Instructor: Dr. Richard T. Cimino, Senior Lecturer

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Class: T/Th, 11:30-12:50; Face-To-Face

Room: TIER-LECT1

Links to an external site.

Office Hours: MWF Virtual

Virtual Office Hours - **by arrangement only** - please sign up online at https://drcimino.youcanbook.me. Virtual office hours will take place using my personal Zoom.

Course Description and Requirements

A study of the technical fundamentals of chemical process safety: includes impact of chemical plant accidents and concepts of societal and individual risk; hazards associated with chemicals and other agents used in chemical plants, including toxic, flammable and reactive hazards: concepts of inherently safer design; control and mitigation of hazards to prevent accidents, including plant procedures and designs; major regulations that impact safety of chemical plants; consequences of chemical plant incidents due to acute and chronic chemical release and exposures; hazard identification procedures; introduction to risk assessment.

Prerequisites: CHE 342, CHE 370, CHE 375

Corequisites: CHE 349

Course Objectives

Taking this course, a motivated student will learn to:

1. Calculate and interpret common process safety indicators (PSI) such as injury and fatality rates.
2. Explain and apply the principles of Inherently Safer Design to improve the safety of a process.
3. Apply Probit Analysis to determine the outcomes of exposure to harmful chemicals and to overpressure from explosions.

4. Identify Globally Harmonized System (GHS) pictograms and guidewords for material and energy hazards and their severity.
5. Evaluate the magnitude of exposure to hazardous chemical vapors in various scenarios.
6. Utilize source models to determine the mass flow rate of liquid and vapor releases from vessels.
7. Utilize the Pasquill-Gifford Model of atmospheric dispersion to determine the concentration of hazardous materials downwind from a chemical release.
8. Characterize the flammability of mixtures using upper and lower flammability limit calculations
9. Calculate the peak side-on overpressure and TNT-equivalency of an explosion using scaling models.
10. Determine the number of pressure/vacuum purge cycles and the amount of inert gas necessary to completely inert a vessel with a flammable atmosphere.
11. Describe procedures necessary to prevent the buildup of static electric charges in process vessels.
12. Identify compatible/incompatible chemical mixtures using charts, tables, and chemical compatibility software.
13. Utilize reaction calorimetry to determine the maximum temperature of a reaction (MTR).
14. Design a spring-operated relief valve for vapor or liquid service.
15. Identify equipment necessary to handle effluent exiting through reliefs.
16. Perform a Hazard and Operability Analysis (HAZOP) on a simple process.
17. Calculate the probability of failure and mean time between failure for multicomponent chemical processes in parallel and in series.
18. Perform a Layer of Protection Analysis (LOPA) for a process safety incident scenario and determine the risk level associated with it.
19. Write a professional process hazard analysis report based upon a process safety scenario, incorporating numerical calculations and recommendations for reducing the risk of such a scenario from occurring.
20. Recognize the social and ethical dimensions of process safety, including the impact of process safety incidents on societal and global scales.
21. Participate in collaborative teamwork and learn to establish goals and meet deadlines, while recognizing the importance of diversity and inclusion in effective teamwork.
22. Use online e-learning tools and obtain SACHE certificates while recognizing the need for life-long learning in chemical process safety

Learning Materials

Textbook

Required: Daniel A. Crowl and J. F. Louvar, Chemical Process Safety, Fundamentals with Applications, 4th ed., Prentice Hall, 2019. 656 pages. ISBN-13: 978-0134857770. The

textbook is the main source for preparing for classes and reading the textbook before each class is necessary. Additional materials will be posted on Canvas.

Online Learning Materials: Students will complete online learning courses developed for the Safety And Chemical Engineering Education (SAChE) program by the AICHE.

Calculator: A graphing calculator (TI-83, TI-84 or TI-84SE) is required for solving numerical problems.

Required Hardware:

A working computer running either Windows or MacOS.

Course Outline

Week	Date(s)	Topic (preliminary, subject to minor changes)
1	**1/21-1/23**	**Introduction & Ch. 1: Intro to Process Safety**
2	**1/28-1/30**	**Ch. 2: Toxicology**
3	**2/4-2/6**	**Ch. 3: Industrial Hygiene**
4	**2/11-2/13**	**Ch 4: Source Models**
5	**2/18-2/20**	**Ch. 4: Source Models** **Ch. 5 Dispersion**

6	**2/25-2/27**	**Exam 1 Review, Exam 1**
7	**3/4-3/6**	**Ch. 5: Dispersion** **Ch. 6: Fires and Explosions**
8	**3/11-3/13**	**Ch. 6: Fires and Explosions** **Ch. 7 Mitigating Fires and Explosions**
		Spring Break 3/16-3/23 Woo!
9	**3/25-3/27**	**Ch. 8 Chemical Reactive Hazards**
10	**4/1***	**Process Safety Ethics** ***No class 4/3 (Wellness Day)**
11	**4/8-4/10**	**Exam 2 Review, Exam 2**
12	**4/15-4/17**	**Ch. 9 Relief Concepts** **Ch. 10 Relief Concepts & Calculations**
13	**4/22-4/24**	**Ch. 11 HAZOPS**
14	**4/29-5/1**	**Ch. 12 Risk Analysis**
15	**5/6**	**Final Exam Review**

Final Exam: TBA

Assessment and Grading

Weekly Discussions: Each week, you will watch a CSB.gov video and discuss the process safety implications with your classmates. These discussions are graded for participation. Please see the Discussions tab on Canvas for details.

SAChE Certificates: These will be due at fixed points throughout the semester, and follow the order of topics covered in class. Students will upload completed SAChE certificates to Canvas. Each completed certificate carries the same weight (100% for each completion). Failure to upload your certificates by the specified deadlines will result in deductions for those certificates.

Team Assignments & Project: Other assignments will require you to work in teams of up to 3 students. The instructor will designate the teams.

Peer Evaluation: You will use the Comprehensive Assessment of Team Effectiveness (CATME, www.catme.org) to evaluate the teaming behaviors of yourself and your teammates during the term project. These evaluations will be incorporated into the assignment of final grades.

Quizzes: Regular in-class quizzes will be given regularly based on the weekly material. In order to prepare for these quizzes, each module has a set of Practice Problems that you can use to practice. No make-up quizzes will be allowed.

Exams: There will be two midterm exams (80 min long) and one final exam (2.5 hours long).

Grading: Your final course grade will be calculated by weighted average, using the following weights:

Category	**Weight**
Discussions & In-Class Activities	**10%**
Quizzes	**10%**

Project (team and individual work)	**20%**
SACHE Certificates	**10%**
Midterms (x2)	**30%**
Final Exam	**20%**
Total	**100%**

Final course grades will be assigned according to the following rubric:

Lower Bound	Letter Grade	Upper Bound
90	**A**	**100**
85	**B+**	**89**
80	**B**	**84**
75	**C+**	**79**
70	**C**	**74**
60	**D**	**69**
0	**F**	**60**

Policies

NJIT Honor Code: The NJIT Honor Code will be upheld and any violations will be brought to the immediate attention of the Dean of Students.

Special Needs: If you need accommodations due to a disability please contact OARS to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

Lectures: This course is a face-to-face course. This means that each lecture will take place in-person during the class hours. Attending the sessions in person is strongly recommended. Quizzes will take place in-class so failure to attend could result in zeros on quizzes. Additionally, the examples discussed in the class are not necessarily from the main textbook and therefore missing a class will have consequences for your preparation for quizzes and exams. ***Note, if at any point the course is forced to go virtual, you will be provided with additional information on how to access the course lectures online.***

Students are expected to be in the classroom at the starting time of the class period. Being late to class may have consequences for your final course grade.

No audio or video recording is allowed.

Cellphones should be turned off during exams and silenced during lectures.

Course materials, office hours and correspondence

The course Canvas page is the main platform for delivering information about the course. All relevant course materials and assignments will be posted on Canvas, so a student should check it regularly.

Students must upload a professional-looking head shot for their Canvas profile.

Students are strongly encouraged to attend Office Hours. Long questions which require derivations will be discussed only during the Office Hours and will not be answered by email. Questions regarding grades can be discussed only during the Office Hours.

E-mail and Canvas correspondence is intended only for quick questions. Questions which require a detailed discussion should be discussed in person during the Office Hours.

All correspondence should be conducted in a professional style, using formal English.

To assure a quick response to your emails, please add "ChE312" in the subject of your emails.

The instructor reserves the right not to respond to emails at his personal discretion.

Exams, Quizzes, Homework and Grades

A letter grade is based on the final score, calculated using Canvas in accordance with the Tables given in this syllabus. The assigned letter grade is final and cannot be negotiated.

A student can dispute the exam scores within a week after the announcement of the score. Exam scores can only be disputed during the official Office Hours, not during class time or via email.

Students will get zero for not coming to quizzes, exams, or any other course activity. If students miss an exam due to extreme circumstances (such as a medical problem), they need to notify the instructor via email before the beginning of the exam, and bring proof of the circumstance to the Dean of Student's office. Only in the case of official approval from the Dean of Student's office, may a make-up be given at the discretion of the instructor.

A student must show full details when solving a problem during an exam or a quiz. Not showing the work will cause the losing points even if the final answer is correct.

Partial credit can be given for solving the exam and quiz problems, though no partial credit will be given if there are not enough details to follow.

The final answer should be always evaluated with respect to its reasonability. No partial credit will be given if the final answer is wrong and unreasonable, and it is not recognized and stated explicitly on the exam by the student.

If a student misses a quiz due to a legitimate reason (absence approved by the Dean of Students), this quiz is excluded from the quiz average calculation.

Student handwriting must be legible in order to receive points.

Honors Supplement: To receive honors credit for this course, you must:

1.) Log at least 15 hours of external, self-guided honors project work (see options on Canvas under Honors Supplement).

2.) Submit an honors project report detailing your Honors project experience and its relevance to chemical process safety.