ME465 OPTIMAL DESIGN
FALL 2011
MWF 3:00 - 3:50
1234 Engineering Building

Instructor: Prof. A. Diaz
Office Hours: TBA & by appt
(make appointments through Lindsay Niesen
burnslin@egr.msu.edu)
2555 EB, 353-9861

Recommended Text: J. Arora, Introduction to Optimum Design 2nd Ed Elsevier 2004

Web Page: http://www.egr.msu.edu/~diaz/me465/


Prerequisite: ME471 or concurrently

Important skills required: Course will require extensive use of MATLAB programming language.

OUTLINE
1. Introduction to the Design Optimization Problem (Ch 1,2,3)
   - The process of systematic design of engineering systems
   - The optimal design problem: design variables, objective function, constraints.
   - Review of linear algebra concepts.
   - Graphical interpretation of the optimization process.
   - Using Matlab

2. Optimization Concepts (Ch 4,5)
   - Review of vector calculus: gradients, Hessians; Taylor expansions.
   - Optimality conditions for unconstrained problems.
   - Constrained problems: Kuhn Tucker conditions.
   - Engineering examples solved using optimality conditions.

3. Basic Optimization Algorithms (Ch 8, Notes, Matlab)
   - Descent directions and the basic search strategy.
   - The steepest descent algorithm.
   - Using the Matlab Optimization Toolbox.
   - Genetic algorithms
   - Response surface approximations

4. Structural Optimization (Ch. 14)

5. Case Studies and Projects (Notes, reading assignments)

Learning objectives
- Formulate a meaningful design optimization problem statement in terms of objectives, constraints and design variables
- Demonstrate optimality of a design by applying the KKT conditions
- Develop mathematical models of engineering systems in a form that is suitable for use in a mathematical optimization process
- Apply modern optimization software to optimize a mechanical system or component
- Write technical reports that clearly communicate the purpose, the process and the results of a design optimization study
- Decide what category of optimization algorithm to apply for a given optimization problem, given specifications of the objectives, constraints and design variables
- Perform several manual steps associated with basic optimization algorithms such as steepest descent
- Describe the basic assumptions and the process associated with non-classical optimization methods such as genetic algorithms.
- Calculate the least squares approximate response surface for a function given a set of function evaluations at prescribed points
GRADING:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>Quizzes (4)</td>
<td>40 %</td>
</tr>
<tr>
<td>P</td>
<td>Projects (3)</td>
<td>10% + 15% + 15%  40 %</td>
</tr>
<tr>
<td>F</td>
<td>Final Exam (Dec 12)</td>
<td>20 %</td>
</tr>
</tbody>
</table>

- Each item (Q, P, F) will be assigned a grade in the range [0.0 - 4.0]
- Exams or quizzes missed and projects turned in past their due date receive grade = 0.0
- Quizzes may be in-class or take home.
- Course grade = 0.40*Q + 0.40*P + 0.20*F rounded (up or down) to the nearest “university scale” grade in the set {0.0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0}
- Final Exam: Monday December 12 3:00-5:00 p.m Except as prescribed by university regulations, you MUST take the final exam at this time to receive a grade.

Missed quizzes: All quizzes must be taken when scheduled. There will be no make-up quizzes except in cases of documented emergency, medical excuse, university addressed absence, or (at most ONE) job interview. Documentation regarding absences due to medical excuse, university addressed absence, or job interview must be provided at least one week in advance. Make-up quizzes are given on the day immediately following the missed quiz. Other absences are not excused (e.g., family gatherings, vacations and other leisure trips, ME481 trips or other industry visits, extra-curricular activities, etc.)

PLAGIARISM: Department policy posted on [http://www.eegr.msu.edu/me/undergrad/forms](http://www.eegr.msu.edu/me/undergrad/forms) will be observed.