MAE 195 – PRODUCT DESIGN AND DEVELOPMENT – FALL, WINTER, SPRING 2017 – 2018

Class Times: TuTh, 11:00 - 11:50 am | **Discussion**: F, 11:00 - 11:50 am | **Location**: EG3161

Instructor: Terry Wang | terry.wang@uci.edu

Faculty Coordinators: Mark Walter, Derek Dunn-Rankin, Ken Mease

Office Hours: by appointment

Course Description: MAE195 Product Design and Development (Credit Units: Fall 3, Winter 4, Spring 3). This is a 3 part program that introduces a stepwise process in designing and developing new products. Students will use contemporary industry methods and processes in conceiving, planning, designing, and prototyping a minimum viable product – a product with sufficient features and benefits to satisfy early customers.

Course Objectives:

- Understand product design and development process with the ability to define, document, and create a minimum viable product.
- Understand the functions various roles undertake in creating a new product (sales, marketing, design, engineering, production, quality)
- Work in a dynamic team environment to coordinate multiple, interdisciplinary tasks in order to achieve a common goal
- Ability to communicate effectively on a professional level
- Integrate learned engineering analysis tools (statics, dynamics, thermodynamics, fluid dynamics, heat transfer, electronics, vibrations, and control) in the design process
- Understand and be able to work within the constraints on given resources
- Identify risks during the development cycle and find ways to mitigate them
- Be able to pivot (course correct) when confronted with new information, changes, or failures
- Understand ethical, environmental, and societal impacts from engineering decisions

Learning Environment: Designing and developing a new product requires active participation on various levels. You'll research, brainstorm, speak with potential customers, sketch out concepts, create prototypes, disagree with your teammates, fail, reassess, pivot, be enlightened with the process, see the pieces come together, and achieve a goal. Lectures will be delivered in person as well as through distance communication tools such as Webex or Zoom. They will provide you with the tools as you go through the design journey. Discussions are group activities to be held with all teams. They are designed to evaluate your assignments, monitor your progress, and provide feedback. Hence, lectures and discussions attendance are absolutely required, necessary, and critical to your project's success.

Grading: The grading is a 50/50 split between individual contribution and group output. Below is the breakdown that will be used for every quarter:

Individual contribution		Group output	
Class participation and attendance	15%	Peer review presentation	15%
Individual assignments and quizzes	15%	Design review poster	15%
Intra-group peer review	20%	Product development report*	20%

Note (*): Fall Quarter – Discovery, Winter Quarter – Design, Spring Quarter – Delivery.

Requirements: Students must have senior standing in the Mechanical and Aerospace Engineering program in order to enroll in this program. Students must take parts I and II (Fall and Winter quarters) in order to petition to receive credit for MAE 189 and MAE 151 courses. Students who fail to complete both quarters will not receive credit for the aforementioned courses. With the sponsor's or instructor's approval, students may enroll in part III (Spring quarter). Completing part III will provide students with another 3 units which may be petitioned for additional credits for MAE 189.

Text: There is no required text for the class but we will be taking excerpts from the books below:

- Ulrich, K.T., Eppinger, S.D., *Product Design and Development, 5th Edition*, McGraw-Hill Education, 2011
- Olsen, D., *The Lean Product Playbook: How to Innovate with Minimum Viable Products and Rapid Customer Feedback*, Wiley, 2015
- Kelley, T., *The Art of Innovation: Lessons in Creativity from IDEO*, America's Leading Design Firm, Crown Business, 2011
- Ries, E., *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*, Crown Business, 2011
- Watts, F.B., *Engineering Documentation Control Handbook, Fourth Edition*, William Andrew, 2011
- Hubbard, D., *How to Measure Anything: Finding the Value of Intangibles in Business 3rd Edition*, Wiley 2014
- Ullman, D., *The Mechanical Design Process 4th Edition*, Mcgraw Hill, 2009
- Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition*, Project Management Institute, 2017
- Sutherland J., *Scrum: The Art of Doing Twice the Work in Half the Time*, Crown Business, 2014
- McGowan, B., *Pitch Perfect: How to Say It Right the First Time, Every Time*, HarperBusiness, 2014
- Reinertsen, D., *Managing the Design Factory*, Free Press, 1997
- King, S., *On Writing: A Memoir of the Craft*, Simon & Schuster, 2001
- International Organization for Standardization, *ISO 9001:2015, Fifth Edition: Quality management systems - Requirements 5th Edition*, American National Standards Institute (ANSI), 2015
- Pyzdek, T., *Keller, P.A., The Six Sigma Handbook*, Fourth Edition (Mechanical Engineering), McGraw-Hill Education, 2014
- American Society of Mechanical Engineers, *ASME Y14.5-2009 Dimensioning and Tolerancing: Engineering Drawing and Related Documentation Practices*, American Society of Mechanical Engineers, 2010
- Burnett, B., Evans, D., *Designing Your Life: How to Build a Well-Lived, Joyful Life*, Knopf, 2016
- Dweck, C.S., Mindset: *The New Psychology of Success*, Random House, 2006
- Levitin, D.J., *The Organized Mind: Thinking Straight in the Age of Information Overload*, Dutton, 2015
- McKeown, G., *Essentialism: The Disciplined Pursuit of Less*, Crown Business, 2014
- Csikszentmihalyi, M., *Flow: The Psychology of Optimal Experience*, HarperCollins, 2009
- Duckworth, A., *Grit*, Simon and Schuster, Scribner, 2016

Fall 2017 Schedule

Week	Date	Lecture Topic	Assignment
1	10/3**	Introduction to product design and development. Expectations. Start with self	Self-assessment, project interest, doodle availability, liability waiver
1	10/5	Teams, team organization, and communication	Goal, objectives, meeting schedule, code of ethics, pledge of excellence
2	10/10	Engineering documentation (crafting vs engineering)	Establish shared directory, documentation numbering, templates
2	10/12**	Who is the product for? Technology adoption life cycle	Create persona, identify underserved needs, define value proposition
2	10/13**	Group Discussion	Project Status Review
3	10/17	What are the customer needs? What is the product value proposition?	Initial customer needs, hierarchal customer needs, creating customer value
3	10/19	Benchmarking	Research commercially available products, processes, or systems
4	10/24	Minimum Viable Product (MVP). Features vs benefits	Specifying minimum viable product. Market Requirements Document. Project Definition, Timeline
4	10/26**	Project safety	Complete safety packet
4	10/27**	Group Discussion	Project Status Review
5	10/31	Product specification (Patents, standards, constraints)	Create product specification
5	11/2	Concept generation	Brainstorming, concept sheets
6	11/7	Concept selection	Concept evaluation, screening, development, scoring, and selection
6	11/9	Prototype models, simulation tools, optimization methods	Create initial model of concept, simulation analysis
7	11/14	Work breakdown structure, scheduling and task management	Create work breakdown structure, update timeline
7	11/16**	SDP Intergroup Peer Reviews	Peer review presentation
7	11/17**	Group Discussion	Project Status Review
8	11/21	Task calibration, SCRUM	Task assignment, SCRUM Board
8	11/23	Thanksgiving	Enjoy holiday break
9	11/28	Project risk	Create risk matrix, risk mitigation
9	11/30**	Poster creation	Fall design review poster due
9	12/1**	Group Discussion	Project Status Review
10	12/5	Product realization	Setup for design and development planning, input, output, review, verification, validation
10	12/8**	Fall design review	Product development discovery report due

Notes: The schedule is created to be as complete as possible. There may be some shifting to accommodate guest lectures and additional topics. Dates marked with (**) will be live lectures. All others will be delivered via Webex or Zoom.

Winter 2018 Schedule

Week	Date	Lecture Topic	Assignment
1	1/9**	Teams, teamwork revisited	Team evaluation, reorganize
1	1/11	Product teardown	Product Teardown Assignment (BOM, Cost, Analysis)
2	1/16	Project Management	Scope Review, Cost Review, Human Resources Review, Time Management, Procurement Management
2	1/18**	Intellectual Property, Patents (Guest Lecture)	Invention disclosure
2	1/19**	Group Discussion	Project Status Review
3	1/25	Design for: cost, manufacture, assembly	Estimation of Product Costs
4	2/1**	Design review, Design Failure Mode Effects Analysis	Review notes, DFMEA, initial BOM, assembly and component Drawings
4	2/2**	Group Discussion	Project Status Review
5	2/6	Engineering ethics	Ethics write-up
5	2/8**	SDP Intergroup Peer Reviews	Peer review presentation due
5	2/9**	Product Management (Guest Lecture)	Project Status Review
6	2/15	MVP prototype	MVP prototype build
7	2/22	Design verification	Statement of compliance due
8	3/1**	Designing your life	Resume, LinkedIn
8	3/2**	What companies are looking for (Guest Lecture)	Project Status Review
9	3/6	Manufacturing Review	Manufacturing methods, make/buy, vendor sourcing
9	3/8	Product validation	Acceptance test procedure
10	3/15**	Persevere or pivot?	Project analysis write-up
10	3/16**	Winter Design Review	Product development design report due

Notes: The schedule is created to be as complete as possible. There may be some shifting to accommodate guest lectures and additional topics. Dates marked with (**) will be live lectures. All others will be delivered via Webex or Zoom.

Spring 2018 Schedule

Part III of the Product Design and Development program requires instructor's approval and the schedule will be determined by the manufacturing schedule for the minimum viable product.