University Of California, Berkeley  
Department of Mechanical Engineering

ME 206 – Engineering Design and Prototyping: Pedagogy & Assessment (3 units)  
Graduate Course

Syllabus

CATALOG DESCRIPTION

This course explores contemporary research in engineering design and prototyping, as well as related cognitive issues in engineering curricular development, pedagogy, and assessment. One recurring theme throughout the course will be the duality between learning and design: design-based research, design as a pedagogy for integrative learning and the role of cognition and the learning sciences in the practice of engineering design. It has been motivated by several reforms: (1) National efforts to better train and educate engineers for the engineering workplace in the 21st Century: to better prepare engineers to face multidisciplinary problems and product design in competitive industries and improve their skills in teamwork and communication. (2) Efforts to improve how engineers build robust problem-solving, design and prototyping skills. (3) Advances in accessible prototyping technologies such as 3D printing and laser cutters and the popularity of the Maker movement. (4) Diversity Issues of ethnicity and gender in the engineering programs and practice. This course includes both qualitative and quantitative research methods in the pedagogy and assessment of engineering design and prototyping, coverage of key research findings, and a course project.

COURSE PREREQUISITES

None.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

(All required readings will be available online)

COURSE OBJECTIVES

This course has been developed to bridge student’s previous knowledge of disciplinary research in design and prototyping with engineering education research.

- Provide learners the opportunity to question (usually tacit) assumptions about what engineering is, what the purpose and process of engineering education is, and who gets to be an engineer.
- Understand design as a pedagogy for integrative learning and the role of cognition and the learning sciences in the practice of engineering design and prototyping.
- Provide the participants with an understanding of theories and practices in content, assessment, and pedagogy for teaching engineering design and prototyping.
- Familiarize learners with quantitative and qualitative methodologies for data analysis associated with the assessment of design and prototyping interventions.
- Promote critical thinking and a social construction of knowledge by having face-to-face and online discussions of readings from a variety of sources.
DESIRE COURSE OUTCOMES

Students will be able to:

- Identify their own role in shaping engineering and engineering education, and explore paths of connecting their research in Mechanical Engineering (or a related field) educational interests in design and prototyping;
- Think critically, reflectively and holistically about engineering and education;
- Become aware of the theoretical and practical issues of learning, instruction, and assessment as these concern the design of educational environments and technologies;
- Apply design research methods to inform and validate designs involving educational issues.
- Articulate their own view of the design of educational tools and become more confident about their ability to work as an engineer and educational designer.

TOPICS COVERED

1. Philosophy and epistemology of education and engineering
2. Learning Process: How people learn
3. Research methods: Qualitative and quantitative
4. Creativity and project-based learning
5. Motivation and diversity in learning strategies
6. Design thinking and learning
7. Constructivism and constructionism
8. Design, making and prototyping
9. Education, engineering and technology as an agents of emancipation
10. Assessment
11. K-12 education and recruitment
12. Diversity and equity in engineering: Women and underrepresented minorities

CLASS/LABORATORY SCHEDULE

3 Hours Lecture Per Week

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- 30% on assignments
- 40% on attendance and participation in class
- 30% on final project

TOPICS COVERED/WEEKLY AGENDA

Please see attached.

PERSON(S) WHO PREPARED THIS DESCRIPTION

Professor Alice Agogino, 3/6/16
ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM):
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Agogino
DURATION OF COURSE: 15 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None
**WEEK 1:** Philosophy and epistemology of education and engineering


**Optional:**


**WEEK 2:** Learning Process: How People Learn


**Optional:**


**WEEK 3:** Research methods


**Optional:**

- Laurel, Brenda, Design Research: Methods and Perspectives.
WEEK 4: Creativity and project based learning
  Optional:

WEEK 5: Motivation and diversity in learning strategies
  - Reis, Rick. Student Motivation: Problem Solved?
  - Joi Ito’s blog posts: Formal vs Informal Education.
  Optional:

WEEK 6: Design thinking and learning
  Optional:

WEEK 7: Constructivism and constructionism


Optional:


**WEEK 8:** Design, making and prototyping


o “Prototyping Is The Shorthand Of Design”, IDEO.

o Sandhu, Jaspal S. (Jan, 2013) “Measure early, measure often: rapid, real-time feedback in design for social innovation”.

o Scan: Build Methods on theDesignExchange

**WEEK 9:** Education, engineering and technology


Optional:


**WEEK 10:** Assessment

o (Video) Assessment: The Silent Killer of Learning / Eric Mazur (start at minute 8:30)

o ABET Accreditation Assessment Planning.


Optional:
Week 11: K-12 education and recruitment


Optional:
- Next generation science standards: Science and Engineering Practices
- Next generation science standards: Three dimensional learning

Week 12: Diversity and equity in engineering: Women and underrepresented minorities

- (Video) Thinking About Making – An examination of what we mean by making (MAKEing) these days. What gets made? Who makes? Why does making matter? - Leah Buechley

Optional:
- (Video) Young, Valierie, “Overcoming the Imposter Syndrome”
- Weinbaum, Sheldon, “Fulfilling the Dream: The Importance of Doing What You Believe and Being Taken Seriously”

Week 13 & 14: Project presentations
WEEK 15: Reading, Review and Recitation