

Course Objectives: This course introduces the student to the product design and development process. Tools, techniques and methods for product design and development are discussed in the class. Tools and techniques presented and discussed include teamwork (team dynamics, team norms and team tools), product development processes in organizations, customer needs and requirements analyses, setting product specifications, product concept generation methods, product concept selection methods, patents and intellectual property, product architecture design methods, design for usability, design for maintainability, design for assembly and disassembly, design for environment and product costing. The course includes a team based project in which student teams will generate and select concept designs for a consumer product [or a service]. After taking this course, students are expected to be proficient in using product design tools and techniques.

Course Meetings: Class meets Tuesdays from **6 to 850 PM in Education Building 202**. Every class session will include a lecture, in-class activities illustrating the lectures, sharing of in-class work and discussion, and activities on the product design project work.

Instructor: Dr. Arunkumar Pennathur, IMSE Department, apennathur@utep.edu.

Office Hours: Tuesdays, 3 to 430 PM. Other times by appointment – please send an email for either an in-person meeting or a Teams meeting. Email is a fast, convenient way to contact me. I read my email usually twice a day when I am in town and respond within a day if I am in town on weekdays. If I am traveling or if it is the weekend, please expect a slight delay in my response to your email.

Course Materials: The recommended textbook for this course is *Product Design and Development (Seventh Edition)* by Karl T. Ulrich (U Penn), Steven D. Eppinger (MIT) and Maria C. Yang (MIT). The book can be bought (either paperback or e-book) or rented from Amazon at the following link; this is the cheapest price I have been able to find:

https://www.amazon.com/Product-Design-Development-Karl-Ulrich/dp/1260566439/ref=sr_1_1?crid=IUYGWEEEMAX&keywords=product+design+and+development&qid=1705350657&srefix=%2Caps%2C136&sr=8-1&ufe=app_do%3Aamzn1.fos.006c50ae-5d4c-4777-9bc0-4513d670b6bc

You can also use the older editions of the book.

The other recommended book you can consult is *Product Development: A Structural Approach to Consumer Product Development, Design, and Manufacturing* by A. Mital, A. Desai, A. Subramanian, and A. Mital (Elsevier, 2008). This book can be purchased at Amazon.com. Some other references you can consult (especially if you want to work in the product design field in the future) are:

1. M. Crawford and A. Di Benedetto, *New Product Management*, McGraw Hill, New York, 2005.
2. M.A. Annacchino, *New Product Development: From Initial Idea to Product Management*, Elsevier, New York, 2003.
3. D.W. Whitney, *Mechanical Assemblies*, Oxford University Press, New York, 2004.
4. Y. Haik, *Engineering Design Process*, Thompson Books/Cole, Pacific Grove, CA, 2003.
5. D.G. Ulman, *The Mechanical Design Process*, McGraw Hill, New York, 2000.

6. Donald Norman, The Design of Everyday Things. Basic Books, 2013.

I will also supply notes in the form of slides and other material – these can be found in the Blackboard page for the course.

Course Topical Coverage:

- Teamwork
- Product development processes in organizations
- Customer Needs Identification
- Concept Specification
- Concept Generation
- Patents and IP
- Concept Selection
- Product Architecture
- Design for Usability
- Design for Maintainability
- Design for Environment
- Design for Assembly and Disassembly
- Product Costing (time permitting)

Course Evaluation and Assessment Components

The course includes work you must complete individually and work you must complete with your team outlined as follows:

INDIVIDUAL WORK

Quizzes: This course will have a series of online, open-book, open notes, quizzes you will need to take individually via Blackboard. The quizzes are intended to ensure you keep up with reading and internalizing the material. The quizzes will be multiple-choice and/or short-answer and will test concepts from your text. Please refer to each quiz for further instructions about the quizzes.

Individual assignments: These assignments are of three kinds in general: an extension and analyses of tools and techniques we discuss in class to application examples, one page reflections on assigned videos, an individual project proposal pitch (please see pitch requirements below in the project section), a list of barriers to successful teaming, individual notes and work that you perform on your team project, and your individual participation in class during class activities in general. For individual project notes, I would advise you to create a Teams page and add me in as a member of your page, so I can view and comment on your individual work for the project.

TEAMWORK

Class Project: Class Project will carry 60% of the total grade in this course. Note that we will spend time in class for your project team activities every class period and is intended to help you work toward project goals. The projects are team-based. There will be a team peer evaluation component in the course, so all members in the team will evaluate each other, and all

members in a team will not get the same grade. Please see the peer evaluation document for how you will rate your team members. The grade obtained by an individual for project work (final presentation, final report and team activities in class) will be the product of the team grade and the peer evaluation score of the individual. Please refer to the project activities document for a description of the assignment and requirements.

The goals of this project are to identify market opportunity/need for a product or service, translate customer needs into technical specifications, generate conceptual designs to fulfill the technical specifications, evaluate and select the best concept for the product/service, and generate virtual prototypes for your final design.

Please attempt and choose a project satisfying the following constraints:

- There should be a demonstrable need for the product/service. You can verify a market need by identifying existing products or service that meet the need. Your product/service can be or need not be a variant of an existing product/service. The product/service need not have a large economic potential, but should, at the very least be an attractive opportunity.
- The product/service should contain at least 4 or 5 components, but fewer than 10 parts. Although you cannot anticipate every design detail at this stage, it is easy to anticipate that a can opener will have fewer parts than an automobile!
- The product you choose should not require any major technological breakthroughs for it to function – you do not have time to deal with technological uncertainties in this class.
- You should try to have access to more than 10 users of the product (20 or more would be swell). If you are collecting survey data, you can also post all surveys online on our class Blackboard page, so all your classmates can also answer the surveys, so you can collect more raw data.
- You should be able to find existing or similar products/service in the supermarket – for example, an emergency flashlight, a bicycle helmet, a can opener, ice cream scoop, etc.

Project Proposal (will count as an individual assignment): In the second class, each individual student will be required to present a project proposal, and should include the following information:

- Your name;
- A verbal or visual demonstration of up to 5 product opportunities you identified in your proposal. Describe your idea for the product(s), why you think it is needed, and the market opportunity; you could also demonstrate existing competing products quickly if you wish (bring these to the class); give it a catchy title;
- Any specific skills or assets you may have that you think will benefit the project if the class chooses your idea for further development this semester;
- Your pitch for each product should be no longer than a minute long. The 60-second time limit will be enforced strictly (think about how much information can be presented during a 30-second television commercial during a Superbowl game.)

After we have had the opportunity to hear all the proposals from individual students in the class, we will vote and rank the products, and form random teams of for each project. The class sizes will determine how many teams we have.

Each team will engage in class activity (during the second half of the class sessions) intended to generate project outcomes for important milestone intermediate outcomes for the project, the final project presentation, and the final project report. You can create hand sketches (in fact, hand sketches are encouraged for conceptual sketching at the concept generation stage of the project). Your team must use Creo, AutoCAD or some other CAD package to generate your final drawings for your concept after you have selected promising concepts for further development and prototyping.

Final Project documentation report: The narrative should contain, at a minimum, the following elements [this is a suggested outline; you may have your own variation of this outline]:

- Mission Statement and Customer Needs List
 - A mission statement and design brief
 - An organized customer needs list for your product;
 - Describe the team's process for getting organized for customer needs assessment, and for identifying customer needs, analyzing the needs, and refining the final set of needs used. Please follow the process outlined in the text for these outcomes.
- Target Technical Specifications of Product/QFD Matrix
 - Please follow the process outlined in the text for generating this outcome.
- Concept Sketches (each student in the team will generate at least 4 concepts)
 - Concept Sketches
 - Describe the steps and the process you followed for concept generation
 - Be sure to include patents, competitive benchmarks, and any other special considerations you used for generating your concepts.
 - Please follow the process outlined in the text for these outcomes.
- Concept Selection
 - Sketches of 2 or 3 concepts you believe are the most promising
 - Show the concept selection matrix you used to make these choices
 - Include a sketch of the other alternative concepts you considered
 - Describe the team's process in concept selection. Please follow the process outlined in the text for this outcome.
- Final concepts and drawings – use CAD software of your choice to create software prototypes for your designs.
- Product usability and maintainability considerations
- Environmental considerations for product
- Documentation of your team processes, team meetings, and team reflections.
 - You should keep thorough design documentation for all team project activities. The documentation should clearly indicate progress in your team project work. All the raw data, the meeting calendars, planning, minutes, and all documentation and the products generated from the meetings must be on MS Teams (you can create a MS Teams page for your project team and invite me and add me to it), so I can track teamwork and team progress.

For a more detailed breakdown of requirements for the project report, please consult the assignment guidelines for final project report. There is a team peer evaluation component for the final report, so all members in the team will evaluate each other, so all members in a team will not get the same grade. Please see the peer evaluation document for how you will rate your team members. The grade obtained by an individual will be the product of the team grade and the peer evaluation of the individual.

Final project presentation: Final presentation should be about 30 to 40 minutes long. The following is a suggested format for the final presentation:

- Title page
- Outline of the presentation
- Mission Statement/Design Brief
- Overview of your development process
- Project plan
- Task list (Gantt or PERT charts are good to have)
- Customer Needs List
- Product Specifications/QFD Matrices
- Any benchmarking
- Target Specifications
- Concept Generation & Sketches of various concepts considered
- Concept Selection and a Visual Prototype
- Conclusions & Lessons Learned
- References (if any)

The final presentation should be of the quality you will make to convince a top management group or a venture capitalist to purchase the rights to your concept and fund the final prototype development, and product launch.

An electronic copy of the report and the presentation should be submitted to the instructor before the final presentation on Blackboard. There is a team peer evaluation component for the final presentations, so all members in the team will evaluate each other, so all members in a team may not get the same grade. Please see the peer evaluation document for how you will rate your team members. The grade obtained by an individual will be the product of the team grade and the peer evaluation of the individual.

Classroom team activity and generation of milestone outcomes: Every class session related to the project will have team-based activities for your project work. Teaming will occur Figma and MS Teams project spaces. During the team activity, each team is expected to organize and work on activities that will help your team make progress towards milestone outcomes (of course, you can always be early). Please don't be absent for a class team activity. You can continue working with the draft and refining it further outside of class time as well.

Please include specific meeting agendas in your MS Team documentation with team members present, items you discussed in your team, the outcome from the activity (what you generated from the meeting), and items for follow-up activities.

For your in-class project team activities, please note the following:

- 1) You are expected to sort out upload/technology/team problems in advance.
- 2) Discuss team/project issues with me in advance. While I expect you to hold each other accountable in your teams, please notify me in advance if you need my help.
- 3) For any resources specific to the project (instruments, tools, books etc.,) and guidance, please contact me in advance.
- 4) Please come prepared to the class team project activities.
- 5) Project slides/presentation needs to be professional – clear, readable and thoughtful presentations.

- 6) Technical details and ideas need to be of the highest standards, like what you would give a real client. Mediocre work is never acceptable and will need to be revised to higher standards.

Course grading

Project Proposals (Individual):	2%
Project design notes (Individual):	3%
In class participation (Individual):	5%
Quizzes (Individual):	15%
HW Assignments (Individual):	15%
Project Milestone Outcomes (Team):	10%
Project Final Written Report:	30%
Project Final Presentation:	20%

Note that the project final report and the project final presentation will include a peer team member evaluation which will be factored in for the project final report and the project final presentation grades.

Standard UTEP letter grading scheme will be used for the final course grade:

A:	90-100%
B:	80-89%
C:	70-79%
D:	60-69%
F	<60%

Policy on Academic Dishonesty: Any attempts of academic dishonesty in any aspect of the course will **not be tolerated** and will be dealt with according to applicable UTEP Policy.