IE 3332 SAFETY ENGINEERING/ IE 4334 WORK DESIGN, PRODUCTIVITY AND SAFETY

Prerequisite(s):

(BE 3373 w/C or better AND CE 2315 w/C or better) OR (BE 2434 w/C or better AND IE 2315 w/C or better AND IE 3373 w/C or better AND MECH 1321 w/C or better)

Contribution of Course to Industrial and Systems Engineering Program Student Outcomes:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Contribution of Course to Meeting Curriculum Requirements

This course contributes with three credit-hours for the engineering education component.

Class Schedule:

Two 80-minutes lecture sessions per week

TR 12:00 pm – 1:20 pm

*Updates to guest lecture dates, and consequently some assignment/lecture dates will be made

Instructor: Dr. Priyadarshini Pennathur
Email: prpennathur2@utep.edu

Office hours: Tuesdays 2:00 pm - 4:00 pm; by appointment.

Office: A 241 (Engineering Annex)

Course objective

The objective of this course is to introduce basic concepts in safety engineering and management and to develop an understanding of the importance of considering safety in design. The course will include an overview of major techniques for risk assessment and hazard evaluation, discuss standards, and engineering controls for preventing safety problems.

The course will include 2 mini projects focused on evaluation of safety in a setting and examining safety in complex domains.

Course goals

1. Understanding of fundamental safety concepts and theories
2. An ability to apply standards and basic principles for evaluation and design
3. An ability to apply engineering techniques for risk assessment and hazard control
4. Understanding of safety implications in various domains
5. An ability to formulate solutions for safety problems through control design and engineering recommendations

Course Expectations

1. Read, prepare and understand assignment materials for every class, critically and reflectively.
2. I will provide you class material slides when needed/available after the class on Blackboard. The class slide materials are based on several sources. Some recommended books are provided below if you would like to refer them.
3. Participate and contribute to class discussions, by including your thoughtful ideas and opinions, with due respect for your peers' ideas.
4. Bring additional insights and opinions by sharing other resources, articles or ideas that you are aware of.
5. Be punctual and courteous in attending the class sessions, and in submitting assignments on time.
6. Plan your time to work with your team on projects and team assignments.
7. Please be courteous to your peers and instructor. Talking to your friends, using the phone, and browsing on the computer disrupts the classroom environment and takes valuable time away from class activities.

Course format and technology setup.

We will meet in-person during prescribed class days and times. Additionally, almost every class, we will work on class activities that need to be turned in that day. For class activities, we will use Google Docs/your hardcopy notebooks to complete your group activities.

I will have in-person office hours primarily and use zoom office hours as needed. If you are unable to make it to one of the Office Hours, you can always email me and we can find a good time to meet.

Blackboard. We will utilize Blackboard for all assignment submissions, exams, announcements and grading.

Teamwork

There is a team peer evaluation component in the course, so all members in the team will evaluate each other confidentially (only I will know how your teammates rated you), and all members in a team will not get the same grade in a team assignment based on the rating. Please see the peer evaluation document for how you will rate your team members. The grade obtained by an individual for team related assignments (product liability, class activities, mini project 1, mini project 2, accident case study) will be the product of the team grade and the peer evaluation score of the individual. For example, if the content of the presentation was graded as 90 out of 100, but you received a 80 out of 100 in your team rubric evaluation, then your final score in this assignment would be 72 (90*0.8). It is important you check the team rubric, participate and contribute fully in your teamwork assignments. Again, I leave how you do the teamwork to you. You can meet in-person, in zoom or a combination based on what everyone in your team is comfortable with.

Recommended Textbooks

Roger L. Brauer. Safety and Health for Engineers. 3rd Edition, John Wiley and Sons, Inc., 2016. (Ebook and Renting options available for amazon.com)

Nicholas J. Bahr. System Safety Engineering and Risk Assessment: A Practical Approach, Second Edition. (Available for Renting from amazon.com)

Description of Assignments and Exams

Exams

There will be 2 exams, one midterm and one take-home exam at the times mentioned in the schedule. All exams are open book. The midterm exam will focus on assessing your understanding of basic concepts and theories in safety engineering, including legal implications.

There will be one take-home exam at the times mentioned in the schedule. The take home exam will be available on Blackboard roughly 2 weeks before the due date. You are encouraged to begin working on the exam as soon as it becomes available, and not wait until the due date. The take home exam will focus on your understanding of safety engineering techniques, and their application to safety case scenarios. You will be provided one to two safety problem case scenarios, and will be asked to identify and use the most effective technique for analyzing and solving the problem, and provide your recommendations for control. The take-home exam needs to be a typed document, 10 pages **maximum,** single spaced. Use examples, figures and illustrations as appropriate. Cite references used.

Make-up exam will be allowed only under exceptional and genuine circumstances and with appropriate and prior notification to the instructor. Personal travel for thanksgiving or holidays not approved by the university does not count as an exceptional circumstance.

Product Liability Presentation:

In this product liability presentation assignment, the goal is for you to identify, discuss and analyze a consumer product with recalls, or liability issues. The Consumer Product Safety Commission routinely tracks consumer products for safety problems, and issues recalls. In this team assignment, you will identify a specific product from the product liability database and case studies and analyze the following:

1. Describe the product or class of products with details on its form and function.
2. Describe the safety problem or accident that has led to a recall, warning or discontinuation of this product.
3. Describe the law and/or regulations that apply to this liability case.
4. Describe in detail the type of defect (design or manufacturing) and provide details why it was caused.
5. Describe a potential design solution that could have prevented this safety problem from occurring.
6. Discuss how this product or class of products has implications globally, and whether international regulations, standards or laws apply differently.

Your team will prepare a short presentation on your findings and present it as a team during the semester. **There is no written report for the product liability presentation assignment.**

A presentation rubric will be used for evaluation, and will be uploaded to Blackboard for you to understand the evaluation elements. A team peer evaluation rubric will be used to assess each individual's contribution to the teamwork.

For the product liability presentation, Blackboard Assignments will close on the time specified in the schedule (typically 11:30 AM on the due date) and late submissions will not be accepted. Email and hardcopy submissions are hard to manage and will not be accepted.

Accident Analysis Case Report:

In this case report assignment, the goal is for you to identify, analyze and discuss safety case studies that have either resulted in major accidents or have been prevented from being an accident. The National Transportation Board and other federal agencies typically analyze such accidents and provide a public report on the reasons for the accident.

In this team assignment, you will identify a safety case study from the popular media or safety resources (Safety books, NTSB, CPSC, FAA, NASA etc.,), and analyze the following:

1. Identify the causes of the accident/potential accident.
2. Identify the standards that were applicable in the case.
3. What methods were used to analyze the accident/case?
4. What conclusions did they draw from their analysis?
5. What engineering and design controls could have prevented the accident? What administrative controls could have helped?

Your team will prepare a short report on your findings. The report needs to be a typed document, 5 pages **maximum,** single spaced, not including references or figures. Use

examples, figures and illustrations as appropriate. Cite references used. A team peer evaluation rubric will be used to assess each individual's contribution to the teamwork.

For the safety case report, Blackboard Assignments will close on the time specified in the schedule (typically 11:59 PM on the due date) and late submissions will not be accepted. Email and hardcopy submissions are hard to manage and will not be accepted.

Mini-Project Presentations:

There will be two mini-projects throughout the semester. The mini-projects are team based. In the first few weeks of your class, you will identify topics for the 2 mini-projects with your team. Please discuss with me the idea you plan to pursue to make sure it fits within the goals and scope of the project.

The goal of the mini-projects is to engage you in evaluation of a system or facility for its current safety setup/design and suggestions for design/re-design of a system or facility's safety setup using engineering or administrative controls and discussion of emerging safety engineering related challenges. The details of the two mini-projects are provided below.

For each of the mini-projects, you are required to prepare a presentation to be submitted on Blackboard on the due date. **There is no written report for this assignment.** A presentation rubric will be used for evaluation, and will be uploaded to Blackboard for you to understand the evaluation elements. A team peer evaluation rubric will be used to assess each individual's contribution to the teamwork.

For the mini-projects presentation, Blackboard Assignments will close on the time specified in the schedule (typically 11:30 AM on the due date) and late submissions will not be accepted. Email and hardcopy submissions are hard to manage and will not be accepted.

<u>Mini Project Presentation 1: Identifying Safety Engineering Challenges in Emerging Complex Domains</u>

In mini-project 1, the goal is for you to identify safety considerations in real-world complex systems such as space, medicine etc., In this mini-project 1, you will identify current safety considerations, guidelines for designing safety into these systems or products used in these domains, and safety challenges in these complex systems. For example, what safety considerations do space scientists need to think about when designing space travel for astronauts? What guidelines do they follow? How do safety considerations impact design and process?

You are free to pick specific examples to discuss. Please remember that you are to present a synthesis of what you understood from the research papers and other external sources, and not a slide-by-slide review of each paper/webpage. They are due at the times indicated in the schedule.

Suggested Topics:

1. Space Travel

2. Hyperloop
3. Autonomous Driving
4. Robotics in Medicine
5. Artificial Intelligence and Reverse Engineering the Brain
6. Biomaterials

Suggested Outline:

1. Describe the setting and/or specific examples in that setting.
2. Discuss the major safety implications of this setting. What are the major safety challenges in this domain? How have researchers studied this issue?
3. What are specific reasons for these safety challenges? (e.g., O-ring heating is a specific issue that led to the challenger disaster). Is it design or manufacturing of a product, design of a system or process or a combination of these? How do each of these elements (manufacturing or design of a product, system or process) lead to safety problems in this domain?
4. Describe safety considerations, relevant guidelines, laws and regulations that are applicable. What do engineers do to ensure a safe design? What guidelines do they follow? What standards and regulations do they incorporate to ensure safety?
5. Compare safety implications for this setting globally. Are safety laws and considerations applied differently on a global scale?
6. What are some unanticipated safety challenges in this domain according to you? What are some recommendations to address those challenges?
7. Conclusions
8. Sources

Mini Project Presentation 2: System or Facility Evaluation

In mini-project 2, there are two options for you to pick from. (1) Facility safety assessment using hazard analysis tools (2) safety assessment of a system, process or product using the system safety evaluation tools that you will learn about in class. You can pick whichever option your team wants.

Option 1 - Facility safety assessment using hazard evaluation tools

Choose an actual facility and perform a safety assessment using facility hazard evaluation tools. There are several hazard evaluation instruments available for evaluation from OSHA and other agencies and sources. For this, you will have to examine a physical facility and assess their safety using the instruments. For example, assessing how exits are designed, what hazards are present in the physical environment etc are some ways you can conduct this analysis. Please ensure you have permission and access to the facility to do this. If you do this, please also make sure that you follow any safety precautions for the facility.

Suggested Outline:

1. Describe the facility or system you identified
2. What does your analysis indicate regarding safety of the facility?

3. What engineering design or administrative control changes do these facilities employ?
4. What are your recommendations?
5. Conclusions
6. Sources

OR

Option 2 - Safety assessment of product, process or system using system evaluation tools

Perform a safety assessment of any system, product or process using the system evaluation safety techniques you learn in class. These techniques can include Fault tree analysis, Root cause analysis, Failure Mode and Effects Analysis etc. You can pick any current system, product or process to perform your evaluation.

1. Describe the product, process or system that you are examining.

2. What techniques are you using to evaluate its safety? Why?

3. What does your safety evaluation indicate? Indicate with appropriate figures, tables representing your evaluation.

4. What recommendations do you have?

5. Conclusions

6. Sources

Presentation Preparation and Submission

Each team should submit their product liability and mini-projects presentations online via Blackboard on the afternoon of the presentation due dates. **Note that only the PPTs/presentations uploaded to Blackboard in advance will be used for the in-class presentations.** We will not be able to accommodate any last minute requests for using updated slides to remain fair to everyone preparing and presenting the slides in advance. Please see schedule for the due dates of presentations to be uploaded to Blackboard. No excuses or delays, please.

Teamwork Expectations

- You are expected to sort out upload/technology/team problems in advance.
- Discuss team/project issues with me in advance. While we expect you to hold each other accountable in your teams, please notify us in advance if you need our help. We will use the team evaluation rubric so that your individual contributions are also reflected in your team assignment grades.
- For any resources specific to the projects or case studies (instruments, tools, books etc.,) and guidance, please contact me in advance.
- Project slides/presentation needs to be professional – clear, readable and thoughtful presentations.

Technical details and ideas need to be of the highest standards, similar to that of what you would give your client in your workplace.

Class Activities and Participation:

You will be expected to attend classes regularly. We will have class activities with assignments to turn in almost every class. These class activities are designed to provide you hands-on training identifying and evaluating safety problems, and designing solutions for them. These class activities will be performed in small groups with your peers. These class exercises will range from finding common standards from the internet to working on a hazard evaluation exercise. Class activities count towards your individual grade. Attendance will be taken. You are required to write only the names of the team members who participated in that activity, not all of your team members. Class Activity submissions without attending or participating in class will not be considered for grading.

For class activities, we will use Google Docs or use hardcopy notebooks/paper to complete your group activities.

If there is a genuine need for absence, please contact Dr. Pennathur well in advance, and please inform your team of your absence.

Grading

GRADING SCALE**:**

A:	91-100
B:	81-90
C:	71-80
D:	61-70
F:	≤ 60

Exams:	45% of the total grade (Exam 1-20; Take Home Exam -25)
Accident Analysis Case Report:	5%
Product Liability Presentations	10%
Mini projects	30% (15% each)
Class activities	10%

Tentative Schedule

Week	Date	Topic	Assignment (due dates)
1	Jan 17	Course introduction	
	Jan 19	Introduction to Safety and Fundamental concepts	
2	Jan 24	Introduction to Accident Investigation and Accident Causation Theories	
	Jan 26	Federal Laws on Safety	
3	Jan 31	Workers' Compensation	
	Feb 2	Product Liability	
4	Feb 7	Record Keeping	
	Feb 9	Materials Handling	
5	Feb 14	Machine Guarding	

	Feb 16	Personal Protective Equipment	
6	Feb 21	Review Session	
	Feb 23	Exam 1	
7	Feb 28	Fundamental concepts on hazards and hazard control Risk Assessment	
	Mar 2	Systems Safety Evaluation Techniques: Basic Concepts and Evaluation Techniques and Functional Tree	
8	Mar 7	Product Liability Presentations	Product Liability Presentations **due on Blackboard at 11:30 AM**
	Mar 9	Product Liability Presentations	
	Mar 14	Spring Break	
	Mar 16	Spring Break	
9	Mar 21	System Safety Evaluation Techniques: Facility Hazard Analysis	

	Mar 23	System Safety Evaluation Techniques: What-if Analysis and HAZOP Analysis	
10	Mar 28	Guest Lecture	
	Mar 30	System Safety Evaluation Techniques: Root Cause Analysis	
11	Apr 4	Mini project 1 presentation	Mini Project Presentations 1 **Due on Blackboard 11:30 AM**
	Apr 6	Mini project 1 presentation	
12	Apr 11	System Safety Evaluation Techniques: Root Cause Analysis	
	Apr 13	System Safety Evaluation Techniques: Fault Tree Analysis	
13	Apr 18	System Safety Evaluation Techniques: Fault Tree Analysis	Accident Case Study Reports **Due on Blackboard 11:59 PM**

	Apr 20	System Safety Evaluation Techniques: Failure Mode and Effects Analysis	
14	Apr 25	System Safety Evaluation Techniques: Operations and Support Hazard Analysis	
	Apr 27	Guest Lecture	
15	May 2	Mini project 2 presentation	Mini Project Presentations 2 **Due on Blackboard 11:30 AM**
	May 4	Mini project 2 presentation	
	May 9	Take Home Exam Due	

Administrative Drops:
At the discretion of the instructor, a student may be dropped from a course because of excessive absences, neglect or lack of effort. A grade of "W" will be assigned before the course drop deadline and a grade of "F" after the course drop deadline. A grade of "F" received due to disciplinary action imposed by the University overrides a grade of "W" received through a student-initiated or faculty drop.

Class Attendance:
The student is expected to attend all class sessions. It is the responsibility of the student to inform each instructor of extended absences. When, in the judgment of the instructor, a student

has been absent to such a degree as to impair his or her status relative to credit for the course, a drop for not attending will count toward the State Allowed Six Drop Limit. If you are failing the class at the time of the drop you may also be given a WF designation. Be advised that a drop could adversely impact visa status, financial aid and other programs. As per UTEP rules, you may be asked to show a UTEP ID at any time during class.

Excused Absences for University-Recognized Activities:
Students who will be absent while representing the University in officially recognized University activities (sports, band, professional conferences, etc.) **must notify the Dean of Students not less than ten (10) days prior to the absence**. The Dean of Students will provide the student with a letter of excuse for the professors. It is the student's responsibility to give the letter to the professors prior to the official recognized activity. Students following these procedures will be permitted to make up both assignments and examinations in consultation with faculty.

Students With Disabilities:
If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at https://www.utep.edu/student-affairs/cass/.

Academic Integrity:
The University of Texas at El Paso prides itself on its standards of academic excellence. In all matters of intellectual pursuit, UTEP faculty and students must strive to achieve excellence based on the quality of work produced by the individual. In the classroom and in all other academic activities, students are expected to uphold the highest standards of academic integrity. Any form of academic dishonesty is an affront to the pursuit of knowledge and jeopardizes the quality of the degree awarded to all graduates of UTEP.

Any student who commits an act of academic dishonesty is subject to discipline. Academic dishonesty includes, and is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, and any act designed to give unfair advantage to a student or the attempt to commit such acts. Proven violations of the detailed regulations, as printed in the *Handbook of Operating Procedures (HOP)*, and available in the Office of Student Life and on the homepage of the Office of Student Life at www.utep.edu/dos, can result in sanctions ranging from disciplinary probation, to a failing grade on the work in question, to a failing grade in the course, to suspension or dismissal, among others.

Engineers are educated professionals, and every engineer is expected to subscribe to a professional canon of ethics. Paramount among these is the canon that engineers shall not affix their signatures to documents that are not their own work. This is also expected of engineering students, whether or not the work is being graded individually or as a group! **If academic dishonesty is suspected or observed, please report it to the instructor -- this will be kept in the strictest confidence.**

- If you are suspected of scholastic dishonesty you may not be directly confronted about your conduct by the instructor or proctor. You will however, be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) and your exam will not be admissible. Your grade in the class may not be available until OSCCR makes a final ruling, this may adversely impact your ability to enroll in other classes or graduation.

- If you miss more than one exam, the instructor may choose to administratively drop you from the class. This may adversely impact a visa and financial aid.

- No food or drinks will be allowed in the examination room.

- Scholastic dishonesty on homework, lab assignments and all other class assignments will be held to the same standards and requirements of academic honesty as quizzes and exams.