Chemical Process Safety
ECH 4714, Section: CPS1(23974)
Class Periods: MWF, Period 8 (3:00 PM - 3:50 PM)
Location: RNK 0110
Academic Term: Spring 2024

Instructor:
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Description
3 credit hours. Laboratory and process safety analysis which emphasizes prevention and mitigation. Application of chemical engineering principles to assessing hazards and risk. Integrated with ECH 4224L.

Course Pre-Requisites/ Co-Requisites
Prerequisites: ECH 3101 (Process Thermodynamics), ECH 3203 (Fluid and Solid Operations) and ECH 3223 (Energy Transfer Operations).

Course Objectives
Upon completion of this course, a student should be able to:
1. Work safely in a laboratory setting.
2. Be familiar with personal protection equipment and the reasons for use.
3. Be familiar with proper methods for disposing of chemical waste.
4. Be familiar with known hazards such as dust and vapor explosions.
5. Understand the fire triangle and the methods used to avoid explosions.
6. Be aware of methods used for incident investigation.
7. Be aware of the factors that can lead to an accident.
8. Be aware of societal issues concerning technology and the impact of the practice of chemical engineering on the surrounding and larger community.
9. Be aware of ethical issues and principles in chemical engineering practice.
10. Understand risk assessment.
11. Understand Process Safety Management (PSM).

Specific topics covered will include:
- Laboratory safety, gas cylinder safety, personal protection equipment.
- Hazardous materials, waste disposal
- Factors leading to major accidents. Current topics: recent incidents
- Engineering ethics, inherent safety, accident and loss statistics, acceptable risk, public perceptions, the nature of the accident process (Chapter 1)
- Toxicology, TLV, dose response curves (Chapter 2)
- Industrial hygiene, government regulations (OSHA: PSM; EPA: RMP) (Chapter 3)
- Ventilation calculations, control of worker exposure (Chapter 3)
- Source models (liquids and gases) (Chapter 4)

- Toxic release and dispersion models (Chapter 5)
- Fires and explosions, fire triangle, flammability diagram, characteristics of explosions (Chapter 6)
- Designs to prevent fires and explosions (Chapter 7)
- Chemical reactivity (Chapter 8)
- Relief sizing (Chapter 9,10)
- Hazard identification (Chapter 11)
- Risk Assessment, revealed and unrevealed faults, event trees, QRA, LOPA (Chapter 12)

Materials and Supply Fees
N/A

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	
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	High
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- **Title**: Chemical Process Safety: Fundamentals with Applications
- **Authors**: Daniel A. Crowl and Joseph F. Louvar
- Prentice-Hall, Upper Saddle River, NJ, 2011, 3rd edition (2011) or 4th edition (2019)
- ISBN-13: 9780131382268 (3rd Ed), ISBN-13: 9780134857848 (4th Ed)
- Course Notes, which includes personal notes from lectures and documentation uploaded on Canvas (such as PowerPoint presentations and other information files).
- We will utilize the Chemical Reactivity Worksheet to identify incompatible chemicals. Version 4 of this software is available for free from AIChE: https://www.aiche.org/ccps/resources/downloadinstall

Note: Exams will be open-book, and use of computers and phones will be prohibited. Thus, **a paper copy of the book will be required**. Also, older versions of the book (2nd edition and older) **CANNOT** be used.

Recommended Materials

As the course represents the synthesis of chemical engineering courses taken to date, e.g., material and energy balances, transport phenomena, fluid and solids operations, and thermodynamics, students are advised to refer to textbooks used in those classes as needed.

Course Schedule

Week 1: Laboratory safety, safety definitions, Chapter 1
Week 2: Major accidents, toxicology, probit correlations, Chapters 1-2
Week 3: Industrial hygiene, evaluation of exposure, ventilation calculations, Chapter 3
Week 4: Source models, liquid flow, Chapter 4
Week 5: Review, Exam 1
Week 6: Source models, flow of gases, flashing liquids, Chapter 4
Week 7: Dispersion models, toxic effect criteria, Chapter 5
Week 8: Fires and explosions, Chapter 6
Week 9: Estimating blast damage, preventing fires, Chapters 6-7
Week 10: Review, Exam 2
Week 11: Chemical reactivity hazards, Chapter 8
Week 12: Relief and relief sizing, Chapters 9-10
Week 13: Hazard identification, Chapter 11
Week 14: Risk assessment, Chapter 12
Week 15: Review, Exam 3
Week 16: In-class project

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is highly recommended to allow students to ask questions during lectures. Students must be present to take exams during the scheduled times. Arrangements must be made in advance if exam conflicts occur.
Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Assignments and Quizzes	100 each	25%
Exam 1	100	25%
Exam 2	100	25%
Exam 3	100	25%
		100%

Late Homework Submission

Late homework is subject to a penalty of 10 pts/day, until the solutions are posted. This penalty may be waived for extenuating circumstances (at the instructor's discretion) if communicated in writing before the deadline.

Grading Policy

Grades for this class are curved at the discretion of the instructor. Attendance and class participation will be considered.

The following is an approximate grading scale.

Percent	Grade	Grade Points
93.4 -100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B -	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

All students are required to complete **two** SAChE safety certificates; "Chemical Reactivity Hazards" and "Process Safety Ethics - A Brief Introduction". Extra credit is given for completion of additional **Level Two** and **Level Three** SACHE certification as follows:

1-2 certificates 1/3 letter grade
3-4 certificates 2/3 letter grade
5 or more certificate 1 letter grade

Maximum extra credit for completion of SAChE certificates is one letter grade. ***To be eligible for extra credit, the student must have achieved a C or better through homework, quizzes, and exams***.

Please note: a score of C or better is required before continuing in the Chemical Engineering program. By University of Florida policy, a C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/studentsj. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https:/ /ufl.bluera.com/uflj. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-resultsj.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. *A* class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. *A* student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance,** located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus:

https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/, https://care.dso.ufl.edu/.

On-Line Students Complaints: https://distance.ufl.edu/getting-help/; https://distance.ufl.edu/state-authorization-status/#student-complaint.