Department of
MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

SYLLABUS

ME EN 5150/6150

Product-Safety Engineering and Engineering Ethics

Instructor: Kenneth d'Entremont, Ph.D., P.E., Associate Professor (Lecturer)
MEB 2105 (*Merrill*—not MEK/Rio Tinto)
(801) 581-6766
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Office Hours: Monday, 4:00-6:00 PM (In Person, MEB 2150)
Thursday, 1:00-3:00 PM (Virtual via Zoom)
https://utah.zoom.us/j/93872776742; meeting ID: 938 7277 6742 (No Password)
Or by appointment

Grader: Mr. Will Jenkins (u1396611@utah.edu)

Lectures: Monday, 6:10-9:10 PM—In-Person
MEK 3550
Two short breaks will be taken during classroom lectures
Recording of lectures (by any means) is explicitly ***not*** permitted

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Course Description

This course introduces the elements of product-safety engineering within a fast-paced, innovative international design and manufacturing corporation subject to significant regulatory and public scrutiny. Subjects covered include the role of the product-safety engineer in the design, development, testing, manufacturing, and post-manufacturing stages of a product as well as engineering ethics and its role in responsible decision making. Both conceptual and applied tools will be introduced and used. An integrated, systems approach to product safety will be taught including the influences of designers, manufacturers, regulators, consumers, and the use environment as well as the importance of effective and consistent information, instruction, and marketing materials for a product. Students will study the role of compliance with standards and regulations. Standards-development processes as well as the need to actively maintain standards to keep pace with technological advances—and apply engineering ethics to critical design decisions—will be covered.

Guest lecturers will provide unique perspectives and further broaden student understanding of important aspects to designing and delivering safe products.

Course Objectives

1. To consider the roles of engineering ethics—including Corporate Social Responsibility (CSR)—in engineering practice
2. To recognize the diverse components needed to construct and operate a corporate product-safety engineering program
3. To understand and use product-safety engineering concepts
4. To be able to implement the product-safety *function* within a product-development process
5. To learn the components of an effective product-safety process before, during, and after product development, manufacture, and sale
6. To be able to support the product-development process pursuing product safety with documents containing clear logic using supporting design and testing concepts, methodologies, materials, and other sources as necessary
7. To recognize the important elements of a post-sale product-safety surveillance process/program to identify and evaluate product issues that may lead to a high risk of user injury or death and subsequent product-safety recalls
8. To help a company learn from past safety problems and recalls
9. To learn how to develop effective product-safety facilitators such as owner's manuals, warning labels, website content, and video content for product users
10. To recognize the appropriate role of compliance with regulations, standards, and agreements regarding product safety—and to realize when blind compliance alone is insufficient and even compliance it may be *contrary* to safety
11. To learn the basics of use evaluation, hazard identification, risk evaluation, accidents, and their outcomes
12. To learn how to use and understand the limitations of product-safety engineering tools such as the Haddon matrix, FMECA, FTA, and the Product-Safety Matrix to analyze and develop safe products
13. To be able to think critically to solve new and challenging product-safety issues of the future
14. To better serve the public as competent and ethical engineers

Course Format

The format for this class will be ***Semi-Flipped***. Rather than focusing upon lecturing over the reading material, much of the class will be interactive. I will try to engage students in discussions and pose questions. This interaction will include guest lecturers with Q&A following, break-out groups to examine and report-back to the class on findings, and demonstrations. Some class time will be spent on lecture over the reading—but will focus on the high points, generally, rather than the details of the reading material. (Any such lecture notes will be posted in Canvas *after* the class.)

Students will be *expected to have read* the book and other assigned reading materials before they come to class. Students will be given ample opportunity—and be encouraged—to ask questions about any materials in class.

Classroom Vision

It is hoped that these lecture periods will be a place for open and honest discussion about this important topic.

- Critical thinking is encouraged—if not demanded
- This is a ***fault-tolerant*** environment
- No one will make more mistakes than the professor!
- Let us all learn together!

COURSEWORK

ME EN **5150** grades will be based on student performance on the following:

Academic-integrity quiz	5 points
ASTM as Student Member (no cost)	5
2 exams	200
8 (of 10) Homework assignments (25 points each)	200
Drop two lowest	
Undergraduate project (**Written** only for ME EN 5150)	100 points
(Performed in groups of 3-5)	***510 points***

ME EN **6150** grades will be based on student performance on the following:

Academic-integrity quiz	5 points
ASTM as Student Member (no cost)	5
2 exams	200
8 (of 10) Homework Assignments (25 points each)	200
Drop two lowest	
Graduate-Project **Written** Report	100
Graduate-Project **Presentation**	100 points
(Performed in groups of 3-5)	***610 points***

Final grades for both ME EN 5150 & 6150 will use the same grading scale (by percent as shown below). The professor reserves the right to grade "on the curve" (to the benefit of students)

Grade	**%**
A	94+
A-	90+
B+	87+
B	84+
B-	80+
C+	77+
C	74+
C-	70+
et seq.	—

Exams will be Closed materials, notes, computer/phone/tablet

- Exams will be not more than 120 minutes in length—probably 90 minutes
- No lecture on exam days—only the exam
- Headphones or other audio devices are not permitted

- Final exam will be ***non-comprehensive*** *(You're welcome!* 😊*)*

Homework Re-Submission Policy

- HW due at date/time specified
- Students may correct and re-submit homework assignments within one week after the HW has been returned
- 80% credit of the new score will be used for HW grade
- Student can only re-submit HW once

Questions about Grading

If you have questions regarding how your homework or quiz was graded, ***please attempt to get your answer from the grader first***. If that fails to resolve an issue, please then contact the professor.

Exams and projects will be graded by the professor.

Additional Course Content

The professor may add a couple of short lecture videos if the guest lecturers cut into class time significantly or to compensate for missing lecture(s) due to holiday(s).

Assignments will NOT be added.

Academic Integrity

Engineering is a profession demanding a high level of personal honesty, integrity and responsibility. Therefore, it is essential that engineering students, in fulfillment of their academic requirements and in preparation to enter the engineering profession, adhere to the Department of Mechanical Engineering Policy for Academic Misconduct. This policy is based upon the University of Utah's Policy 6-400: Code of Student Rights and Responsibilities (student code) where academic misconduct "...includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information. It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct."

As part of the ME policy, students must review and acknowledge the "ME Academic Misconduct Policy" and the "ME EN 5150/6150 Definition of Academic Misconduct" provided as an attachment to this syllabus. Both documents can be downloaded from the course Canvas page at https://utah.instructure.com. Students must provide acknowledgment of the ME Academic Misconduct Policy and course specific definitions of academic misconduct via the Canvas Academic Integrity Module for this course before the end of the second week of class or they will be asked to drop the class and will otherwise receive an EU grade.

Course Materials

Apart from the textbook, any required reading materials are available free of charge. Some materials are referenced in lecture, but not required due to costs. Not all materials will be covered each semester, but are included for future reference.

1. Textbook (REQUIRED)
   K.L. d'Entremont, *Engineering Ethics and Design for Product Safety*, McGraw-Hill, New York, 2021. (List price: $90.00)
   Available from Amazon and other retailers
   The U of U bookstore will carry—unsure of details
   Instructor makes no money on book sales to his students
   These royalties are donated to charity
2. Newspaper Article
   David Jeans, *The Polaris RZR, an Off-Road Thrill That Can Go Up in Flames*, New York Times, September 6, 2019.
   https://www.nytimes.com/2019/09/06/business/polaris-rzr-fires.html
3. Other d'Entremont materials (PDF, XLS, DOCX, PPT & MP4) as needed
4. Ralph L. Barnett / Triodyne Inc. materials
   a. Safety Briefs (http://triodyne.com/Publications.htm)
      i. Principles of Human Safety, V5 N1
      ii. The Dependency Hypothesis (Part I), V2 N3
      iii. The Dependency Hypothesis (Part II), V3 N1
      iv. On Classification of Safeguard Devices (Part I), V1 N1
      v. On Classification of Safeguard Devices (Part II), V1 N2
      vi. Safety Hierarchy, V3 N2
      vii. The Principle of Uniform Safety, V10 N1
      viii. Philosophical Aspects of Dangerous Safety Systems, V1 N4
      ix. Safeguard-Evaluation Protocol, V11 N2
         1. Also see Safety Bulletin, V1 N1
      x. On Safety Codes and Standards, V2 N1
      xi. Standards—Impact & Impotence, V27 N2
      xii. The Doctrine of Manifest Danger, V8 N1
      xiii. Safety Interlocks—The Dark Side, V7 N3
      xiv. Ten Critical Factors in the Design Process, V19 N1
      xv. Engineering-Design Process Issues, V6 N3
      xvi. Design Defect: Doctrine of Alternative Design, V13 N4
      xvii. Reasonably Foreseeable Use, V14 N3
      xviii. Auto-Deploying Vertical Band Saw Guard, V31 N1
      xix. "Slip and Fall" Theory—Extreme Order Statistics, V21 N3
      xx. Stochastic Theory of Human Slipping, V22 N4
      xxi. Floor Reliability with Respect to "Slip and Fall," V24 N3
      xxii. Slip and Fall Characterization of Floors, V26 N2
      xxiii. Extreme Value Formulation for Human Slip—A Summary, V27 N4
   b. Safety Bulletins (http://triodyne.com/Publications.htm)
      i. Safety Rules of Thumb, V2 N4
   c. Training Manuals (USDOT/FHWA)
      i. Commercial Vehicle Preventable Accident Manual (CVPAM) (in Canvas)
      ii. HazMat Manual (in Canvas)
   d. Machine-Guarding Posters
      i. Punch Presses (in Canvas)

   ii. Press Brakes (in Canvas)
  e. Other Technical Papers
   i. Barnett, Ralph L. 2020a. "On the Safety Theorem." American Journal of Mechanical Engineering 8 (2): 50–53. https://doi.org/10.12691/ajme-8-2-1. (http://pubs.sciepub.com/ajme/8/2/1)
   ii. Barnett, Ralph L. 2020b. "Safety Definitions: Colloquial, Standards, Regulatory, Torts, Heuristic, and Quantitative." American Journal of Mechanical Engineering 8 (2): 54–60. https://doi.org/10.12691/ajme-8-2-2. (http://pubs.sciepub.com/ajme/8/2/1)
5. ANSI Standards
  a. ANSI/NEMA Z535.4-2011, American National Standard for Product Safety Signs and Labels
  b. ANSI/NEMA Z535.6-2011, American National Standard for Product Safety Information in Product Manuals, Instruction, and Other Collateral Materials
  c. ANSI/SVIA 1-2010, American National Standard for All-Terrain Vehicles (ATVs)
  d. ANSI/ROHVA 1-2014, American National Standard for Recreational Off-Highway Vehicles (ROVs)
6. European Commission (EC) Directives
  a. European Machinery Directive (2006/42/EC)
  b. Restrictions on Hazardous Substances ("RoHS 2") Directive (2011/65/EC)
7. US CPSC Materials
  a. 1988 Consent Decree with All-Terrain Vehicle (ATV) manufacturers (https://www.cpsc.gov/content/cpsc-approves-consent-decrees-for-all-terrain-vehicles)
8. US DOT/NHTSA
  a. Federal Motor Vehicle Safety Standards (FMVSS) – 49 CFR 571 & 572
   i. FMVSS 500: LSV
  b. Denial of GG Quad Petition
9. US CDC Growth Charts – Stature & Weight for boys & girls ages 2 through 20 years
10. US Military Standards
  a. MIL-STD-882E (2000), *System Safety*
  b. MIL-STD-1629A Notice 3, *FMECA*
11. Instructional materials on DVDs
12. Recreational Off-highway Vehicle Association (ROHVA) Training Materials
13. NASA Report of *Columbia* Accident Investigation Board (2003)
14. IIHS vehicle crash-testing video footage
15. Dreyfuss & Associates, *The Measure of Man & Woman*
16. Tillman, Fitts, Woodson, Rose-Sundholm, and Tilman, *Human Factors and Ergonomics Design Handbook*, 3e, McGraw-Hill, New York, 2016.
17. Ian Sommerville lectures (http://www.software-engin.com/)
18. ISO Engineering Design-Safety Standards
  a. ANSI/ISO 12100:2012. Safety of Machinery—General Principles for Design—Risk Assessment and Risk Reduction, 03/05/2012.
  b. ISO 13849-1:2006. Safety of Machinery—Safety Related Parts of Control Systems—Part 1: General Principles for Design, 11/01/2006.
19. U.S. Nuclear Regulatory Commission, NUREG-0492, *Fault Tree Handbook*, January 1981.
20. U.S. Naval Surface Warfare Center, CARDEROCKDIV, NSWC-11, *Handbook of Reliability Prediction Procedures for Mechanical Equipment*, May 2011.
21. Crownlite Manufacturing Corp., Failure Modes of Electronics (www.crownlite.com)
22. C.A. Ericson II, *Hazard Analysis Techniques for System Safety*, Second Edition, John Wiley & Sons, Hoboken, NJ, USA, 2016.

23. NASA Office of Safety and Mission Assurance, Fault Tree Handbook with Aerospace Applications, Version 1.1, August 2002.
24. R. Nader, *Unsafe at Any Speed: The Designed-In Dangers of the American Automobile*, Grossman Publishers, New York, NY, USA, 1965. (Chapter 1: The Sporty Corvair)
25. Ken Ross, see http://www.productliabilityprevention.com/

Recommended Reading (at some point in your life, if interested or necessary—but *not* part of this class)**:**

Books

Florman, Samuel C. 1994. *The Existential Pleasures of Engineering*. Second. New York, NY, USA: St. Martin's Griffin.

Janis, Irving L. (Yale University). 1982. *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*. Second. Boston, MA, USA: Wadsworth, Cengage Learning.

Petroski, Henry (Duke University). 1982. *To Engineer Is Human: The Role of Failure in Successful Design*. New York, NY, USA: Vintage Books.

Pirsig, Robert M. 1974. *Zen and the Art of Motorcycle Maintenance: An Inquiry into Values*. New York, NY, USA: Morrow Quill.

Thaler, Richard H., and Cass R. Sunstein. 2008. *Nudge: Improving Decisions About Health, Wealth, and Happiness*. New Haven, CT, USA: Yale University Press.

Functional-Safety Standards

ISO 13849-1:2015, *Safety of machinery—Safety-related parts of control systems (SRP/CS)—Part 1: General principles for design* [for hydraulic, pneumatic, mechanical, electric/electronic, and other types of control systems]

IEC 61508-2010, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems (E/E/PE or E/E/PES)*.

IEC/EN 62061-2021, *Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems*.

ISO 26262-2018. *Road vehicles–Functional safety*.

ISO 25119-1:2018. *Tractors and machinery for agriculture and forestry—Safety-related parts of control systems—Part 1: General principles for design and development.*

College of Engineering Guidelines

The College of Engineering Guidelines for this semester are available at https://www.coe.utah.edu/semester-guidelines and, the current copy, is available on Canvas under Files/Syllabus.

It is your responsibility to know, understand, and observe the dates and procedures.

Student Services

The University of Utah provides support to numerous student populations, such as those listed below. Please contact the professor if you need anything to make the learning process and environment better.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services (CDS), 162 Olpin Union Building, 801-581-5020 (V/TDD). CDS will work with you and the professor to plan for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services. (www.hr.utah.edu/oeo/ada/guide/faculty/)

Wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources, contact the Center for Student Wellness, www.wellness.utah.edu, 801-581-7776.

Student Veterans: The University of Utah has a Veterans Support Center on campus. They are located in Room 161 in the Olpin Union Building. Hours: M-F 8 AM-5 PM. Please visit their website for more information about what support they offer, a list of ongoing events, and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

Members of the LGBTQ Community: Please know that the University of Utah has an LGBT Resource Center on campus. They are located in Room 409 in the Olpin Union Building. Hours: M-F 8 AM-5 PM. You can visit their website to find more information about the support they can offer, a list of events through the center, and links to additional resources: http://lgbt.utah.edu.

Students for Whom English is a Second Language: Please be aware of several resources on campus that will support you with your language development and writing. These resources include: Department of Linguistics ESL Program (http://linguistics.utah.edu/esl-program/), the Writing Center (http://writingcenter.utah.edu/), the Writing Program (http://writing-program.utah.edu/), and the English Language Institute (http://continue.utah.edu/eli/).

Center for Disability & Access (CDA): See services that might be available at www.disability.utah.edu.

To avoid any complications due to timing of accommodations, meet with University resources as soon as you believe that you need assistance. Processing have recently been backlogged.

Please let the professor know if there is anything that you need beyond the above.

COVID-19

Stay up to date on policies, practices, and guidance with the University of Utah's COVID-19 webpage: https://coronavirus.utah.edu/.

Syllabus Calendar

Introduction to Product-Safety Engineering and Engineering Ethics					
University of Utah -- ME EN 5150 & 6150					
Fall 2021					
Monday at 6:10-9:10 PM -- In-Person Lectures (MEK 3550)					
Prof. Kenneth L. d'Entremont					
Week	**Date**	**Chapter**	**Topics**	**Reading (for THIS Lecture)**	**Assignments Due**
1	08/23/21	N/A	Conduct of the course		[None]
		N/A	Syllabus	Syllabus	
		--	Preface and Acknowledgements	Preface & Acknowledgements	
		0	Notice	Chapters 0 & 1	
		1	Introduction		
		2	Product Safety	NHTSA Denial of Petition	
2	08/30/21	2	Product Safety (continued)	Preface & Acknowledgements	HW 1: Introduction to
		3	Engineering Ethics	Chapters 2 & 3	Product-Safety Engineering
					Academic-Integrity Module
				https://www.nytimes.com/2019/09/06/business/polaris-rzr-fires.html	
				Nader, *Unsafe at Any Speed* (chapter)	
3	09/06/21		**Labor Day -- No Lecture**	Barnett references i-vi	HW 2: Value systems, Recalls,
				Chapter 4 (begin)	and CSR
					ASTM Student Membership
					[Both due (Tuesday) 09/07/21]
4	09/13/21	**GL**	**Ms. Molly Lynyak, ASTM, F15 Committee of Consumer Products**	**CPSC Press Releases (two)**	
		4	Product-Safety Concepts	Chapter 4 (finish)	
5	09/20/21	**GL**	**Hon. Robert S. Adler, Acting Chair, US CPSC**		HW 3: Product-Safety Concepts
		5	Hazards, Risks, Accidents, and Outcomes	Chapter 5	(Part 1)
				Appendix A	
6	09/27/21	**GL**	**Mr. Don Mays, Chief Safety & Quality Officer, Samsung USA**		HW 4: Product-Safety Concepts
		5	Hazards, Risks, Acccidents, and Outcomes (continued)	Chapter 5	(Part 2)
				Appendix A	
7	10/04/21	**GL**	**Mr. Ken Ross, Bowman & Brooke, "Product Liability and the Engineer"**		HW 5: Hazard, Risk, Accident,
		6	A Product-Design Process	Chapter 6	and Outcome
		7	Product-Safety Engineering	Chapter 7	
			Review for Mid-Term Exam: Come with Questions	**Study for Mid-Term Exam**	**Study for Mid-Term Exam**
8	10/11/21		**Fall Break -- No Class**	10/13: ASTM F15.71 meeting	Attend/participate if you can
					[No penalty if you cannot]
9	10/18/21	**Exam 1**	**Midterm: Exam 1 (on all material in lectures and Part 1 of textbook)**		
			(No lecture after exam)		
10	10/25/21	**GL**	**Ms. Yvonne Halpaus, QNET LLC, "CE Marking for Europe"**	EC Directive 2006/42/EC: Machinery	Semester-Project Proposal
			Review of Mid-Term Exam		
		8	Engineering-Design Guidance	Chapter 8	
				ANSI/ROHVA 1-2016 Standard	
11	11/01/21	**GL**	**Prof. Ralph L. Barnett, Safety Philosophy Topics**		HW 6: Product Design, PSEg,
		9	Product-Safety Facilitators	Chapter 9	and Design Guidance
				Manuals: CVPAM and HazMat	
				R.L. Barnett readings (TBD)	
12	11/08/21	**GL**	**Prof. Dan Hair (WCF, CRO, retired), "Risk Management"**		HW 7: Product-Safety Facilitators
		10	Product-Safety Engineering Methods (Part I)	Chapter 10	
				Appendix B	
13	11/15/21	**GL**	**Mr. Jon Bready, CSE, "Forensics and Accident Reconstruction"**		HW 8: FMECA
		10	Product-Safety Engineering Methods (Part II)	Chapter 10	
				Appendix B	
14	11/22/21	**GL**	**Prof. Ryan Stanfield, Moog, "Medical-Device Safety"**		HW 9: FTA
		11	Product-Safety Defects and Recalls	Chapter 11	
15	11/29/21	**GP**	**Graduate Presentations (No *Undergraduate* presentations)**	Chapter 12	Semester-Project Present'n
					[ME EN 6150 students only]
16	12/06/21	**GL**	**Mr. Barry C. Toone--Intersection of Engineering and Law**		HW 10: Bow-Tie Analysis
			Review for Final Exam: Come with Questions	**Study for Final Exam**	Semester-Project Written Report
					(Report due **Wednesday 12/08**)
FINAL	**12/13/21**	**Exam 2**	**Final: Exam 2 (*Non*-Comprehensive on all material *since* Exam 1) -- 6:10-8:10 PM**		
	Legend:		**Exam or Quiz Related**		
			Guest Lecturer (Lecture will open with guest lecturer)		
			Graduate Presentations	**(No *Undergraduate* Presentations)**	
			No Class		
	*** Schedule subject to change according to Guest-Lecturer availability ***				
Date Revised: 09/16/21 (©K.L. d'Entremont 2022)					

Semester Project

Select a group project that is of interest to you. I am flexible about projects—so long as there is a safety component to the product, system, issue, item, etc.

Your project may focus on Capstone design or work-related topics. You may take an existing product and tear it down and look at it from the course's perspective and do FMEAs, FTAs, PSMxs, (better) warning labels, owner's manuals, intended-use and limitations-for-use analyses, etc.

I would like to see you have an exercise that will permit you to work through the various aspects and analyses presented in this course.

Show me that you know how all of these pieces fit together to produce a system to improve product safety through sound engineering principles and judgement.

Please see me or email me if you have questions.

- Undergraduate & Graduate students
  - Undergraduate: Work in teams of 3-5 *(6 is O.K. in a pinch)*
  - Graduate: Work in teams of 3 (if possible; there are six grad students enrolled)
- **Select a Product of the group's choice**
  - **"Product"** = Product, Process, Vehicle, etc.
  - Evaluate the Product using tools learned in this class
    - Safeguard classification, PHL, PHA, PSMx, FMEA, FTA, Risk Analysis, …
    - Other methods you may find
  - May be work-related project

PRODUCT-SAFETY ENGINEERING DEVELOPMENT PLAN

Prepare and present a product-safety plan for a product in the engineering-design, development, and testing process. *(What has already been done—or what you would do if you were developing this product.)* The product chosen for this project is up to the groups.

The ***body*** of the group's work—aside from Introduction, Conclusions, Recommended Future Work, etc.—should be organized as follows (there will be exceptions):

SAMPLE PRODUCT-SAFETY ENGINEERING DEVELOPMENT PLAN

I. Intended-Use Statement
   Limitations of use (Temperatures, Weights, Altitudes, Ages, …)
   Consider Reasonably Foreseeable Misuse
II. Performance Specifications
   Establish safety-related spec's
      Maxima, minima & nominal
      What must always happen
      What must never happen
      Consider all Functions / Modes

- Attachments
- Others

Any benchmarking that should be conducted prior to release of product

III. Engineering Design (Synthesis)
- Type of Safeguard Device(s)
  - Types I-VII
  - Zero-Order, …, n^{th}-Order System
- Guards & Safeguards
  - To be used (and why?)
  - To not be used (and why?)
- Accessories? (Yes/No)

IV. Engineering Analysis (do those analyses that make the most sense)
- PHL / PHA / SRM
- Haddon Matrix
- FMECA (a few significant **Failure Modes**)
- FTA (a few significant **Top-Level Events**)
- Risk-Assessment methods

V. Testing Plan
- Laboratory & Field testing
- System & Component testing
- Environmental conditions
- Ultimate & Fatigue (or Single & Repeated)
- Ergonomics & Human Factors Concerns

VI. Safety Materials
- Instruction Manual (Product-Safety section only)
  - Operation
  - Maintenance
  - PPE
- Warning Labels
- Sales & Marketing requirements? (Remember the Intended-Use Statement)
- Description of material which must be contained in safety video or materials

VII. Post-Sale Monitoring
- Potential problem areas to monitor
- Sources of such information
  - Distributors
  - Stores
  - Regulators (e.g., US CPSC)

VIII. Supplemental Materials
- References
- Appendices
- Other Materials

Not all of the items above may apply, but state the group's rationale for its decisions in your proposal, presentation (if in 6150), and written report.

Limit the group's consideration, work, and scope to:

- USA sales only
- Product safety—assume that the product is legal in all jurisdictions

When:

Proposal	10/25/21
In-Class Presentation (6150 only)	11/29/21
Written Report	12/06/21

Points:

Proposal*	0 points (All students)
In-Class Presentation (6150 only)	100 points (Graduate students only)
Written Report	100 points (All students)

* This is the deliverable by which the group demonstrates that it has thought through the project

Where & How:

Student groups will present in classroom (MEK 3550) during lecture time using computer, PowerPoint, and any other exhibits or props as needed.

1. REQUIRED CONTENT FOR SEMESTER-PROJECT OUTLINE/PROPOSAL

One outline per group

Names of the students in the group

You may give your group a suitable ***team name*** to have some fun ☺

1. Brief overview of Intended Use statement
2. Summary of Safety-Related Performance Specifications
3. Overview of Guards & Safeguards to be *considered* (not necessarily incorporated)
4. FMECA—Identify some *potential* major Failure Modes
5. FTA—Identify some *potential* Top-Level Events
6. Identify a few Testing objectives to be demonstrated before product release/production
7. Identify several Safety Materials that may be necessary and main topics therein
8. Anything else you feel is needed

*The outline is considered a **working draft** document. It is **NOT** a binding document. You may always change analyses, content, etc., since such changes in plan are common—and to be expected—as more understanding is gained during the course of a project.*

You are free to determine the length of your outline. Just be sure to make it easy to understand your plan and methods for the project.

2. REQUIRED FORMAT FOR SEMESTER-PROJECT WRITTEN REPORTS

Cover Page: The cover page should include: Names of authors/contributors, Course title and number (ME EN 5150/6150 "Introduction to Product-Safety Engineering"), Semester & Year, Project/Report title, and Submission date

Abstract: Two to three paragraphs (250 words max) summarizing the background, goal(s) and results of the project.

Table of Contents: Include page numbers for major sections. A separate list of tables, figures and appendices should also be included.

Introduction/Background: Discuss the general background of the subject area. Include relevant research or information. Introduce the project and note the goal(s).

***PRODUCT-SAFETY ENGINEERING DEVELOPMENT PLAN*:** This section is the body of the paper and contains a discussion of synthesis & analysis performed for the project. Briefly explain/introduce any tools (methods) used in the group's plan. Explain the results of each effort. Do not just say that a particular score went from a "3" to a "1." The naïve reader (read management) may have no idea what that means.

Include figures and tables as appropriate. Figures are graphic illustrations of things or data. Tables are arrays of data with headings to identify the entries. All tables, figures, etc. must be addressed in the text and located as close as possible to (but not preceding) where they are first mentioned in the text. Tables and figures should have a separate numbering sequence (Table 1, 2, etc. and Figure 1, 2, etc.). If much data is collected, summarize the results in a figure or table and include relevant raw data in an appendix.

Conclusion: Draw out key findings contained in the previous *Product-Safety Engineering Development Plan* section and present the implications of those findings. If the project has made the group aware of other problems or potential areas for further research or analysis, note them in this section.

References: There is no need to reference material that is either common knowledge or opinion. References in the text should be tied to the reference list at the end of the paper. The reference method may be in any accepted format. Enough information should be presented in the reference list to facilitate retrieval of the source material by an interested reader. Reliable, trusted, web sources can be used but must be appropriately referenced.

Appendix: The appendix should include secondary information such as raw data. In general, do not include figures and tables in appendices. (They generally belong in the text.) A listing of the appendices should be included in the Table of Contents *and* at the beginning of the appendix section. All appendices should be discussed/referenced in the text. Appendices may also contain relevant material that is too detailed or too voluminous to be included in the text. All appendix pages should be numbered but may be numbered separately from the text if convenient. For example, if there are Appendices A, B, and C, they should have page numbers A1, A2, B1, B2, B3, C1, C2, C3, etc.

Other Content/Issues:

1. Submit ***one*** written report for the entire group with the names of ***all*** group members

2. All pages except the cover page must be numbered. The abstract and table of contents should be numbered with Roman numerals.
3. When tables and figures are in landscape format, the top of the table/figure should be at the left/**binding** side of the report.
4. The axis on plots or graphs should have a zero point on the axis or labeling/notation to show otherwise.
5. If much data is used, summarize the results in a table or figure and include relevant raw data in an appendix.
6. Please submit the group's written/printed report in a folder with a strong spring clip to hold it together. That makes it easier to grade, scan, and transport. Please, do NOT staple your report together!!!
7. Use letter-size paper unless you need a larger size for drawings, charts, or tables.
8. Again, only use one side of each leaf/page of paper.
9. Group name and page number on each page (O.K. if handwritten).

Scoring: The 100 points will be assigned in the table below.

Portion	Criteria	Points
Cover Page Abstract Table of Contents		10
Introduction Background		10
BODY Problem Statement, Analysis, Results & Discussion	Use & Presentation of material learned in Course; Correctness of any Analyses performed; Originality	50
Conclusions		10
References Appendix Other Content		10
Other Overall Impressions		10
Total Score		100

3. REQUIREMENTS FOR SEMESTER-PROJECT ORAL PRESENTATIONS

(GRADUATE STUDENTS ONLY)

EVALUATION FORM (SAMPLE)

Evaluate the graduate projects in these general areas:

1. **CONTENT** (40%—40 points):

   Did content of the presentation increase your awareness/understanding of a particular area of, or concept in, the field of **product safety**?

and/or

Did the presenter(s) describe and solve a problem using the **product-safety** concepts and tools presented during the course?

2. **EFFICIENCY** (20%—20 points):

   Was the time used effectively? Did the presentation follow a logical order of events (for example, but not necessarily required, (1) introduce the problem or discussion area, (2) present the material, (3) summarize. Was the presentation too long or too short?

3. **PRESENTATION FORMAT** (20%—20 points):

   Were visual aids effective? Did the visual aids help you follow/understand/appreciate what the presenter was trying to say?

4. **OVERALL** (20%—20 points):

   What did you think of the presentation overall? Did you feel that the presenter(s) made a good effort? Did the presentation hold your interest?

Category	**(40%)**	**(20%)**	**(20%)**	**(20%)**	**(100%)**
	40 Pts	**20 Pts**	**20 Pts**	**20 Pts**	**100 Pts**
	Content	**Efficiency**	**Format**	**Overall**	**TOTAL**

GROUP 1

Students: _____

Presentation ____ ____ ____ ____ _____

Comments

4. EXAMPLES OF PRIOR SEMESTER-PROJECT TOPICS

Capstone-Design projects
- Formula SAE electric vehicle competition
- Product-safety analysis of your Capstone project (with design of facilitators)

Work projects
- Design
- Testing
- Manufacturing
- Risk Analysis

Student-inspired
- Medical device
  - Endoscope sheath
  - Prosthetics
  - Liquid-oxygen tank for outdoor/sporting use
- Applied Virtual Reality or Augmented Reality (VR or AR)

Steam-cooking pot for home use
Electric rental scooter—e-scooter (e.g., Bird)
E-bike
Specialty electric vehicle
Solar-cooking appliance
Additive manufacturing: 3-D printer (FDM or SLA)
Electric go-kart for competition
Hand-held leaf blower/mulcher
Flame thrower
Gasoline-powered chain saw
Table saw
Motorcycle floor boards
Barbeque grill
Convention-cooktop unit
Multi-position ladder
Waste-water treatment equipment
Automobile air bags
Jet pack
Snow thrower/blower
Electric tiller
Miter saw
Reciprocating saw
Air gun
Six-axis robot
Garage-door opener
Mountain bike (MTB)
Segway
Powered Nordic ski
Scissor lift
Food preparation appliance: electric blender, mixer, dicer, etc.
Smart appliances and other Internet-of-Things (IoT)-enabled devices

Professor-assigned

Electrically-powered front bicycle wheel

Other ideas

Purchase suitable affordable consumer product
An "As Seen on TV" product (e.g., https://www.asseenontvlive.com/)
A product of interest from
Prior work experience
Prior lifetime experience
A hobby or other interest

Syllabus-Revision History

Rev. 0:	08/22/21	Original Document; no changes
Rev. 0a:	08/22/21	Confirmed Mr. Don Mays as Guest Lecturer on 10/04/21 Corrected Exam information at bottom of p. 3
Rev. 1:	09/09/21	Added information for course Grader Fixed schedule and reading-material errors
Rev. 2:	09/16/21	Clarified office hours: "Or by appointment" Delayed HW 3, 4 & 5 by one week each Swapped dates for two guest lecturers (09/27 and 10/04)