

## Chemical Kinetics and Reactor Design

ECH4504

**Class Periods:** Tuesday and Thursday: 12:50 PM – 2:45 PM (T,R: Periods 6-7) **4 Credit Hours**

**Location:** Williamson 0100 (WM 0100)

**Academic Term:** Fall 2019

### **Instructor:**

David Hibbitts

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352-392-0751

CHE 221

**Office Hours:** Monday and Friday, 12:00 PM – 1:30 PM, (See **Course Schedule** for exceptions)

### **Student Teacher:**

Purboja Purkayastha

[ppurkayastha@ufl.edu](mailto:ppurkayastha@ufl.edu)

### **ST Office Hours:**

Wednesdays, 5:10 PM – 7:05 PM, Black Hall, Room 315

### **Course Description (4 credits)**

Homogeneous and heterogeneous reaction kinetic modeling and data analysis. Analysis and design of ideal batch, mixed, plug and recycle reactors. Heterogeneous catalysis and reactor design.

### **Course Pre-Requisites**

Prereqs.: ECH 3264 and ECH 4123.

### **Course Objectives**

- To learn the fundamentals of the chemical kinetics of homogeneous and heterogeneous reactions and reactor design.
- To develop and apply methods for designing chemical reactors and reaction processes.

### **Required Textbooks and Software**

- Elements of Chemical Reaction Engineering, H.S. Fogler, 5<sup>th</sup> Ed., ISBN: 0-13-388751-0
- <http://www.umich.edu/~elements/5e/>

*Course notes are not obtained from published resources.*

### **Recommended Materials**

- *Chemical Reaction Engineering*, O. Levenspiel, 2<sup>nd</sup> Ed., Wiley (1972).
- *Chemical Engineering Kinetics*, J.M. Smith, 3<sup>rd</sup> Ed., McGraw-Hill (1981).
- *Chemical Kinetics*, K.J. Laidler, 3<sup>rd</sup> Ed., Harper Collins (1987).

## Course Schedule

Date	Meeting	Topic
08/20	Meeting 01	Reaction Rates and Rate Equations
08/22	Meeting 02	Elementary & Complex Reactions
08/27	Meeting 03	PSSA (cont.) & Chain Reactions (ST)
08/29	Meeting 04	Temperature Dependence of Reactions (ST)
09/03	Meeting 05	Activation Energy and Potential Energy Surfaces
09/05	Meeting 06	General Mole Balance
09/10	Meeting 07	Conversion and Reactor Sizing
09/12	Meeting 08	Stoichiometric Relationships
09/17	Meeting 09	Isothermal Reactor Design
09/19	Meeting 10	Tubular Reactors
09/24	Meeting 11	Reactions with Phase Change
09/26	Meeting 12	Pressure Drop in Reactors
10/02	Meeting 13	<b>Exam 1</b>
10/03	Meeting 14	Collection & Analyses of Rate Data
10/08	Meeting 15	Multiple Reactions
10/10	Meeting 16	Multiple Reactions (cont'd.)
10/15	Meeting 17	Solution Approach for Complex Rate Eqns
10/17	Meeting 18	Heat Effects in Chemical Reactions
10/22	Meeting 19	Heat Xfer to reactor
10/24	Meeting 20	Interstage heating or cooling
10/29	Meeting 21	Non-isothermal Tubular Reactors
10/31	Meeting 22	Multiple reactions w/ Heat Effects
11/06	Meeting 23	<b>Exam 2</b>
11/07	Meeting 24	Multiple Steady States
11/12	Meeting 25	Runaway Reactions (ST, AIChE)
11/14	Meeting 26	Review / Padding (ST, AIChE)
11/19	Meeting 27	Catalysis
11/21	Meeting 28	Surface Reaction Kinetic Models
11/26	Meeting 29	<b>Exam 3</b>
11/28	No Class	Thanksgiving
12/03– 12/04	Meeting 30	No Class. Unused if we don't fall behind.
12/12	Final Exam Slot	(5:30 PM - 7:30 PM) Unused if we don't fall behind.

### Irregular office hours

Office hours will not be held on:

Monday, 08/26 (ACS Conf.)  
Monday, 09/02 (Labor Day)  
Monday, 09/23 (SECS Conf.)  
Friday, 10/04 (Homecoming)  
Monday, 11/11 (Veteran's Day)  
Friday, 11/15 (AIChE Conf.)  
Friday, 11/29 (Day after Thanksgiving)

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

Attendance is strongly suggested.

#### **Please refrain from the use of cell phones and laptops.**

Excused absences are consistent with university policies in the undergraduate catalog and require appropriate documentation (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>).

### **Grading Policy**

Homework problems will be graded on a 0-2 scale (0 = no effort, 1 = little effort, 2 = significant effort). *No credit will be given without work being shown.* Your lowest homework scores will be dropped. Your homework average in the course cannot lower your final grade, but can help your final grade in the course. Final scores will be tabulated using the Table below and grade-averages may be increased to account for class performance.

#### **Evaluation of Grades**

<b>Assignment</b>	<b>Percentage of Final Grade</b>
Homework	0% or 15%
Exam w/ Best Grade	36% or 31%
Exam	32% or 27%
Exam	32% or 27%

### **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>

### **Campus Resources:**

## Health and Wellness

### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto: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](mailto: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](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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