Introduction to Engineering Design with Professional Development I (ENGR 2050)

Fall 2018 Syllabus

Credit Hours: 4

COURSE DESCRIPTION

While the steps involved in the design process may change depending upon a variety of factors, most design experts agree that the engineering design The process involves identifying opportunities, performing analysis and synthesis, generating multiple solutions, evaluating those solutions against requirements, considering risks, and making trade-offs to identify a high quality solution under the given circumstances, all of which are required. Since design problems are by nature open-ended (meaning that there are many possible solutions) and multi-faceted (meaning that there are multiple levels of complexity), the process of problem definition followed by formulation of system concept solution is an iterative process that usually continues until a complete and unambiguous system solution is identified. Design is an iterative stepwise process that is best learned by doing. As a result, this is primarily a project-based course.

In the real world, resources are rarely considered infinite, so the best engineering designers learn how to implement the design process using the most efficient and effective methods available. This course will teach you some of these methods including basic project management. The ultimate goal in the engineering design process is to meet or exceed customer wants and needs, while reducing cost and time. Teamwork and communication are essential elements of the engineering design process. Engineers who do not know how to communicate and work effectively with others are ineffective designers. Learning how to communicate in the context of the design process and learning how to work in a team environment are integral elements of this course.

COURSE OBJECTIVES

This course will teach you about the importance of teamwork and communications in the context of the engineering design process. Interactive professional development exercises will provide you with the knowledge and skills necessary for effective teamwork. Coursework is designed to challenge you to improve and expand upon your oral, written and visual communication skills.

LEARNING OUTCOMES

1. Students will have the capacity to solve engineering design problems, while instilling the importance of creativity in developing innovative solutions.
2. Students will know how to identify customer needs, establish design objectives, and translate these into engineering design specifications.
3. Students will exercise and improve important design skills of visualization, calculation, experimentation, and modeling.
4. Students will have skills in organizing people and ideas for successful design. Skills include teamwork, project management, verbal and written communication, and documentation.
5. Students will be able to function on multi-disciplinary teams and communicate effectively.
6. Students will understand professional and ethical responsibility.

Prerequisites: ENGR 1100 or ECSE 1010 and either CIVL 1200 or ENGR 1200 or ENGR 1400. Co requisite: PHYS 1200.
Course Coordinator: Mark Anderson, Sr. Project Eng., Design Lab, JEC 2027, email: anderm8@rpi.edu
Section Schedules and Instructors: Please see instructors for office hours, locations, phone numbers and email addresses.

Section	Days	Times	Instructors
1	MR	08:00 am-09:50 am	Casey Hoffman/ Judith Obiero
2	MR	10:00 am-11:50 am	Ahmad Abu-Hakmeh / Susan Henry
3	MR	10:00 am-11:50 am	Robert Niemiec / Graham Knowles
4	MR	12:00 pm-01:50 pm	Ahmad Abu- Hakmeh / Christine Allard
5	MR	12:00 pm-01:50 pm	Paul Moon / Susan Henry
6	MR	02:00 pm-03:50 pm	Randy McFarlane/ Glen Gross
7	MR	02:00 pm-03:50 pm	Randolph Franklin / Casey Jakubowski
8	TF	02:00 pm-03:50 pm	George Gela / Glen Gross
9	TF	10:00 am-11:50 am	Bill Foley / Karyn Dyer
10	TF	10:00 am-11:50 am	Deanna Thompson/ Amy Corron
11	TF	12:00 pm-01:50 pm	Bill Foley / Karyn Dyer
12	TF	12:00 pm-01:50 pm	Yuri Gorby / Amy Corron
13	TF	02:00 pm-03:50 pm	Dan Lander / Audrey Scranton
14	MR	10:00 am-11:50 am	Paul Moon / Judith Obiero

COURSE ORGANIZATION

This course will consist of two major phases. The first phase will involve a short "warm-up" mini-project that is intended to familiarize you with the major elements of teamwork, communication and the design process. Students will work on the mini- project in teams of two or three for the first four weeks of the semester. Focus is on the design of a system that performs a simple measurable function. The second phase builds upon the teamwork, communication and the design process skills and involves a more complex system design project that will encompass the remainder of the semester. For this second project, teams will be organized into groups of five to seven students. Instructional aspects of the course will include video lectures to introduce concepts that will be used during the studio-lab sessions. Studio-lab sessions will include formal meetings and interactive exercises between student teams and instructors. Instructors will work with student teams on their projects and activities to help guide the team in the design process. Team members should come to studio-lab sessions prepared to discuss design work, project assignments, and team dynamics. On a day-to-day basis, your instructors may assign specific tasks to be completed by the team or by individual team members related to both the design process and the development of your team.

STUDIO-LAB SCHEDULE

Notes:

1. This is a tentative schedule and subject to change
2. *Italicized items are led by Archer Center instructors*
3. **Reading assignments & video lectures to be completed prior to taking the weekly quiz**
4. **Reading assignments and video lectures are due by end of Wednesday on the weeks shown**

Week	Assignments	Video / Lecture Slides	Monday/Tuesday Lab	Thurs/Fri Lab
1				Dates: 8/30 & 8/31
	Read Mini Project Descriptions Ulrich & Eppinger Chapter 1: Introduction Chapter 2: Development Processes and Organizations Chapter 3: Product Planning	**Videos:** • Introduction • Gantt Charts	**Classes have not started yet!**	**Activity 01-02-1:** Team communication and process. Safety guidelines, introduce mini-project and form teams, develop a GANTT chart. **Activity 2-2:** Conduct user needs/functional analysis. Brief lab / shop tour (only if time allows). **Homework Assignment:** Take on-line safety quiz and collect statements of customer needs for mini-project (due on next lab session). Collect materials and supplies to work on mini-project next week.
2			Dates: 9/3 (no classes) & 9/4	Dates: 9/6 & 9/7
	Chapter 4: Identifying Customer Needs Chapter 5: Product Specifications Introduction to Myers-Briggs Type pp. 1-4	**Videos:** • Customer Needs • Requirements • Benchmarking **Lecture Slides:** • Technical Writing **Quiz #1 Opens**	**Activity 3-1:** Develop list of engineering design requirements. Use needs-metrics matrix (see p 77 in text) to show one to one correspondence with customer needs (due on next lab session). **OPEN SHOP HOURS START**	**Activity 4-1:** *Practice public speaking. Conduct audience analysis; organize presentation and delivery elements.* **Activity 4-2:** Establish specifications for your project.
3			Dates: 9/10 & 9/11	Dates:9/13 & 9/14
	Ulrich & Eppinger, Chapter 6: Concept Generation Chapter 7: Concept Selection	**Videos:** • Design Creativity Tools • Concept Generation • Concept Selection **Quiz #2 Opens**	**Activity 5-1:** *MBTI activities and information (2 hours)*	**Activity 6-1:** Design creativity exercises: sketching, brainstorming, mind mapping, morphological chart, concept screening decision matrix. **Activity 6-2:** Technical Writing

Week	Assignments	Video / Lecture Slides	Monday/Tuesday Lab	Thurs/Fri Lab
4			Dates: 9/17 & 9/18	Dates: 9/20 & 9/21
	Chapter 14, Patents & Intellectual Property Course reading articles: 5 Stages of Group Development, Team Performance Model	**Lecture Slides:** • Entrepreneurship • Intellectual Property **Quiz #3 Opens**	**Activity 7-1: Mini-project reviews, presentations and sectional competitions**	**Activity 8-1: Mini-project reviews, presentations and sectional competitions**
5			Dates: 9/24 & 9/25	Dates: 9/27 & 9/28
	Video: TED Talk by Simon Sinek for team formation	**Quiz #4 Opens**	**Activity 9-1:** Exploration of problem areas for team project	**Activity 9-1:** Exploration of problem areas for team project (continued) *Team formation / consultation*
6			Dates: 10/1 & 10/2	Dates: 10/4 & 10/5
	Chapter 12: Prototyping	**Lecture Slides:** • Application of Machine Elements • Materials **Quiz #5 Opens**	**Activity 10-1:** Continue discussion of potential problem areas, select focus area and write team statement of work. Brainstorm potential end user needs/wants and organize using affinity diagramming and prioritize.	**Activity 11-1:** *Continuation of team consultations* **Activity 11-2:** Requirements definition
7			Dates: 10/8 (no classes) & 10/9 (Mon)	Dates: 10/11 & 10/12
		Lecture Slides: • Controls / Basic Electronics **Quiz #6 Opens**	**Activity 12-1:** Concept generation and selection	**Activity 14-1: Milestone One: System Concept Reviews**
8			Dates: 10/15 & 10/16	Dates: 10/18 & 10/19
	Chapter 13: Robust Design Course reading articles: The Johari Window and Modes of Conflict	**Lecture Slides:** • Robust Design • Risk Management **Quiz #7 Opens**	**Activity 16-1:** Conduct informal design reviews to evaluate safety, life cycle, manufacturing, and cost issues.	**Activity 15-1:** *Giving and receiving feedback* **Activity 15-2:** *Managing conflict, five styles of conflict management*
9			Dates: 10/22 & 10/23	Dates: 10/25 & 10/26
	Chapter 11, Ulrich and Eppinger, DFM	**Lecture Slides:** • Design for Mfg. **Quiz #8 Opens**	**Activity 17-1:** Project work & *team consultations*	**Activity 20-1:** Apply Design for Manufacture methodology
10			Dates: 10/29 & 10/30	Dates: 11/1 & 11/2
	Chapter 15, Product Development Economics	**Lecture Slides:** • Engineering Economics **Quiz #9 Opens**	**Activity 18-1:** Project work & *team consultations*	**Activity 19-1:** Project work & *team consultations*
11			Dates: 11/5 & 11/6	Dates: 11/8 & 11/9
		Quiz #10 Opens	**Activity 21-1:** Informal Subsystem demos & *team consultations*	**Activity 22-1:** Informal Subsystem demos & *team consultations*
12			Dates: 11/12 & 11/13	Dates : 11/15 & 11/16
		Quiz #11 Opens	**Activity 23-1:** Project work & *team consultations*	**Activity 24-1:** Project work & *team consultations*
13			Dates: 11/19 & 11/20	Dates: 11/22 & 11/23
			Activity 25-1: Project work & *team consultations*	**HOLIDAY BREAK**
14			Dates: 11/26 & 11/27	Dates: 11/29 & 11/30
			Activity 25-1: Project work & *team consultations*	**Activity 25-1:** Project work & *team consultations*
15			Dates: 12/3 & 12/4	Dates: 12/6 & 12/7
			Milestone Two: Project Demos	**Activity 25-1:** Project work & *team consultations*
16			Dates: 12/10 & 12/11	Dates: 12/13 & 12/14
			Milestone Three: Team Presentations	**READING DAYS**

Mini Project Memos Due – Monday, Week 5, start of day
Milestone 1 Memos Due – Wednesday, Week 8, end of day
Milestone 3 Reports Due & Peer Evaluations – Last Class, end of day. Submit Peer Evaluations AFTER the Report.
All Quizzes Open at noon (12:00PM) and close at midnight (12:00AM) the next week unless specifically noted in the quiz.

Materials and Supplies: Students are expected to provide their own materials and supplies for their projects as needed. Kits for the line tracker and mousetrap car mini-projects will be available for purchase. Loaner 80-20 and motor kits are available for a deposit for the major team project. Students will typically need their textbook and laptop computer (with power supply / charger) and note taking tools (notebook / pens / pencils) for studio-lab sessions.

Team Formation: Teams will be formed by the instructors to include individuals of diverse backgrounds, skills or perspectives. This may involve different majors or fields of study with a major, geographic diversity, cultural diversity, differing experience levels, etc. Teams will be practicing project management skills by establishing goals, planning tasks, meeting deadlines, and creating a collaborative and inclusive environment. Teams will perform all aspects of the engineering design process as stated above.

Textbooks (available at the campus bookstore):

1. Product Design and Development, 6th edition, by Karl Ulrich and Steven Eppinger, McGraw-Hill
2. Introduction to Myers-Briggs Type (7th edition), Author: Isabel Briggs Myers (revised by Linda K. Kirby & Katharine D. Myers)

Grading: Overall course grades will use grade modifiers (A-, C+, etc.). Grades will be based upon a combination of:

1. The quality of system design responses to the challenges and objectives of the overall course and individual projects. This includes both the breadth and depth of understanding and development that communicates the technical, economic, social, and environmental impacts of engineering design.
2. Willingness and ability to work in a team environment to explore existing and new approaches that present innovative and practical solutions for engineering system design problems.
3. Individual Contribution Factor - The individual contribution factor (ICF) represents how much each student contributed to the team's success. Instructor in-class observations and the student peer evaluations are the major elements in determining this factor.

While time and effort expended toward work often reflects positively in the quality of project results, it cannot be, in itself, a guarantee of a high grade. Students will receive feedback at the end of every major assignment in the course. Those not doing satisfactory work will receive a written notice with an evaluation of what steps might be taken to improve. The following weightings will be used to compute the final course grade:

Major Element	Rubric	% Rubric Element		% Final Grade
Mini Project 25% of final grade	Competition	10%		2.5%
	Presentation	30%		7.5%
	Memo	60%		15.0%
		100%		25%
Team Project 50% of final grade * ICF	MS 1 - System Concept Presentation	40%		4.0%
	MS 1 - System Concept Memo	60%		6.0%
	MS 2 - Demonstration	100%		15.0%
	MS 3 - Design Review Presentation	40%		10.0%
	MS 3 - Design Review Report	60%		15.0%
		100%		50%
Attendance 10% of final grade	Classroom			10.0%
Quizzes 15% of final grade	On-line (LMS)			15.0%
				100%

ICF = Individual Contribution Factor
ICF for an individual member of a team may be less than, equal to, or greater than one.
Final Grade = Mini project + (ICF * Team Project) + Attendance + Quizzes

The following numerical to letter grade mapping will be used:

Grade Letter	0-100	Grade Letter	0-100	Grade Letter	0-100
A	92-100	C+	77-79.99	F	0-59.99
A-	89-91.99	C	74-76.99		
B+	86-88.99	C-	71-73.99		
B	83-85.99	D+	68-70.99		
B-	80-82.99	D	60-67.99		

Quizzes:
During the first eleven weeks of the semester there will be a series of quizzes administered via LMS on topics covered in your textbook and during class. Each quiz is cumulative and may cover any course material to date. These LMS quizzes will be available for one week only, from 12:00PM on the Wednesday shown on the schedule to the following Wednesday at 10:00AM unless otherwise stated/announced. You should take **all** of the weekly LMS quizzes. The highest ten out of eleven total quiz scores will be averaged to calculate your final quiz grade. The lowest quiz score will be dropped. As the quizzes are available for a week, there are no make-up quizzes.

Shop Access:
Students will have supervised access to the shop at various hours. The shop schedule will be posted on the shop door and on LMS.

Attendance, Class Policies, and Academic Integrity:
Attendance at studio-lab sessions is mandatory. A student may miss part or all of a studio-lab only if prior notice and/or acceptable reason is given. Students are responsible for all missed content and work. If a student misses more than two studio-labs, grades will be affected accordingly. Class presentations, criticisms, and discussions are essential to the development of ideas in the context of the design and team processes. Missing an assignment or design review without an authorized excuse will result in a grading penalty. All work submitted for grading should represent the student's own effort. Work that builds upon the prior work of others should be properly acknowledged. Collaboration with other students is expected and essential within the contexts of design and team development and on designated team assignments. Student should be mindful that the work they submit truly represents their own efforts. Students found submitting work for a grade that is not their own will result in course failure. If students are at all confused about the application of this policy, they should seek clarification from their instructor.

See this web page for excused absences:
http://studentlife.rpi.edu/student-experience/excused-absence/

Mobile Devices:
All mobile devices (cell/smart phones, computers, pagers, etc.) must be stored securely away during studio-labs and are not to be used unless specifically directed otherwise by the instructor.