ASEN 5519 – Topology Optimization
Spring 2018

Instructor: Kurt Maute
Office: ECAE 183
Phone: (303) 735-2103
e-mail: maute@colorado.edu
Office Hours: W/F 1:00-2:00 pm in ECAE 183

Lectures: T/Th: 12:30- 1:45 pm, ECCR 131.

Class Web Site: log on to https://learn.colorado.edu/ to find
ASEN5519 – Design Optimization.

Class e-mail list: This is automatically done through D2L.

Texts:

Topology Optimization

1. *Optimization of structural topology, shape, and material* by Martin P. Bendsøe and O. Sigmund (available online: https://link.springer.com/book/10.1007%2F978-3-662-05086-6)

2. Topology Optimization in Structural and Continuum Mechanics by Rozvany, George I. N., Lewiński, Tomasz Eds (available online: https://link.springer.com/book/10.1007%2F978-3-7091-1643-2)

General textbooks on design optimization (mostly in the context of solid mechanics):

1. *Introduction to Optimum Design* by J.S. Arora

2. *Structural Optimization : Fundamentals and Applications* by U. Kirsch

3. *Elements of Structural Optimization* by R.T. Haftka, Z. Gurdal

4. *Foundations of Structural Optimization : A Unified Approach* by A. J. Morris

5. *Introduction to Optimization of Structures* by N.V. Banichuk

6. *Numerical Optimization Techniques for Engineering Design* G.N. Vanderplaats

Useful books on special topics

3. *Parameter Sensitivity in Nonlinear Mechanics* by M. Kleiber, et al.

4. *Design Sensitivity Analysis of Structural Systems* by E.J. Haug, et al.

Course Objectives: Introduce the fundamentals of topology optimization of problems in solid and fluid mechanics and heat transfer with a focus on problems in aerospace engineering. Topics include PDE constrained optimization, nonlinear programming, sensitivity analysis, shape optimization.

Major Course Topics:

1. Introduction into Optimization

   (a) Overview and terminology
   (b) Formulation of optimization problems

2. Topology Optimization of Discrete Systems - I

   (a) Ground structure method
   (b) Review of finite element analysis of trusses
   (c) Global search Methods:
       a. Integer and mixed-integer problems
       b. Genetic Algorithms and Evolutionary Strategies
       c. Particle swarm methods
   (d) Multi-objective and min-max problems

3. Topology Optimization of Discrete Systems - II

   (a) Relaxation of Integer Problems
   (b) Parameter sensitivity analysis of truss systems
   (c) Nonlinear programming methods
   (d) Optimality criteria methods

4. Topology Optimization of Continuous Systems – Fundamentals

   (a) Maxwell and Michell Design Theories
   (b) Review of finite element analysis of continuous systems
       in solid and fluid mechanics and heat transfer
   (c) Parameter sensitivity analysis of continuous systems

5. Density Methods

   (a) Regularization methods and geometry control
   (b) Optimization with stress constraints
   (c) Optimization of heat transfer problems
   (d) Optimization of low problems

6. Level-Set Methods

   (a) Parametric level-set methods
   (b) Hamilton-Jacobi approach
   (c) Topological Derivatives

Grading Guideline:

Group work:	Projects – Group effort	50%
Individual:	1 Midterm Exam	20%
	Projects – Individual effort	30%
		_____
		100%

Note: We reserve the right to make minor changes to this distribution of weights based on variations in assignments.

Course Policies and Procedures:

1. The instructor reserves the right to reply to email questions only in business hours, i.e. Monday through Friday, 8:00 am – 5:00 pm. Emails received 24 hours or less before the exams are not guaranteed to be responded to.

2. The instructor reserves the right to make changes to the weekly course schedule based on occurring events that require different dispositions. The instructors will give sufficient advanced notice through announcements in class and posting on D2L. Changes to this syllabus and assignments may be announced at any time during class periods. The instructors will post the current syllabus and assignments on D2L. Both are dated in the footnote.

3. This course exclusively uses D2L to send out announcements, to provide comments to students daily on class activities, and to provide general information about course assignments. It is strongly recommended that all students setup their D2L account such that they receive automatically a notification about new postings and updates to the D2L course page.

4. Acceptable excuses, such as medical certification of an emergency, are required to make up any exam. Any other medical or academic-related absences need to be communicated and approved ahead of the expected absence.

5. If a student qualifies for accommodations because of a disability, the student is asked to submit an accommodation letter from Disability Services to the instructors in a timely manner so that the student's needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website (www.colorado.edu/disabilityservices/students). Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If a student has a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website and discuss your needs with your professor.

6. Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, students must let the instructors know of any such conflicts within the first two weeks of the semester so that reasonable arrangements can be worked out. See campus policy regarding religious observances for full details.

7. Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. The instructors will gladly honor requests to address the student by an alternate name or gender pronoun. Students are asked to advise the instructor of this preference early in the semester so that the instructors may make appropriate changes to the student's records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

8. The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

9. All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at the Honor Code Office website.