FALL 2019
ENME610: Engineering Optimization

Objective:
To present an introduction to computational models and methods for single- and multi-objective engineering optimization problems which are time-invariant, with a focus on optimization models with *continuous* variables and smooth (differentiable) functions. The course topics include an overview of engineering optimization terminology, concepts, model construction, optimality conditions, model boundedness, and numerical optimization methods. The course also includes a semester-long group project.

References:
(*Required Textbook*:) Principles of Optimal Design, Papalambros & Wilde (**PW17**), 3rd Edition, 2017, Cambridge University Press (ISBN: 9781107132672).
(*Recommended Book*:) An Engineer's Guide to Matlab, Magrab et al. (**M11**), 3rd Edition, 2011, Prentice Hall (ISBN: 9780131991101).
(*Recommended Book*:) Introduction to Optimum Design, Arora (**A17**), 4th Edition, 2017, Academic Press (ISBN: 9780128008065). An online copy of this book is available through UMD Library!

Note: *There are some significant differences between the latest and earlier editions of the Required Textbook. Solution to Exercises will be from the 3rd edition of the textbook.*

Outline:
- Concepts, definitions and examples
- Model construction
- Optimality conditions: unconstrained and constrained problems
- Model boundedness (Monotonicity Analysis)
- Single-objective optimization: unconstrained/constrained linear/nonlinear methods
- Multi-objective optimization: concepts and methods
- Optimization with Matlab and Excel

Grading:
There will be two exams during the class period: Exam I (25%; ~75 minutes) which will cover the first half material, and Exam II (31%; ~90 minutes) which will cover the entire course material (comprehensive). There will be four quizzes (6% each). Each Quiz is to be held during the class period and expected to last about about 15-30 minutes. Also, there will a semester-long group project (25%). For the dates, see the table on the next page.

Exercises:
There will be no homework assignment in the course. However, I will post the solution to some exercises from the references.

Project:
Coursework will consist of a semester-long group project, details of which will be presented later. Each group will propose a problem from an engineering design optimization area which the group has sufficient familiarity and interests. Each group will formulate their project problem as an *optimal design problem*. The group then will apply the methods learned in the course to simplify, solve the project problem and report the findings. Midterm and final power point presentation are required, with presentation involvement by all group members. Also, there will be a written final (group) report for the project.

Policy:
In an attempt to be fair to the entire class, the following policy will be enforced. All assignments are due by the specified deadline: There will be a penalty for late submissions: 25% reduction of the grade

between 1 and 19 minutes late submission to Canvas; 75% grade reduction between 20 to 59 minutes late submission, and 100% reduction for submissions which are later for an hour or more. All exams/quizzes will be "open textbook" (for hard- or e-copy of the textbook). In addition, you may bring to Exam I or each quiz a single sheet of paper (8.5" X 11") with your notes written on both sides of the paper (in any font size -- you will be allowed to use a magnifier). You can bring up to 2 sheets of paper (8.5" X 11") to use in Exam II. Otherwise, the exam is closed for everything else! Note that 4% of all quizzes, exams, reports will be allocated based on neatness of submission.

If you miss the midterm exam or any quiz due to an "excused absence", i.e., one that follows the University guidelines, the percentage missed will be added to the final exam. Students with an excused absence must provide documentation in support of their absence to the instructor. While an absence from the class is discouraged, sometimes circumstances arise that require missing a class. In the event that you miss a class, it is your responsibility to contact someone in the class or TA or Dr. Azarm to determine the material that was missed. Please note that that the TA or Dr. Azarm can assist you in identifying the lecture material that you might miss, but a detailed synopsis of the missed lecture will not be given.

For your information, the University of Maryland (UMD), College Park, has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This code sets standards for academic integrity at UMD for all students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. Violation of the Code of Academic Integrity may lead to grade reduction, course withdrawal, dismissal (suspension or expulsion) from the University. For more information on the Code of Academic Integrity or Student Honor Council, please visit http://www.shc.umd.edu. To further exhibit your commitment to the Code of Academic Integrity please sign the Honor Pledge for all exams, quizzes and assignments: "I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."

Canvas:

I will use Canvas in the course. While I occasionally but not always might inform you of a new posting (e.g., solution to a quiz or an exam), it is your responsibility to review Canvas on a regular basis in case I post any new announcement, file, etc. It is also your responsibility to update your email address to ensure that you will receive my emails through Canvas. Finally, **PLEASE send me or TA your course related messages by way of Canvas. If you us a message using our regular email addresses, there is a good chance it might go to our spam folder and we might never see them!**

Instructor and Office Hours:

Professor Azarm, 2155 EGR; Tuesdays 2-3:15 PM, other times by appointment

Teaching Assistant (TA) and Office Hours:

Mr. Pattanun Chanpiwat, 3109 (TA Lounge); Tuesdays **12:00-2:00 PM**, other times by appointment

Timeline (as of August 25, 2019)

Date	**Topic**	**Assignment***
Aug 27	Course overview; math review	PW17: Chap 1; *A17: Chaps 1, 2, Appendix A*
Sep 3	Model construction; examples	Chapter 2
Sep 10	Project instructions; optimality conditions	PW17: Chap 4 (4.1, 4.2, 4.3, 4.4); Chap 5 (5.1, 5.2, 5.3, 5.4, 5.6, 5.7); *A17: Chaps 3 (except 3.2) and 4 (except 4.7)*
Sep 17	Optimality conditions	**Quiz #1**; Chap 4 (4.1, 4.2, 4.3, 4.4); Chap 5 (5.1, 5.2, 5.3, 5.6, 5.7); *A17: Chap 5 (except 5.5)*
Sep 24	Optimality conditions	Continue optimality conditions
Oct 1	Model boundedness	PW17: Chap 3
Oct 8	Midterm project proposal presentations	**Quiz #2; Project presentation slides due by 12 Noon to Canvas**
Oct 15	**Exam I (75 minutes)**; midterm project presentations	**Project peer evaluations due by 12 Noon to Canvas**
Oct 22	Matlab/Excel; unconstrained optimization	*M11: Chap 13*; *A17: Chaps 6 and 7;* PM17: Chap 4 (4.5, 4.6, 4.8); Chap 6 (6.1, 6.2, 6.3); *A17: Chaps 10 and 11*
Oct 29	Unconstrained optimization; penalty method; ALM	PM17: Chap 4 (4.5, 4.6, 4.7, 4.8); Chap 6 (6.1, 6.2, 6.3, 6.6)
Nov 5	ALM; multi-objective optimization (MOO)	**Quiz #3;** *A17: Chap 18 (except 18.3)*
Nov 12	Linear programming; constrained methods	PW17: Chap 5 (5.8); *A17: Chap 8 (except 8.7)*
Nov 19	Constrained methods	Select topics from PW17: Chap 5 (5.1, 5.5) and Chap 6 (6.4, 6.7, 6.8. 6.9); *A17: chaps 12 & 13 (e.g., 13.5)*
Nov 26	Final project presentations	**Quiz #4; Project presentation slides due by Noon to Canvas**
Dec 3 (Last class)	**Exam II (90 minutes)**; final project presentations	**Project written report due by 12 Noon to Canvas on December 7, 2019; project peer evaluations due to Canvas by 11:59 pm on December 7, 2019**

* PW17: Papalambros & Wilde, 2017 (textbook); *A17*: Arora, 2017 (recommended book); *M11*: Magrab et al., 2011 (recommended book)