

## **Chemical Process Safety**

ECH 4714, Section: 4997 (12970) OR 4B65 (23985)

**Class Periods** (Section 4997, #12970): MWF, Period 6 (12:50 PM - 1:40 PM)

**Class Periods** (Section 4B65, #23985): MWF, Period 8 (3:00 PM – 3:50 PM)

**Location:** PSY 0151 (4997, #12970)

**Location:** FAC 120 (4B65, #23985)

**Academic Term:** Spring 2020

### **Instructors:**

#### **Section 4997, #12970:**

Helena Hagelin-Weaver

E-mail: [hweaver@che.ufl.edu](mailto:hweaver@che.ufl.edu)

Office: 323 Chemical Engineering Building

Office Phone: 392-6585

Office Hours: Fridays, 11:30 PM - 12:30 PM; or by appointment (323 CHE Building)

#### **Section 4B65, #23985:**

VJ Tocco

E-mail: [vjtocco@ufl.edu](mailto:vjtocco@ufl.edu)

Office: 322 Black Hall

Office Phone: (352) 294-1290

Office Hours: MWF, 11 AM - Noon

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

N/A

### **Course 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 engineering problems by applying principles of engineering, science, and mathematics.	
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	
4. An ability to communicate effectively with a range of audiences	Assessed
5. 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.	
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	Assessed

### **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, 3<sup>rd</sup> edition (2011) or 4<sup>th</sup> edition (2019)
- ISBN-13: 9780131382268 (3<sup>rd</sup> Ed), ISBN-13: 9780134857848 (4<sup>th</sup> Ed)
- **Course Notes**, which includes personal notes from lectures and documentation uploaded on Canvas (such as PowerPoint presentations and other information files).

**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 (2<sup>nd</sup> 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, Chapters 1-2
Week 3:	Industrial hygiene, evaluation of exposure, ventilation calculations, Chapter 3
Week 4:	Source models, liquid flow, Chapter 4
Week 5:	Source models, flow of gases, Chapter 4
Week 6:	Review, Exam 1
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, make-up quiz

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance and participation will count towards grade; penalties for absence and tardiness may be assigned at the discretion of the instructor. Cell phones and other distractions may not be used in class 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**

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

### **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

All students are required to complete **two** SChE safety certificates; “Chemical Reactivity Hazards” and “Process Safety Ethics - A Brief Introduction”. Extra credit is given for completion of **Level Two** and **Level Three** SChE 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 SChE 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 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>.

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***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 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.ua.ufl.edu/students/>. 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/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-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://sccr.dso.ufl.edu/policies/student-honor-code-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 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](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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:** <http://www.counseling.ufl.edu/cwc>, 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](mailto: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/>.

**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://care.dso.ufl.edu>.

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