communicate with a range of audience**	**4 recognize ethical & professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.**	**5. effective on a team provide leadership, collaborative and inclusive envirn, plan tasks & meet objectives**	**6. develop and conduct experiment, analyze and interpret data & use engineering judgement to draw conclusions.**	**7. acquire and apply new knowledge using appropriate learning strategies**
1. Formulate det math programs in practical systems	H						
2. Understand basic optimization techniques	H						
3. Interpret result	H					H	
4. Know the limitations of solution method		M					
5. Use software to solve problems	H						

Evaluation of the important outcomes

Course outcomes 1, 2 based on direct questions on final exam, 3 and 5 will be assessed via large computer assignment.

The approximate relationship from prior ABET a – k to new ABET 1 – 7.

OLD Criterion 3. Student Outcomes The program must have documented student outcomes that prepare graduates to attain the program educational objectives. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.	NEW Criterion 3: Student Outcomes The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.
(a) an ability to apply knowledge of mathematics, science, & engineering (e) an ability to identify, formulate, and solve engineering problems	(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturable, & sustainable	(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(d) an ability to function on multidisciplinary teams	(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative & inclusive environment, establish goals, plan tasks, and meet objectives.
(f) an understanding of professional and ethical responsibility (h) the broad education necessary to understand the impact of engg solutions in a global, economic, environmental, & societal context (j) a knowledge of contemporary issues	(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
(g) An ability to communicate effectively.	(3) An ability to communicate effectively with a range of audiences.
(i) a recognition of the need for, and an ability to engage in life-long learning	(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Implied in 1, 2 and 6