ESD.051 / 6.902
Engineering Innovation & Design

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.

Design Research Techniques	10-Step Design Process	Psychology of Human-Machine Interaction
Creating Vision, Articulating Designs	Understanding and Creating a Brand	Buy Vs. Build, Handling Ambiguity, Real-World Constraints
Group Project Success, Ethics, Project Management	Usability Testing	Making Insanely Great Presentations

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

Syllabus

Principles of Design (1 - 10)

Class	1	2	3	4	5	6	7	8	9	10
Day of Week/ Date	W Sept 5	M Sept 10	W Sept 12	M Sept 17	W Sept 19	M Sept 24	W Sept 26	M Oct 1	W Oct 3	W Oct 10
Lecture Topic	**Introduction**	**10 Step Design Process** **Dieter Rams**	**Research** **Stakeholder Analysis**	**Articulating Design**	**Psychology**	**Usability**	**Dialogue Systems Technology (Siri+)**	**Dialogue System Design (Questions/ Feedback)**	**Dialogue System Design 2**	**Branding**
Assigned	Good and Bad Design	Design a Game	Stakeholder analysis for games	Articulating Design HW		2 Subject Usability Test	Complete in-class assignment	K-Scripts	K-Scripts 2	Make a Commercial
Due		Good and Bad Design Movie		Game + SHA		Articulating Design HW	2 Subject Usability Test	In-class assignment (7), Transcription assignment	K-Scripts	K-Scripts 2

Design Is Everywhere (11-18)

11	12	13	14	15	16	17	18
M Oct 15	W Oct 17	M Oct 22	W Oct 24	M Oct 29	W Halloween!	M Nov 5	W Nov 7
Creativity	**Project Management**	**Sanjay Sarma Guest Lecture**	**Presentation Skills**	**Group Project Success**	**Innovation & Ethics** **Build a Company**	**Individual Presentations**	**Individual Presentations**
Assign Individual Project				Start Group Projects/ Assign Groups			Read Selection from High-Velocity Edge
Make a commercial	Down-Selected Ideas	Project Management Plan, K-Scripts	Detailed Design Doc (T1 R1 H)	Usability test 1 for IP on functional system		Individual Presentations, UT 2 for IP	Individual Presentations

Group Project/Interdisciplinary Design (19-27)

19	20	21	22	23	24	25	26	27
W Nov 14	M Nov 19	W Nov 21	M Nov 26	W Nov 28	M Dec 3	W Dec 5	M Dec 10	W Dec 12
Buy or Build, Process Improvement	**Group Project Review Session**	**Helvetica**	**Guest Lecture (Harker)**	**Guest Lecture/ Work-Class**	**Guest Lecture (Helfrich)**	**Guest Lecture/ Work-Class**	**Group Project Preso.**	**Group Project Preso.**
Down-Selected Ideas/ Reading	Project Management Plan, K-Scripts		Detailed Design Document		Usability test 1 for GP		Usability test 2 for GP/Preso.	Presos

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

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

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

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
Invention
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 Occupation Names Engineer Activity sectors Application of physical science Description Competencies Mathematics, scientific knowledge, management skills Education required Engineering education

Design

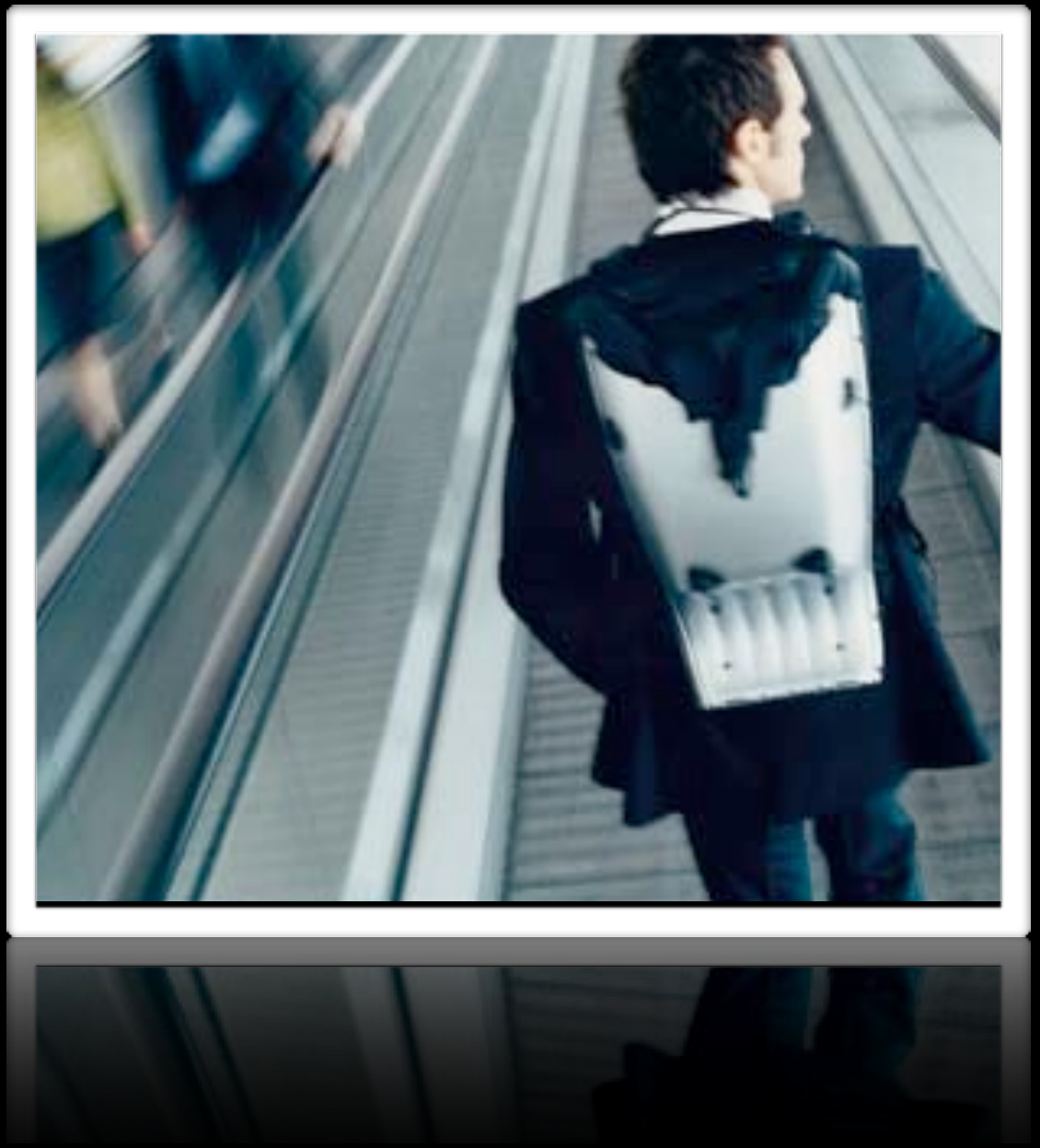
Engineers develop new technological solutions. During the engineering design process, the responsibilities of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions. Much of an engineer's time is spent on 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!

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