### DEPARTMENT: MECHANICAL ENGINEERING

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<tr>
<th>COURSE #: EML 4550, 3 credits</th>
<th>COURSE TITLE: Engineering Design Methods</th>
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<td><a href="http://www.eng.fsu.edu/~shih/eml4550/">http://www.eng.fsu.edu/~shih/eml4550/</a></td>
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<th>TYPE COURSE: Required</th>
<th>TERMS OFFERED: Fall</th>
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<th>CATALOG DESCRIPTION:</th>
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<td>This is a formal lecture component of the Mechanical Engineering ‘capstone’ Senior Design course project. The Course covers the product design cycle: from problem identification and need assessment, to specification, concept generation and selection, preliminary design, materials selection and final design. The design process is placed in context by presenting topics such as legal and ethical issues, product reliability and liability considerations, engineering statistics, engineering economics, and optimal design.</td>
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<th>PREREQUISITES: EML 3002C, 3004C</th>
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| COREQUISITES: None |

| AREA COORDINATOR: Dr. Cesar Luongo |
| RESPONSIBLE FACULTY: Dr. Cesar Luongo |

| INSTRUCTOR(S) OF RECORD: Dr. Chiang Shih |
| DATE OF PREPARATION: 8/1/2008 (Shih) |

| CLASS SCHEDULE: Twice weekly for 1 hr. and 15 min. |
| LABORATORY SCHEDULE: None |

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<th>TEXTBOOKS/REQUIRED MATERIAL:</th>
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**Required:**
- Title: Fundamentals of Engineering Design  
  Author: Barry Hyman, Prentice Hall  
  ISBN: 0-13-046712-x

**Recommended (Optional):**
- Title: Product Design and Development  
  Author: Ulrich & Eppinger  
  Publisher: McGraw-Hill  
  ISBN: 0-07-065811-0
- Title: Fundamentals of Engineering Design  
  Author: Barry Hyman  
  Publisher: Prentice Hall  
  ISBN: 0-13-531385-6
- Title: Engineering Design Process,  
  Author: Yousef Haik,  
  Publisher: Thomson-Brooks/Cole  

| SCIENCE/DESIGN (%): 30 / 70 |

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<th>CONTRIBUTION TO MEETING THE PROFESSIONAL COMPONENT:</th>
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<td>70% engineering design, culmination into a major design experience with all engineering standards and constraints</td>
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| 30% deals with science such as engineering economics and statistics with emphasis in design applications |

<p>| COURSE TOPICS: This is a one-semester course. The topics covered in this |</p>
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<th>ASSESSMENT TOOLS:</th>
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- Homework Problems |
course form the foundation of design knowledge needed to carry out the activities in the concurrent ‘Capstone’ Senior Design Project (EML 4551C and EML 4552C)

| 1. The Product Design Cycle | • Quizzes  
|                           | • Project Reports  
|                           | • Exams  
|   ● Need assessment/Problem formulation |  
|   ● Gathering information/Research |  
|   ● Concept generation and selection |  
|   ● Embodiment Design/Architecture/Design for X |  

2. Materials selection and manufacturing
   ● Materials selection
   ● Materials processing
   ● Manufacturability review and manufacturing efficiency (BDM)

3. Statistics and Reliability
   ● Engineering statistics
   ● Role of statistics in design
   ● Risk, reliability, and safety

4. Optimal design
   ● Optimization methods

5. Engineering economics
   ● Concepts of economics
   ● Economic decision-making
   ● Cost evaluation

6. Legal, ethical, and societal issues in design

**COURSE OBJECTIVES**

(numbers shown in brackets are links to department educational outcomes)

1. Introduce students to the formal product design cycle; including customer needs assessment, product specification, concept generation and selection, product architecture, detailed design, and prototyping and manufacturing. Serve as foundation for the students to be able to succeed in their capstone design experience (EML4551 and EML4552) [1, 3, 5]

2. To teach techniques to generate design concepts, and to present ways to classify and evaluate pros and cons (including functional analysis) so that the concept selection process leads to the best solution. [2, 3]

3. Discuss issues related to product architecture including considerations of design analysis, assembly, maintenance, and operation [1, 3]

4. Present a variety of standards and how they are generated and incorporated in the design process. Discuss ethics in the context of design and engineering practice. [6]

5. Incorporate acquired knowledge in materials characterization and properties and
tie it to the design activities, present a materials selection perspective. Present
the most common techniques to evaluate manufacturing and assembly
efficiency of a design (Boothroyd-Dewhurst method), and ways to improve
manufacturability of the product (DFMA). Teach basic statistical concepts and
how they apply to determination of tolerances in parts and finished products,
present traditional tolerancing techniques as well as more modern approaches
(e.g., Taguchi method). [10, 11]
6. Expose students to other applications of statistical analysis in design: system
availability and reliability. Teach basic concepts of reliability analysis, fault
tree analysis, and failure mode effects and cause analysis (FMECA) [11]
7. Introduction to optimization theory and its application to design. Linear
programming, dynamic programming, Lagrange multipliers, non-linear search
methods, etc. Introduction to decision theory (decision under uncertainty,
decision trees, etc.) [1]
8. Expose students to economic analysis in engineering, applications to product
design, project funding, and investment. Teach methodology to employ
compound interest and net present value analysis to evaluate design and
purchasing options. Application to life-cycle cost analysis. Present variations
and issues of economic analysis, such as different life expectancies, inflation
and escalating operational costs, etc.. Lease vs. but analysis, implications of the
macro-economy on project and product economic viability. [8] [10, 11]
9. Expose students to other applications of statistical analysis in design: system
availability and reliability. Teach basic concepts of reliability analysis, fault
tree analysis, and failure mode effects and cause analysis (FMECA) [11]
10. Introduction to optimization theory and its application to design. Linear
programming, dynamic programming, Lagrange multipliers, non-linear search
methods, etc. Introduction to decision theory (decision under uncertainty,
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and escalating operational costs, etc.. Lease vs. but analysis, implications of the
macro-economy on project and product economic viability. [8]

COURSE OUTCOMES*
(numbers shown in brackets are links to course objectives)
1. Ability to perceive the capstone design project in the context of product design
   cycle [1, 2]
2. Be able to apply engineering standards in the conduct of the capstone design
   project with full understanding of the ethical and legal ramifications of design
   decisions [4]
3. To conduct a manufacturability review for simple or moderately complex
   systems, calculate an assembly efficiency index. Be able to manufacture parts
   and assemble system or prototype for the product under consideration [3, 5]
4. To estimate system reliability from individual component reliability data [6]
5. Able to identify design trade-offs and determine optimization technique or
decision rule to determine the best option [7]
6. Able to conduct economic analyses in support of design or purchase decisions
   (e.g., lease-buy, life-cycle cost analysis, etc.) [8]