Overview
This course is aimed at teaching mechanical engineering modeling, technical analysis and technical design capabilities from a non-compartmentalized perspective. The course focuses on:

(i) modeling complex, multi-disciplinary mechanical engineering problems by identifying critical elements of a problem,
(ii) design and development of analysis tools using analytical and numerical techniques and,
(iii) developing optimized solutions/designs to problems/challenges.

Most engineering problems are open-ended and extend over multiple engineering sub-disciplines and sciences (e.g. heat transfer, materials and controls), may provide too much or too little information on the problem, and may have conflicting design constraints. Moreover, many engineering problems may be modeled and analyzed at different levels of complexity (ranging from first order approximations, such as the back-of-the-envelope calculations, to detailed numerical analysis) depending on the desired/optimum outcome or project constraints. Therefore, it is imperative that engineers have the ability to model and analyze engineering problems, predict the outcomes and efficiently develop/design an optimum solution utilizing a wide variety of tools.

Instructors
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Class Location
XXXXXXX
Monday 1:25pm to 3:20pm (Lecture)
Wednesday 1:25pm to 3:20pm (Lecture)

Course Materials
No required text book. See course website for weekly assignments.

Grading
Midterm exam on October 31st, 2011 (20%)
Quizzes and homework assignments (30%)
Case studies (50%)

Academic Integrity
The College of Science and Engineering expects the highest standards of honesty and integrity in the academic performance of its students. Any attempt by a student to present work that she or he has not prepared, or to pass an examination by improper means, is regarded by the faculty as a serious offense, which may result in immediate expulsion of the student. Aiding and
abetting a student in an act of dishonesty is also considered a serious offense. **Academic dishonesty in any portion of the course shall be grounds for a grade of F for the entire course.**

**Additional Notes**

Attendance is **not** mandatory, however you are very strongly encouraged to attend each and every class and have complete notes for the course. The course contains extensive material from multiple resources and it is your responsibility to obtain lecture notes from your peers if you happen to miss a class. Any objection to and grade should be made within 1 week of the grade assignment.

The University of Minnesota permits absences from class for participation in religious observances. Students who plan to miss exams **must:**
- Inform both instructors by e-mail of anticipated absences at the beginning of the semester (within the first 3 weeks).
- Meet with instructors ahead of time to reschedule any missed examinations and
- Obtain class notes from other students.

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact their instructors early in the semester to discuss their individual needs for accommodations.

**Course Outline**

1. **Application of Engineering Fundamentals to Design** (Weeks 1-5)

   The goal of this part of the course is to review the fundamental concepts covered in the main courses in the undergraduate curriculum (e.g. thermodynamics, heat transfer, fluid mechanics, controls, kinematics and strength of materials) from a unified perspective of engineering modeling, analysis and design while developing scaling and force analysis capabilities. The specific emphasis is to teach the students multi-layered engineering analysis capability while ensuring that every engineering undergraduate student has a working level knowledge of the information included in all fundamental courses in ME curriculum.

2. **Numerical Analysis/Solution Techniques** (Weeks 6-9)

   The main aim of this part of the course is to teach students numerical analysis techniques and solution algorithms. The students will be introduced to a wide range of numerical techniques (e.g. finite difference, finite element/volume), solution algorithms (e.g., Runge-Kutta, Gauss-Seidel) and solution software (e.g. Matlab and ANSYS). The specific emphasis is given to ensure that the students learn a variety of solution techniques and learn to select the most suitable tool (in terms of solution accuracy, time cost vs. monetary cost) specific to solve the problem/model they develop.

3. **Case Studies** (Weeks 10-14)

   The main aim of this part course is to ensure that the students utilize the modeling/design knowledge and analysis tools they learn in the first two parts of the course. A variety of carefully selected cases will be presented to students by faculty who are experts in the particular problem. Modeling and solution development will be conducted in a structured fashion during the lecture followed by individual analysis and solution development.