

Chemical Process Safety

ECH 4714 Section 3291

Class Periods: Tuesday, Period 8-9 (3:00–4:55 PM)
Thursday, Period 9 (4:05–4:55 PM)
Location: FLG 220
Academic Term: Spring 2019

Instructor

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Course Description

3 credit hours. Laboratory and process safety analysis with emphasis on prevention and mitigation. Application of chemical engineering principles to assessing hazards and risk. Integrated with ECH 4224L.

Course Pre-Requisites / Co-Requisites

Prerequisites: ENC 2210 or ENC 3254; Co-requisites: ECH 4224L and STA 3032.

Course Objectives

Upon completion of this course, a student should be able to:

1. Work safely in a laboratory setting.
2. Be familiar with proper methods for disposing of chemical waste.
3. Be familiar with personal protection equipment and the reasons for use.
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:

- Lab safety, gas cylinder safety, personal protection equipment.
- Hazardous materials, waste disposal
- Factors leading to major accidents
- Dust explosions
- Lifting hazards
- Current topics: recent incidents
- Incident investigation
- Engineering ethics, examples of significant disasters

- Inherent safety, accident and loss statistics, acceptable risk, public perceptions, the nature of the accident process
- Toxicology, TLV, dose response curves
- Industrial Hygiene. Government regulations (OSHA: PSM; EPA: RMP)
- Ventilation calculations, control of worker exposure
- Source Models (liquids, vapors, liquid pools, realistic and worst case releases)
- Toxic Release and Dispersion Models, Pasquill-Gifford model, Dense gas dispersions
- Fires and Explosions, Fire triangle, flammability diagram, Characteristics of explosions
- Designs to Prevent Fires and Explosions. Static electricity, chemical reactivity
- Hazard identification
- Chemical reactivity, reactive hazard index
- Risk Assessment, revealed and unrevealed faults, event trees, QRA, LOPA

Materials and Supply Fees

None.

Relation to Program Outcomes (ABET)

5. Relationship of Course Objectives to B.S. Program Objectives:

Student Outcomes → ↓ Course Objectives	a	b	c	d	e	f	g	h	i	j	k	l
1		X									X	X
2		X									X	X
3		X									X	X
4			X								X	X
5	X		X	X							X	X
6	X			X							X	X
7	X		X	X							X	X
8					X	X		X	X	X	X	X
9					X	X		X			X	X
10					X	X		X			X	X
11			X		X	X		X			X	X

Student Outcomes

By the time Chemical Engineering students graduate, they attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- a recognition of industrial health and safety issues, and an ability to engage in fostering and exercising health and safety rules and regulations

Required Textbooks and Software

Daniel A. Crowl and Joseph F. Louvar, *Chemical Process Safety: Fundamentals with Applications*, 3rd edition, Prentice-Hall, Upper Saddle River, NJ, 2011. ISBN-13: 9780131382268.

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. Please be aware that the content of previous editions and the international edition differs from that of the required textbook.

Other materials will be made available on the course website.

Free programs (Aloha, Marplot, Cameo, and CRW4) from the National Oceanic and Atmospheric Administration (NOAA).

<https://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/response-tools/cameo-software-suite.html>

<https://www.aiche.org/ccps/resources/downloadinstall>

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

The tentative schedule for exams and materials covered is attached.

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is required. Attendance records will be used to guide determination of final grades. Cell phones and other distractions may not be used in class. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Evaluation of Grades

Grades are based on exams, completion of homework assignments, attendance, and participation in the class.

Homework and quizzes	10%
Mid-term exams (2)	50%
Final exam	40%

All students are required to complete the [SACHE Chemical Reactivity Hazard](#) certificate. Extra credit is given for completion of [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.

Grading Policy

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

Please note: A score of C or better 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. For more information on grades and grading policies, please visit: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>.

Relevant Aspects of the Chemical Engineering Policy on Exams

a) All exams will include the honor pledge and students must sign their name by the pledge.

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- b) All students must leave backpacks, bags, etc., in the front of the classroom as they enter.
- c) Students are asked not to bring cell phones in the exam. In case they do, they have to place the cell phones in the front of the classroom. The department and proctors have no responsibility in case of theft (cell phones should not be brought). A cell phone discovered on a student's person may result in a zero grade for the exam. If a student is expecting an important call, he or she must discuss this with the proctors before starting the exam.
- d) Students are required to remove their hats during the exam and place them in the front of the classroom.
- e) In open book exams no printed material other than the textbook is allowed. A solution manual or printouts from solution manuals will result in a zero grade for the exam and additional harsher penalties.
- f) Any talking between students is strictly prohibited and will result in a zero grade for the exam.
- g) Students may not leave the room before turning in the exam.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

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://www.dso.ufl.edu/sccr/process/student-conduct-honor-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.

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: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Commitment to a safe and inclusive learning environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination.

It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

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
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@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@ufl.edu

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

Campus Resources

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

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

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 Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.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://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.

Tentative Schedule (updated January 15, 2019)

Date	Topics Covered
Jan. 8, 2019	Introduction to Course. Explosion at T2. Expectations. (Chapter 1) Inherent safety, accident and loss statistics.
Jan. 10, 2019	(Chapter 1) accident and loss statistics, acceptable risk, public perceptions, the nature of the accident process.
Jan. 15, 2019	Chapter 1 Inherent safety, Bhopal. / (Chapter 2) Toxicology, Dose and Response Curves. Threshold Limit Values.
Jan. 17, 2019	Laboratory Safety
Jan. 22, 2019	(Chapter 3). Industrial Hygiene. Government regulations (OSHA: PSM; EPA: RMP) TLV calculations.
Jan. 24, 2019	(Chapter 3) Ventilation calculations, control of worker exposure.
Jan. 29, 2019	(Chapter 4) Source Models. Liquids, gases.
Jan. 31, 2019	(Chapter 4) Release of gases, choked flow.
Feb. 5, 2019	Guest Speaker, Diana Molina, Elastomers Process Technology Supervisor, Global Polymers Technology, ExxonMobil Chemical Company
Feb. 7, 2019	(Chapter 4) Liquid pool evaporation, realistic and worst case releases.
Feb. 12, 2019	
Feb. 14, 2019	Review
Feb. 19, 2019	Exam 1 (2 periods)
Feb. 21, 2019	(Chapter 5) Toxic Release and Dispersion Models. Fundamental approach.
Feb. 26, 2019	(Chapter 5) Pasquill-Gifford model.
Feb. 28, 2019	(Chapter 5) dense gas dispersions.
Mar. 5, 2019	Spring Break (No class held)
Mar. 7, 2019	Spring Break (No class held)
Mar. 12, 2019	(Chapter 6) Fires and Explosions.
Mar. 14, 2019	(Chapters 6) Flammability diagrams.
Mar. 19, 2019	Video presentation: Dust Explosions (quiz 2) Video presentation: BP Texas City (quiz 1)
Mar. 21, 2019	Video Presentation: Lifting Hazards (quiz 3)
Mar. 26, 2019	(Chapters 6,7) Characteristics of explosions. Concepts to Prevent Fires and Explosions. (Chapters 9, 10) Reliefs.
Mar. 28, 2019	Review
Apr. 2, 2019	Exam 2 (2 periods)
Apr. 4, 2019	(Chapter 11) Hazard Identification
Apr. 9, 2019	(Chapter 12) Risk Assessment.
Apr. 11, 2019	Revealed and unrevealed faults, Event trees, QRA, LOPA
Apr. 16, 2019	(Chapter 8) Chemical Reactivity.
Apr. 18, 2019	(Chapter 13) Safety Procedures and Best Practices
Apr. 23, 2019	Review
May 1, 2019	Final Exam (7:30–9:30 am)