

ME317B Design for Manufacturability: Quality by Design for Customer Value

Mechanical Engineering Department, Design Division

STANFORD UNIVERSITY Academic Year 2008

Units:	Four
Meeting time:	Two lectures per week, MW 4:15–5:30. Thornton 102
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Textbook:	None
Reading Materials:	Available online at http://me317.stanford.edu
Course URL:	http://me317.stanford.edu
Type of Instruction:	Lecture, 3 hours per week. Involves 3 homework sets on quality by design and a team project on practical applications. Prerequisite: ME317A Product Definition.
Grading:	Homework: 30% Project: 60% Class & Project Contribution: 10%

Course Summary:

ME317A&B address systematic methodologies to define, develop, and produce competitive products. The methods cover characterization of user values, design for manufacturability, and other life-cycle values such as reliability, serviceability, and environmental compatibility. Following the product definition process covered in ME317A, ME317B focuses on quality implementation of the product definition. In the course project, groups of students apply structured methods to optimize the design of an improved product or process, and plan for its manufacture, testing, and service. Active learning sessions provide mutual group advising in classes (on-campus, SCPD sites) to apply the methodologies to their projects.

About the project:

Project teams (2-4 students) will pick an example product or system and strategically apply the methods covered in the course. The project deliverable is a comprehensive product design and/or life-cycle specification as well as a business plan for implementing the proposed improvement.

Course Contents:

- Review of the Product Definition Methods / Prototyping Rapidly
- Concept Selection: Pugh's Method (Active Learning on Concept Development)
- Quality by Design Fundamentals (Active Learning on Scorecarding)
- Robust Design Basics (Definitions, Robust Concept Design, Parameter Design)
- Robust Design Modeling and Optimization
- Zero Defects and (Poka Yoke) Error Proofing (Active Learning on Variations and Mistakes)
- Decision Analytical Scorecarding, Net Present Value Evaluation, Worth Feasibility Analysis
- Showcasing your proposed concepts (Active Learning on Showcasing)
- Scenario-based Amorphous Systems Design (Active Learning on ME317 Project Process: the WIN curve)
- Socially and Environmentally Responsible dfM
- Towards Advanced dfM

COURSE SCHEDULE**Meeting #1 (4/2 Wed): Orientation (Beiter/Wong)**

- Affirmation of Product Definition
- Project Planning
- Prototyping Rapidly (Wong)

Reading:

- 1.1 Ishii, K. "DFM Quality by Design--Overview"
- 1.2 Barkan, P. "Conformance Quality Fundamentals"

Assignment:

- HW#1:* Concept Generation and Selection related to the Course Project (Due 4/14 Mon)
Develop a Project Gantt Chart for Spring Quarter (part of HW#1)
Produce a one-page advertisement for your product (part of HW#1: place it next to cover page)

Meeting #2 (4/7 Mon): Concept Selection (Ishii)

- Identifying Evaluation Criteria
- Pugh Selection Process

Reading:

- 2.1 "Pugh Analysis: Overview"
- 2.2 Lumsdain, E. and Lumsdain, M. "Pugh Method Example: Design of a Car Horn"

Meeting #3 (4/9 Wed): Active Learning on Concept Development (Ishii)**Meeting #4 (4/14 Mon): Quality by Design Basics**

- Complexity, Variations, and Mistakes
- Six Sigma Basics
- Quality Scorecarding

Reading:

- 4.1 Hinckley, M. and Barkan, P. "Quality by Design Fundamentals"
- 4.2 Ishii, K. and Esterman, M. "Statistics Basics" for dfM

Assignment:

- HW#2:* Robust Design of a Force Sensor: Closed Form + Scorecarding Framework (Due 4/23 Wed)

Due:

- HW#1:* Concept Generation and Selection related to the Course Project

Meeting #5 (4/16 Wed): Active Learning on Scorecarding (Ishii)**Meeting #6 (4/21 Mon): Robust Design Basics (Ishii)**

- Concept of Robustness (Closed Form Robust Design)
- Robust Conceptual Design
- What do you do when there are no models?

Reading:

- 6.1 Ishii, K. "Robust Design Basics"
- 6.2 Ford, R. and Barkan, P. "Beyond Parameter Design—A Methodology Addressing Product Robustness at the Concept Formation Stage.
- 6.3 Gheorghie, R. and Ishii, K. "Robust Parameter Design"

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Meeting #7 (4/23 Wed): Poka Yoke (Zero Defect) for Design and Manufacturing (Ishii)

- Zero Defects / Poka Yoke for Manufacturing
- Mistake Proofing for Design

Reading:

- 7.1 Hinckley, M. "Controlling Mistakes"
- 7.2 "Assured Quality Mistake Proofing Examples"

Assignment:

HW#3: List 3 top variations and 3 top mistakes and corresponding mitigation plans (Due 5/5 Mon)

Due:

HW#2: Robust Design of a Force Sensor: Closed Form

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Meeting #8 (4/28 Mon) Robust Design: Modeling and Optimization (Beiter/DeMare)

- Robust Design Case Study (CD Optical Pick, Server Chassis)
- Modeling and Optimization for Robust Design

Reading:

- 8.1 Seki, K., Ishii, K., & Esterman, M. "Robust Design for Dynamic Performance: Optical Pick-up Example"
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Meeting #9 (4/30 Wed): Active Learning on Variation / Mistakes

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Meeting #10 (5/5 Mon): Decision Analytical Scorecarding (Ishii / Fowler)

- Worth Feasibility Evaluation
- Scorecard Influence Diagram
- Net Present Value

Reading:

- 10.1 Sarbacker, S. and Ishii, K. "Worth Feasibility Evaluation: A Tool to Plan and Track Innovative Product Development."
- 10.2 Whit's paper on DA-based Scorecarding

Due:

HW#3: List 3 top variations and 3 top mistakes and corresponding mitigation plans

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Meeting #11 (5/7 Wed): Mid Quarter Project Review

- Focus on deliverables
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Meeting #12 (5/12 Mon): Showcasing Your Proposed Innovation (Examples from past projects)

- Prototype / mock-ups
 - Storyboarding
 - Animation
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Meeting #13 (5/14 Wed): Active Learning on Showcasing

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Meeting #14 (5/19 Mon): Scenario-based Amorphous Systems Design (Ishii)

- Scenario-based design revisited
- Reflecting on your ME317 project process

Reading:

- 14.1 Sun's paper on Scenario-based Amorphous Systems Design
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Meeting #15 (5/21 Wed): AL on ME317 Project Process (the "Winning" Curve: Project Roller Coaster)

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5/26 (Mon) Memorial Day, No Classes

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Meeting #16 (5/28 Wed): Social and Environmentally Responsible Design

- What is Social and Environmental Responsibility?

Reading:

- 16.1 Gheorghe, R. and Ishii, K. "Eco-design Value Alignment—Keys to Success"

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Meeting #17 (6/2 Mon): Towards Advanced dfM (Ishii)

- Beyond ME317A&B
- Advanced topics in dfM
- FEEDBACK SESSION

Reading:

17.1 K. Ishii (2007) "Design for Value Creation: Course Epilogue"

- IMPORTANT:** ME317B Final Report DUE at 16:00 PST to reach MML (On campus and local sites)
- Remote sites with appropriate delay

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Meeting #18 (6/4 Wed) Final Presentation (all teams to be videotaped and scripted on Stanford On-line)

- Final Presentation (16:15 – 18:15 PDT)
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Key Dates for on-campus students

6/2/2008 (Mon)	ME317A&B Overall Final Report (by 1600 PDT)
6/4/2008 (Wed)	ME317A&B Overall Final Presentation (1615 – 1930 PDT)