Engineering Innovation & Design

Learn to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact. This project based course gives students the ability to understand, contextualize, and analyze engineering designs and systems. By learning and applying design thinking, students will more effectively solve problems in any domain. Lectures focus on teaching a tested, iterative design process as well as techniques to sharpen creative analysis. Guest lectures from all disciplines illustrate different approaches to design thinking. This course develops students' skills to conceive, organize, lead, implement, and evaluate successful projects in any engineering discipline. Additionally, students learn how to give compelling in-person presentations. Open to all majors, all years.
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<thead>
<tr>
<th>Design Research Techniques</th>
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What students take away from the class

- Ability to communicate with high impact
- Ability to recognize and solve user needs
- Ability to critique designs effectively
- Ability to understand what makes great products, great
- Ability to improve the effectiveness of a team
- Ability to use the tools of their profession to create and implement new products
- Techniques for building a strong useful network
- Ability to create insanely great designs (...at least sometimes)
- Ability to see the world through the eyes of a designer: design is everywhere
- Techniques used in creating a successful start-up & effective intrapreneurship
Evolve Your Thinking
About you

- Majors
- Year
- Things you enjoy
How the Class Works
Grading

- Pop quizzes 10%
- Homework 25%
- Projects 55%
  - Individual 25% of total grade
  - Group 30% of total grade
- Attendance, Participation 10%
Pop Quizzes

- Covers important class material
- Covers readings, lectures, case studies
- Not a way to take attendance
Projects

- You choose the topic / “customer”
  - Individual project: fixed technology platform
  - Group project: flexible technology platform

- Grading
  - Design
    Does it work? Functional implementation: 30%
    How well does it work? Interface design: 40%
  - Deliverable 20%
  - Presentation 10%
In Class

- Lecture
- Interactive exercises (lots)
- Videos
- Guest lectures
  - MIT Professors
  - Restauranteur
  - Product Manager
- Time to work together in groups, time for reviewing homework and providing feedback
Class Conduct

- Ask questions: clarify & over communicate
- Running late? Need to miss a class? SMS/ Email / Call
- Professionalism counts
- Laptops...
About the Instructors
Who we are

- Instructors
  - Blade Kotelly
  - Joel Schindall
# Principles of Design (1 - 10)

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
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<th>8</th>
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</thead>
<tbody>
<tr>
<td>Assigned</td>
<td>Good and Bad Design</td>
<td>Design a Game</td>
<td>Stakeholder analysis for games</td>
<td>Articulating Design HW</td>
<td>2 Subject Usability Test</td>
<td>Complete in-class assignment</td>
<td>K-Scripts</td>
<td>K-Scripts 2</td>
<td>Make a Commercial</td>
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<tr>
<td>Due</td>
<td>Good and Bad Design Movie</td>
<td>Game + SHA</td>
<td>Articulating Design HW</td>
<td>2 Subject Usability Test</td>
<td>In-class assignment (7), Transcription assignment</td>
<td>K-Scripts</td>
<td>K-Scripts 2</td>
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## Design Is Everywhere (11-18)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Activity</th>
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<tr>
<td>11</td>
<td>M Oct 15</td>
<td>Make a commercial</td>
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<td>W Oct 17</td>
<td>Down-Selected Ideas</td>
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<tr>
<td>12</td>
<td>M Oct 22</td>
<td>Project Management</td>
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<td>W Oct 24</td>
<td>Sanjay Sarma Guest Lecture</td>
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<td>13</td>
<td>M Oct 29</td>
<td>Presentation Skills</td>
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<td>W Halloween</td>
<td>Group Project Success</td>
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<td>14</td>
<td>W</td>
<td>Innovation &amp; Ethics Build a Company</td>
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<td>15</td>
<td>M Nov 5</td>
<td>Individual Presentations</td>
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<td>16</td>
<td>W Nov 7</td>
<td>Individual Presentations</td>
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**Additional Activities:**
- Creativity
- Start Group Projects/Assign Groups
- Individual Presentations
- Usability test 1 for IP on functional system
- Individual Presentations, UT 2 for IP
- Individual Presentations
- Read Selection from High-Velocity Edge

*Wednesday, September 5, 12*
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<td>Guest Lecture (Harker)</td>
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<td>Guest Lecture/Work-Class</td>
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<td>Guest Lecture (Helfrich)</td>
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<td>Guest Lecture/Work-Class</td>
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**Down-Selected Ideas/Reading**
- Project Management Plan, K-Scripts
- Detailed Design Document
- Usability test 1 for GP
- Usability test 2 for GP/Preso.
- Presos

**Wednesday, September 5, 12**
An Introduction to the Gordon Engineering Leadership Program and Engineering Innovation & Design

1. What is the Gordon Engineering Leadership Program?
2. Why does engineering leadership matter?
3. What is Engineering Innovation & Design?
Necessary but Not Sufficient
Capabilities of Effective Engineering Leaders

The Attitudes of Leadership - Core
Personal Values and Character:
- Initiative
- Decision Making in the Face of Uncertainty
- Responsibility, Urgency and Will to Deliver
- Resourcefulness, Flexibility and Change
- Ethical Action, Integrity and Courage
- Trust and Loyalty
- Equity and Diversity
- Vision and Intention in Life
- Self-Awareness and Self-Improvement

Making Sense of Context:
- Awareness of the Societal and Natural Context
- Awareness of the Needs of the Customer or Beneficiary
- Enterprise Awareness
- Appreciating New Technology
- Systems Thinking

Visioning:
- Identifying the Issue, Problem or Paradox
- Thinking Creatively, and Imagining and
- Communicating Possibilities
- Defining the Solution
- Creating the Solution Concept

Relating:
- Inquiring and Dialoging
- Negotiation, Compromise and Conflict
- Resolution
- Advocacy
- Diverse Connections and Grouping
- Interpersonal Skills
- Structured Communications

Delivering on the Vision:
- Building and Leading an Organization and Extended
- Organization
- Planning and Managing a Project to Completion
- Exercising Project/Solution Judgment and Critical
- Reasoning
- Innovation
- Implementation and Operation
Terminology

Engineering

The application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems. [American Heritage Dictionary of the English Language, Fourth Edition]

Innovation

“The term innovation means a new way of doing something. It may refer to incremental, radical, and revolutionary changes in thinking, products, processes, or organizations. .... The goal of innovation is positive change, to make someone or something better.” [Wikipedia]

Design

“’To design’ refers to the process of originating and developing a plan for a product, structure, system, or component with intention. [Wikipedia]
Engineer

From Wikipedia, the free encyclopedia

An engineer is a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics and ingenuity to develop solutions for technical, social and economic problems. Engineers design materials, structures and systems while considering the limitations imposed by practicality, safety and cost. The word engineer is derived from the Latin roots *ingeniare* ("to contrive, devise") and *ingenium* ("cleverness").

Engineers are grounded in applied sciences, and their work in research and development is distinct from the basic research focus of scientists. The work of engineers forms the link between scientific discoveries and their subsequent applications to human needs and quality of life.

*Conference of Engineers at the Menai Straits Preparatory to Floating one of the Tubes of the Britannia Bridge*, by John Seymour Lucas, 1868

<table>
<thead>
<tr>
<th>Occupation Names</th>
<th>Engineer</th>
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<tbody>
<tr>
<td>Activity sectors</td>
<td>Application of physical science</td>
</tr>
<tr>
<td>Description</td>
<td>Competencies Mathematics, scientific knowledge, management skills</td>
</tr>
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<td>Education required</td>
<td>Engineering education</td>
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Design

Engineers develop new technological solutions. During the engineering design process, the responsibilities of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions. Much of an engineer's time is spent on researching, locating, applying, and transferring information. Indeed, research suggests engineers spend 56% of their time engaged in various different information behaviors, including 14% actively searching for information.

Engineers must weigh different design choices on their merits and choose the solution that best matches the requirements. Their crucial and unique task is to identify, understand, and interpret the constraints on a design in order to produce a successful result.
The Challenge
Ready?
Good or Bad Design?
Design Challenge 2
Olympics

If you could do anything to break existing records in a sport (e.g., swimming, cycling, running), what might you do?
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Olympics - New World Records
See you on Monday!