IND 406 Industrial Design Process

Course Description:
The goal of the course is to help students to understand the whole process involved in the product design and development. Student will perform product research, conception design, model creation, ergonomic design, apply engineering design methodologies to real-world engineering problems using the computer as the central design tool. Emphasis will be placed on how to effectively test design concepts using computer simulation and animation. Student will learn techniques to present and evaluate their design ideas through virtual prototyping and physical prototyping. Students shall demonstrate the abilities to design and modify their product through engineering analysis, animation, and diagnostic feedback from the customers.

Prerequisites: MECH 1233, IND 2313
Credits/Hours: 2 course credits, 1 classroom hour, and 2 Lab hours

Required Text: David G. Ullman,
The Mechanical Design Process, 3rd Edition

Reference Book: John X. Wang
Engineering Robust Designs with Six Sigma
Publisher: Prentice Hall, Copyright: 2005

Other References: Lecture Notes (distributed as handouts or available in library)

STUDENT LEARNING OUTCOMES

Assessment Methods:
Students will exhibit skills in class, labs, and all homework assignments, laboratory exercises, quizzes, exams, and design project.

For the successful completion of this course, the students should be able to do the following:

1. Perform product research and produce product design specification. Search for subjective aesthetic opinions and tangible information related to the product from credible sources in early stages of product development process. Identify new opportunities based on market research.

   Evaluation:
   Students will demonstrate skills in using various searching techniques, in accumulating information related to the product, and in producing product design specification

2. Conceive design concepts. Explore all valid ideas and outline key design components and their arrangement before performing elimination processes using various design criteria.

   Evaluation:
   Students will display competency in creating sketches to reflect design concepts and requirements. Exhibit sound judgement during elimination process.
3. Create 3D conception models. Present the final selections in realistic 3-D color renderings. Use the state of art solid modeling and rendering and tools in design projects.

Evaluation:
Students will illustrate skills in producing complex models using advanced solid modeling and rendering features. Students will demonstrate ability to create realistic 3D conception models.

4. Perform ergonomic design; Apply ergonomic criteria to produce mockup that meet the end user’s level of comfort and tactile feedback. Perform user interface design to create user-friendly product.

Evaluation:
Students will demonstrate skills in applying ergonomic criteria to create user-friendly products that maximize user comfort when using the products.

5. Create functional products; Use of concurrent engineering concepts to create functional products. Apply engineering principles as well as aesthetic criteria throughout the various product design phases.

Evaluation:
Students will illustrate skills in using concurrent engineering design concepts in creating functional products.

6. Perform product evaluation in terms of functionality, performance, and variation effects. Predict market behavior and establish advertising and promotional strategies.

Evaluation:
Student will develop skills in evaluating a product using functionality, performance, and effects of variation criteria and in selecting proper advertising and promotional strategies.

7. Perform product evaluation in terms of cost, manufacture, assembly, and other measures.

Evaluation:
Student will develop skills in evaluating products using costs, manufacture, and assembly measures.

8. Refine products based on consumer feedback. Improve products based on diagnostic information from models of the consumers.

Evaluation:
Students will demonstrate ability in using proper methods to refine and improve products.

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**GRADING PROCEDURES:** 10% In-class participation, such as asking and answering questions. 15% Laboratory projects. 15% Homework assignments, 30% Midterm exam. 30% Final exam

**Course Outlines:**

**Week 1**

**Lecture:** *Overview of Product Design Process.* Product design specification, concept design, detail design, manufacturing and testing.

**Laboratory work:** *Overview of Various Product Design Software Packages.* Discussion of the capabilities of major design software.

**Week 2 & 3**

Laboratory work: Research Project. Discussion of formation of focus group to obtain tangible information related to product development.

Week 4 & 5
Lecture: Concept Design and Creation of Concept Models. Explore valid ideas and creation of concept ketches and models using design software.

Laboratory work: Concept Design Project. Students will be given assignment to produce concept models.

Week 6 & 7
Lecture: Ergonomic Design and User Interface Design. Create mockup that meets end user’s level of comfort and tactile feedback. Create user-friendly products through user interface design.

Laboratory work: Product Design Project I. Students will be given project to create a product that meets the ergonomic design criteria.

Week 8

Mid Term

Week 9 & 10

Laboratory work: Product Design Project I (continued). Students will apply concurrent engineering concepts to continue the design project.

Week 11 & 12
Lecture: Product Evaluation. Use of engineering model to evaluate the performance of the product.

Laboratory work: Design Project II. Students will create a second project, which requires motion analysis, and verification of the design intent.

Week 13
Lecture: Virtual Prototyping and Prototype Design. Creation of virtual and physical prototypes.

Laboratory work: Design Project II. Students will perform animation based on the virtual prototype and create physical prototype model using 3D Printer.

Week 14
Lecture: Product Refinement. Further improvement of product based on animation, engineering analysis, prototyping and consumer feedback.

Laboratory work: Final modification of design projects.

Week 15

Final Exam