PURDUE UNIVERSITY

DAVIDSON SCHOOL
OF CHEMICAL ENGINEERING

Fall 2026

Course Syllabi Packet

The following syllabi were collected from the instructor(s) or through Banner *Course Insights*. Please remember most of the syllabi are from a previous semester so dates will not align with the Fall 2026 semester.

The Banner *Course Insights* tool is available to you through *myPurdue* and logging in with your Purdue Career Account.

Specific Notes for Fall 2026 Courses:

1) CHE 20500, 30600 and 34800 are courses required by those with an admission condition to take these courses. The syllabus for these courses is included in this packet for those students,

2) CHE 59700 Industrial Chemical Technology has a new course number starting Fall 2026, which is CHE 57000. The course syllabus enclosed is from an earlier semester when it was numbered 59700,

3) The course syllabus for CHE 56000 Intro to Energy Storage Systems was not available at the time this packet was assembled,

Purdue University CHE 20500: Chemical Engineering Calculations, Fall 2025

A. Catalog Description. Quantitative applications of steady-state mass and energy balances to solve problems involving multi-component systems and multi-unit chemical processes. Single-component and multi-component phase equilibria, single-reaction and multiple-reaction stoichiometry, coupled mass and energy balances, chemical processes involving bypass and recycle streams.

B. Prerequisites. Chemistry 116 or Chemistry 136; Mathematics 161 (or equivalent); Physics 172 (or equivalent)

C. Course Text. *Elementary Principles of Chemical Processes, 4th Edition* **with the WileyPlus account** by R. M. Felder, R. W. Rousseau, and L. G. Bullard. Wiley and Sons, 2016. Purchases can be made through the bookstore or directly from Wiley.

- WileyPLUS Access with downloadable eText ISBN: 9781119498704
- WileyPLUS Access with downloadable eText and Loose Leaf 1 semester ISBN: 9781119760818

D. Course Learning Objectives. It is expected that, by the conclusion of the semester, class participants should be able to:

- Work professionally and ethically as a member of a chemical engineering team.
- State and describe the diverse social, economic, and environmental issues associated with being a chemical engineer.
- Apply the law of conservation of mass and conservation of atomic species in order to solve mass balances in unit operations with and without chemical reactions and with and without recycle streams.
- Determine, using first principles and well-established correlations, the relations between thermodynamic equilibria and multiphase systems.
- Integrate the first law of thermodynamics with the concept of energy balances in unit operations with and without chemical reactions and with and without recycle streams.
- Apply the laws of conservation of mass and energy and thermodynamic equilibrium data in order to formulate solutions for mass and energy flow rates in multi-unit systems.
- Utilize the concepts of transient mass balance problems in order to develop a basis for non-steady state applications.
- Design multi-unit chemical processes using steady-state and transient mass and energy balances in order to create multi-unit operations similar to those in future courses and applications in industry.

E. Course Outcomes. By the end of the course, the student should be able to:

1. Estimate physical properties of real chemical systems (Utilized in CHE 21100, 30600, 34800, 37700, 37800, 42000, 43500, 45000)
2. Evaluate introductory single-component and multi-component phase equilibria and incorporate these concepts into solutions of mass and energy balance problems (Utilized in CHE 21100, 30600, 37800, 43500, 45000)
3. Solve steady state and transient mass and energy balance problems for both reacting and non-reacting systems with or without recycle using analytical and computational methods (Utilized in CHE 21100, 30600, 34800, 37700, 37800, 42000, 43500, 45000, 45600)
4. Work professionally and ethically in teams to solve mass and energy balance problems (Utilized in CHE 30600, 34800, 37700, 37800, 43500, 45000)
5. Identify contemporary chemical engineering problems, including their impact on societal, economic, public welfare, environmental, and global factors (Utilized in CHE 30000, 40000, 42000, 45000)

F. **Davidson School of Chemical Engineering Program Outcomes for ABET.** Graduates of the Charles D. Davidson School of Chemical Engineering at Purdue University will (**bolded items are addressed in this course**):

1. **Apply principles of engineering, science, and mathematics to solve complex chemical engineering problems.**
2. **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.**
3. Communicate effectively with a range of audiences.
4. **Recognize ethical and professional responsibilities in chemical engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.**
5. **Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.**
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. **Acquire and apply new knowledge as needed, using appropriate learning strategies.**

G. **Expectations.** This is a 4 credit hour course, and it is expected that each student will spend a minimum of 12 hours each week (3 hours per credit) outside of lectures working on homework, studying, and reading the course text. In many cases, the first year in the university is harder than high school, but it is manageable with noticeably less effort than described above. This class, and all subsequent chemical engineering classes, will be much more challenging, and hence more rewarding, than anything that most students will have seen in previous courses. We encourage you to take studying seriously and establish good study habits (e.g., read the text during the assigned week, practice using additional problems). This will lead to a successful start of the student's chemical engineering career.

H. **Instructors' Commitment.** Your instructors will: (1) be courteous, punctual, well-organized, and prepared for class activities; (2) answer questions clearly in class or through office hours; (3) be available during office hours or notify you beforehand if they are unable to keep to the original office hour schedule; and (4) grade uniformly and consistently to the posted guidelines.

I. **Consulting with the Faculty Members.** We encourage you to discuss academic or personal questions with us during office hours or via email. These discussions need not be limited to CHE 20500 content.

J. **Academic Dishonesty.** Academic dishonesty ***will not be tolerated*** in any form in this course. Specifically, Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Section B-2-a, Code of Student Conduct] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972] AI tools may only be used during the learning process to summarize readings. All incidents of academic dishonesty will be reported to the Dean of Students. **Such incidents include: (i) possessing or accessing, in hardcopy or electronic form, solutions to the: course text, previous years' homework problems, and exams (e.g., obtaining solutions from websites such as Course Hero, Chegg, Quizlet, etc.); (ii) claiming credit for work that is not your own original work; (iii) enabling other students to create work that is not their original work; (iv) collaborating with other students (or getting other outside help) during an exam; (v) answering in-class quiz questions when not attending the lecture in person; and (vi) using AI tools for any graded work (e.g., exams, in-class quizzes, homework). The punishment for the first offense is a grade of zero for the entire work (exam, quiz, or homework), and the punishment for a second offense is an F mark for the class.**

K. **Academic Integrity.** Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert your instructors and university officials to potential breeches of this value by either emailing integrity@purdue.edu or by calling (765) 494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

L. **Student-Initiated Purdue Honors Pledge.** As a Boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue.

M. **Student Professionalism.** The highest standards of professionalism and ethics are expected in CHE 20500. Each student is expected to come to class on time and not disrupt the class. Each student is expected to follow Purdue's student conduct code and behave in a professional manner. The rights of students in violation of the code of conduct are outlined on Purdue's website. Each student is expected to exhibit consideration and respect towards the other students, the teaching assistants (TAs), the graders, and the faculty members. Each student is expected to exhibit a positive attitude. Expectations for each student include (but are not limited to):

a. Attending all class sessions.
b. Coming to class on time and prepared by reading assigned material beforehand.
c. Refraining from disrupting class (e.g., turning off or silencing mobile phones, refraining from mobile phone or laptop use during class, and carrying on a loud conversation during class).
d. Maintaining the highest standards of academic honesty and integrity.
e. Being an active contributor to team assignments.
f. Being knowledgeable about the policies and information described in the syllabus.

N. **Website for Course Information (purdue.brightspace.com/).** This course will use the Brightspace site. The website is limited to enrolled students and will have the syllabus, homework assignments, and other important class information associated with it. To login, use your university name and password. Please check the website regularly for assignments. Important announcements will be posted on the Brightspace page and will not be automatically sent to e-mail. To get an e-mail/text notification of new announcements, follow the directions here.

O. **E-mail.** Occasionally, important class announcements will be disseminated through the class e-mail list. It is your responsibility to regularly check your e-mail every day and to read the e-mails regarding CHE 20500 to receive important class information. E-mail is the preferred mode of contact. Please put CHE 205 in your subject line. If you e-mail the instructors with questions or a request to make an appointment, please allow a **minimum** of 24 hours for a response during the week or a response by Monday at 5 pm if the e-mail is sent on the weekend.

P. **Assessment of Course Outcomes.** A weighted average grade will be calculated as follows.

In-Class Quizzes: 5%	Examinations: 20% each = 60% total
Homework: 13%	Final Examination: 22%

The grading scale will be as follows.

A range: 100 – 85% of the weighted points
B range: 84.9 – 75% of the weighted points
C range: 74.9 – 65% of the weighted points
D range: 64.9 – 55% of the weighted points
F: Less than 55% of the weighted points

Grades will use the plus/minus system. If graded material was too difficult (as judged by the faculty instructors), the final course grade may be scaled to a higher value. Grades will never be scaled downward. As a rule, scaling will not be applied. There is no preset distribution of final grades. The grading will reflect demonstrated student capability relative to an absolute performance standard that is expected of all Purdue chemical engineering students, rather than a scale that compares students to a mean performance metric on any evaluation vehicle. In practice, this means the entire class could receive A marks. Note that a grade of C is needed to enroll in the next CHE course.

Q. **In-Class Quizzes.** There will be occasional in-class quizzes related to concepts from the reading or problem solving in class. You will be instructed whether the quiz should be completed individually or in groups. Each quiz will have equal weight, and the ***two lowest quiz grades will be dropped***.

R. **Electronic Homework.** Electronic homework will be performed in groups and turned in via Gradescope. ***Begin each problem on a new sheet of paper, and number the pages***. The solution to each problem ***must*** include a picture or flow chart (hand or computer-generated) of the system or problem of interest, a listing of the known quantities and their units of measurement, and a listing of the unknown quantities that must be determined. ***If your solution to a problem does not contain these items, it will not be graded and you will receive a grade of 0 for that problem.***

The homework will be representative of content posed on the midterm and final examinations. As such, the purpose of the homework is to ensure that learners are comfortable with the course content. **Homework solutions will not be posted. It is your responsibility to get help either before the problems are due or after they have been submitted for grading.**

S. **Late Homework.** All assignments are due on the stated date and time given when the homework is assigned. **Late homework will not be accepted.**

T. **Homework Grading.** Homework will be graded on the basis of 10 points per problem. A problem worked perfectly or with 1 or 2 minor errors will get 10 points. A problem with more than 2 minor errors but no major (logic) errors will get 7.5 points. A problem with 1 major error or more than 3 minor errors will get 5 points. A problem with more than 1 major error will get 2.5 points. A problem with no credible effort will get zero points. The assessment of your performance and contribution by your teammates will be used to scale your homework grades. Each homework will be weighted equally, and **your lowest homework score will be dropped**.

U. **Team Evaluations.** An ability to function effectively on teams is a learning objective of this course. Students will be assigned to two different teams during the semester to complete homework assignments. The first team pairing will be for the first half of the assignments, and the second team pairing will be for the second half of the assignments. Students will use CATME to submit information used for Team Formation and Peer and Team Evaluations. At the halfway and end points of each team pairing, students will be required to log into CATME and rate their performance as well as the performances of their team members. Each student's point total for the team homework assignments completed in that timeframe will be multiplied by the multiplier to obtain the final point total for those homework assignments. The CATME software will use the evaluations to compute a "multiplier" with a value between 0.00 (very poor contributions to group) and 1.05 (extremely excellent contributions to group) for each group member. If one is interested in how these multipliers are calculated, please see the research papers posted at https://info.catme.org/research/. Note that multipliers of 0.00 are very rare; typically, multipliers are between 0.80 and 1.05.

V. **Homework Cover Page.** Each homework assignment must have a cover sheet. A template of the cover sheet is posted on Brightspace (in the Homework module) as a fillable Microsoft Excel sheet. The cover sheet ***must contain*** the printed first and last names of the group members, the date, and the homework assignment number in the appropriate locations. Below this identifying information, the following statement MUST appear:

"Each signature below attests that the signer contributed significantly to the solution of all problems in this homework assignment".

All team members who contributed must sign and print their names next to the signature. The signature and printed names must be clearly legible. IF A TEAMMATE DID NOT PARTICIPATE IN THE SOLUTION OF THE HOMEWORK, THEN THIS TEAMMATE SHOULD NOT SIGN. If multiple groups worked together, indicate that on the cover page. Otherwise, identical solutions will be regarded as cheating. ***If this page is not present, the homework will be awarded a grade of zero and will be returned ungraded. If a team member does not participate in the solution of all the problems on the assignment, that team member will receive a grade of zero on the entire homework assignment.***

W. **Examinations.** Timed examinations will be conducted in person. For each examination you will be supplied with one or more pages of relevant equations. You will not be allowed to use any books or notes in addition to these equations pages, which means that all you will be allowed to have on your desk during the examination period is: the exam itself, the notes pages provided, the paper on which you are writing solutions, something with which to write, and a non-graphing calculator. All other electronic devices are forbidden, including cell phones and smart watches. These must be put inside of your backpack and may not be handled at any time during the exam. Students caught with other materials during an exam will be assumed to be cheating. Remember that no collaboration or outside help is allowed. The final exam is comprehensive (i.e., it will cover the entire contents of the course).

Any student who cannot take an exam as scheduled (e.g., religious holiday, conflicts with another exam) *must* make special arrangements by sending the instructors an e-mail at least one month *before* the exam is given. In cases of extenuating circumstances (e.g., illness, quarantine, bereavement) or extreme duress (e.g., hospitalization), please

provide documentation to your instructors, and if possible, speak to one of the instructors *before* the exam takes place. Travel plans do not constitute extenuating circumstances.

X. **Regrade Requests for Homework and Exams.** A student ***has one week after the graded exam or homework has been released*** to submit a regrade request via Gradescope. This is the only means by which to have work re-graded in this course. Any homework assignments or exams submitted for re-grading will be *re-graded in their entirety* and may be marked lower than the original score that was received. For exams, regrade requests will not be accepted until after the exam solutions have been posted and students have compared their solutions to the posted solutions.

Y. **Accessibility.** Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let us know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: (765) 494-1247. If you are a student with any form of individual learning needs, please speak with the professors whether or not you seek an accommodation so that we are aware of your circumstance and can deliver course content in a manner that is most compatible with your learning situation.
In addition to the University policy, the Davidson School of Chemical Engineering has established procedures for students seeking accommodations. These can be found online at the ChE Undergrad Office website. Only those accommodation requests that conform to both University and ChE policy guidelines will be implemented.

Some important points from the ChE policy include: Please give letters of accommodation to your instructors and your academic advisor (and not the graduate TAs for office hours). If you have your letter at the start of the term, we strongly recommend you give it to us within the first two weeks of the semester. If your accommodation involves exam conditions, we strongly urge you to provide a minimum of one week notice to ensure that the accommodations requested are available.

Z. **Campus Emergencies.** In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. ***Here are ways to obtain information about changes in this course. You are expected to check your @purdue.edu email address frequently.***
Course Brightspace Page: Fall 2025 CHE 20500-003 LEC

AA. **Nondiscrimination Statement.** Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

BB. **Attendance.** This course follows the Academic Regulations: Attendance and Office of the Dean of Students: Class Absences policy posted in Brightspace under "University Policies and Statements." This policy states that students are expected to be present for every meeting of the classes in which they are enrolled. It is understood that, occasionally, you may miss lecture due to unforeseen circumstances (e.g., illness – please do not come to class if you are feeling ill), and, in these cases, you can ask any questions about missed concepts during office hours. Unless it falls under the University excused absence regulations (see below), any work due should be submitted on time. In cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent medical care.

CC. **Illness.** If a student becomes sick (e.g., with flu-like symptoms), the student should seek prompt medical attention, and then not come back to class until the student has been symptom-free for more than 24 hours. That is, the student should utilize the resources at the Purdue University Student Health Center (PUSH) or another trained medical professional. Materials will be made available electronically to assist any students who are ill, and reasonable accommodations will be made on an individual basis to ensure that all students have the opportunity to learn. If possible, the student should let your instructors know as soon as possible such that they can aid in bringing the

student up to speed in the course material as rapidly as possible. In the event of a severe outbreak of illness at Purdue that mandates class not meet, all attempts will be made to deliver the course online.

DD. Mental Health/Wellnes Statement. Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765) 494-6995 during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

EE. Basic Needs Security. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 am - 5 pm Monday through Friday.

FF. Use of Copyrighted Materials. Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Thus, these materials cannot be posted online (e.g., Chegg, Course Hero, etc.). Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally. Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

GG. Disclaimer. This syllabus is subject to change. If any change occurs, it will be announced in the class and/or posted on Brightspace.

HH. Course Material as Listed by Topic.

1. Materials Balances
   a. Open and Closed Systems
   b. Steady-state Systems
   c. Systems in a Transient State
   d. Multi-unit Systems
   e. Balances on Reactive Systems
   f. Balances on Multiphase Systems
2. Solution Thermodynamics
   a. Raoult's and Henry's Laws
   b. Binary Vapor-Liquid Equilibrium
2. Solution Thermodynamics (Continued)
   c. Binary Liquid-Liquid Equilibrium
   d. Vapor-Liquid-Liquid Equilibrium
3. Energy Balances
   a. First Law of Thermodynamics
   b. Balances on Non-reactive Processes
   c. Balances on Reactive Processes
4. Combined Mass and Energy Balances in Systems in a Transient State

II. Course Material as Listed by Text Chapter.

Chapters 2, and 3 Engineering Calculations
Chapter 4: Fundamentals of Material Balances
Chapter 5: Single Phase Systems
Chapter 6: Multiphase Systems
Chapter 7: Energy and Energy Balances
Chapter 8: Balances on Nonreactive Processes
Chapter 9: Balances on Reactive Processes
Chapter 10: Balances on Transient Processes

ChE 30600 Design of Staged Separation Processes Fall 2025

A. Instructor:

Professor Enrico Martinez
FRNY G015
(765) 496-6998
marti309@purdue.edu
Office Hours: Tuesdays 4:30-6:00, other times by appointment

B. Teaching assistants:

Samantha Jernigan
Gautam Kare
Rajeev Kumar

Office Hours: Mondays 3:00-5:00 pm in Forney G014

C. Importance. Separation processes constitute 50% to 90% of the cost (capital and operating) of most chemical plants with distillation being the most used separation method in the chemical and petroleum industries. Separations/mass transfer operations are one of the key items that distinguish chemical engineering from other engineering disciplines.

Classes will meet on Mondays and Wednesdays and some Fridays.

D. Goals. The goal of this course is to apply the principles of mass conservation, energy conservation, phase equilibrium and mass transfer to achieve separations. The concepts and techniques will subsequently be used in ChE 43500 (Chemical Engineering Laboratory) and ChE 45000 (Design and Analysis of Processing Systems). Understanding of separation processes requires a thorough knowledge of mass balances, energy balances, thermodynamics and mass transfer – you must have completed ChE 20500 (C or better) and ChE 21100.

E. Course Objectives. Apply mass balances, energy balances, mass transfer and phase equilibrium to design and analyze separation processes.

F. Course Outcomes.

- Utilize the concepts and relations of phase equilibria, particularly Vapor Liquid Equilibrium, in the analysis, design, and simulation of separation processes (21100→); (→43500, 45000)
- Use mass and energy balances in the analysis of separation processes
- Use the McCabe-Thiele diagram for the solution of problems in binary separations (→43500, 45000)

- Use reflux and multi-stage cascades to increase separation of a given component (20500→); (→43500, 45000)
- Use process simulators for binary and multi-component systems to solve, understand, and design separation processes (→43500, 45000)
- Apply the basic principles of distillation, absorption/stripping, and other unit operations for the solution of problems in separations (21100→); (→37800, 43500, 45000)
- Identify the safety aspects of various separation processes (→42000, 43500, 45000)
- Communicate effectively the results of a designed separation process in writing. (→43500, 45000)

G. Anticipated Course Content

1. Introductory Material..... 1 week

2. Flash Distillation ..... 1 week

3. Binary Distillation ..... 2 weeks

4. Multi-Component Distillation .....2 weeks

5. Complex Distillation Methods ..... 1-2 weeks

6. Batch Distillation ……1 week

7. Staged and Packed Column Design …… 1 week

6. Absorption/Stripping ..... 1-2 weeks

7. Mass Transfer Analysis NTU-HTU Method. 1 week

8. Extraction ..... 1 week

9. Membrane Separations ……..... 2 weeks

10. Adsorption Separations …… 1week

H. Text: P. C. Wankat, *Separation Process Engineering*, 5th edition, Prentice Hall, 2022. Print or e-Book :

9780137468041: Wankat: Separation Process Engineering 5e (Print)
Separation Process Engineering, 5th edition | eTextBook Subscription | Pearson+

I. Software:
During this class, students will gain a working knowledge of the *Aspen Plus* process simulation package.

J. Grading Policy:

Three One Hour Examinations (150 points each) ..... 450 points
Individual Homework Assignments ..... 150 points
Lab Performance/Reports .....150 points
Team Design Project ..... 150 points
TOTAL .....900 points

Course grades will be determined from the adjusted course scores on the following basis:

Adjusted Course Score	**Course Grade**
90 and higher	A- [at least]
80 – 89	B- [at least]
70 – 79	C- [at least]
60 – 69	D- [at least]
Less than 60	F

Course Final grades for this class will be assigned using the +/- system (A+, A, A-, B+, B, etc…)

K. Homework:

Assignments will be posted to Brightspace most Wednesdays after lecture time and are due in completed form by the following Wednesday, beginning of lecture. Late homework will be assessed a penalty of 5 pts if turned in by 6:30 PM. If not received by 6:30, you will receive no credit for that assignment. All late homework should be turned in to one of the teaching assistants. While you may find it helpful to discuss problem sets with one another, *what you turn in must be your own work.* **Written homework's are to be done on Engineering Paper. For team assignments, write the team number and members name on the left top of each page, the course number (CHE 306) at the top middle of each page and the date on the right top of each page. Your homework's are to be neat and legible. Write on one side of the paper only.**

L. Exams

There will be three midterm exams during the semester; September 18, October 23 and November 20 at 6:30 pm in RHPH (Pharmacy), 50 minutes long.

Occasionally students will have to miss a midterm exam for personal or uncontrollable reasons. However, if an exam needs to me missed, **there will NOT be a makeup exam given during the regular semester**. Instead, the final exam will act as a make-up exam. **PLEASE NOTE**: A student can only miss a midterm exam for a legitimate reason (death in the family, illness, emergency, etc.) and **ONLY** if given permission by Professor Martinez. If a student attends all three exams during the semester, the final exam will not have to be taken.

M. On-line Course Evaluation

It is important for department and instructors to receive thorough feedback on all courses taught, so it is your responsibility to provide such feedback. Participation in the on-line course evaluation is mandatory and will be treated as a homework assignment worth 50 homework points.

N. Design Project:

There will be one design project in the second half of the semester. The project will be done in teams of 3 students each. Further details of the project will be supplied after the third midterm exam.

O. Student Expectations.

This is a 3-credit hour course, and it is expected that each student will spend 9 hours each week working on homework, studying, and reading the course text (3 hours/credit). This class, and all subsequent chemical engineering classes, will be much more challenging than you are likely used to, and at the same time much more rewarding than anything that most students will have seen before. We encourage you to take studying seriously and establish good study habits such as previewing the reading material ***before*** the lectures and practicing additional problems.

P. Instructors' Commitment.

Your instructor will: 1) be courteous, punctual, well-organized, and prepared for lecture and other class activities; 2) answer questions clearly in class or arrange for detailed discussions out of class if in-class answers are not suitably clear; 3) be available during office hours or notify you beforehand if we are unable to keep them; 4) provide a suitable guest lecturer when we are traveling; and 5) grade uniformly and consistently to the posted guidelines.

Q. Consulting with the Faculty Member.

We encourage you to discuss academic or personal questions with me during my office hours or via email or Hotseat. These discussions need not be limited to ChE 30600 content.

R. Academic Dishonesty.

Academic dishonesty ***will not be tolerated*** in any form in this course. Specifically, Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Section B-2-a, Code of Student Conduct] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972] All incidents of academic dishonesty will be reported to the Dean of Students. **Such**

incidents include: i) possessing or accessing, in hardcopy or electronic form, the solution manual to the course text, or to the exams, ii) claiming credit for work that is not your own original work, and iii) enabling other students to create work that is not their original work. The punishment for the first offense is a grade of zero for the entire work (exam or homework), and the punishment for a second offense is an F mark for the class.

S. Conduct.
University policy states that it is the responsibility of all students to attend all class sessions (http://www.purdue.edu/studentregulations/regulations_procedures/classes.html). Each student is expected to come to class on time and not disrupt the class. Each student is also expected to follow Purdue's codes of student conduct (http://www.purdue.edu/studentregulations/student_conduct/regulations.html) and behave in a professional manner. The rights of students in violation of the code of conduct are outlined. Each student is expected to exhibit consideration and respect towards the other students, the graders, the teaching assistants (TAs), and the faculty member. Each student is expected to exhibit a positive attitude. Your conduct will be a factor in awarding grades to students between two letter grades. Purdue University's student conduct policy specifically addresses academic dishonesty.

T. Violent Behavior Policy.

Purdue University is committed to providing a safe and secure campus environment for members of the University community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent behavior impedes such goals. Therefore, violent behavior is prohibited in or on any University Facility or while participating in any University activity.

U. Nondiscrimination.

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

W. Emergency Preparedness.
Purdue University is a very safe campus and there is a low probability that a serious incident will occur here at Purdue. However, it is important to emphasize the emergency procedures for evacuation and shelter-in-place incidents. Preparedness will be critical if an unexpected event is to occur. Emergency preparedness is your personal responsibility. Purdue University is actively preparing for natural
disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. The following is a review of the emergency procedures at Purdue University.

1. For any emergency call 911.

2. There are nearly 300 Emergency Telephone Systems throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected to the PUPD.

3. If there is a fire alarm, we will immediately evacuate the building and proceed to the northwest corner of the MSEE building. Do not use the elevator.

4. If there is a Shelter-in-Place requirement for a tornado warning, we will shelter in the lowest level of this building away from windows and doors.

5. If there is a Shelter-in-Place requirement for a hazardous materials release, we will shelter in the classroom shutting any open doors and windows.

6. If there is a Shelter-in-Place requirement for a civil disturbance, we will shelter in a room that is securable preferably without windows.

X. Course Meeting Schedule
Lectures: Monday, Wednesday, (some Fridays) 9:30-10:20, MSEE B012
Lab Sessions: Check Schedule according to your section

Y. Attendance. University policy states that it is the responsibility of all students to attend all class sessions. You are expected to attend all lectures and computer lab periods. iClicker Cloud will be used for class interaction and feedback.
(http://www.purdue.edu/studentregulations/regulations_procedures/classes.html).

Z. Illness. If a student becomes sick with flu-like symptoms, he/she should seek prompt medical attention, and then not come back to class until he/she has been symptom-free for more than 24 hours. A note from P.U.S.H., or another trained medical professional, is required to document illness. Materials will be made available electronically to assist any students who are ill, and reasonable accommodations will be made on an individual basis to ensure that all students have the opportunity to learn. In the event of a severe outbreak of illness at Purdue that mandates class not meet, all attempts will be made to deliver the course online through Brightspace.

AA. Bereavement Policy. Purdue recognizes that a time of bereavement is very difficult for a student. The University therefore provides rights to students facing the loss of a family

member through the Grief Absence Policy for Students (GAPS): http://www.purdue.edu/odos/services/griefabsencepolicyforstudents.php. Students who find themselves in need of assistance in a time of bereavement should contact Professor Bao or Professor Martinez privately to discuss specific needs.

BB. Campus Emergencies. In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructors' control. ***Here are ways to get information about changes in this course. You are expected to check your @purdue.edu email address frequently.***

CC. Individual Learning and Testing Needs.

Any student who feels he/she may need an accommodation with any aspect of the course based on a personal circumstance should contact Professor Martinez privately to discuss his/her specific needs. If you are a student with any form of individual learning needs, please speak with the faculty instructor whether or not you seek an accommodation so that we are aware of your circumstance and can deliver course content in a manner that is most compatible with your situation.

Purdue University ChE 348: Chemical Reaction Engineering (4 credit), Fall 2025 Syllabus

Instructor: Brian Tackett
Assistant Professor
Chemical Engineering
Email: bmtacket@purdue.edu
Office: FRNY 2158
Phone: 765-496-7235
Office Hours: Wednesdays 5:00 – 6:30 pm, FRNY 2158

Instructor: David Hibbitts
Associate Professor
Chemical Engineering
Email: hibbitts@purdue.edu
Office: FRNY 2148
Phone: 765-496-3782
Office Hours: TBD

Teaching Assistant: Ayotunde Alabi (alabi3@purdue.edu)

Lecture Hours: Mon/Wed/Fri
10:30 – 11:20 AM
FRNY 1043
Synchronous, in-person

Recitation Hours:	Recitation Section 1:	Thu. 9:30 – 10:45 AM, HAMP 2118
	Recitation Section 2:	Thu. 11:30 AM – 12:45 PM, HAMP 2118
Laboratory Hours:	Lab Section 1 (9/18, 10/2, 10/16, 11/6):	Thu. 9:30 – 11:20 AM, FRNY G111
	Lab Section 2 (9/18, 10/2, 10/16, 11/6):	Thu. 11:30 AM – 1:20 PM, FRNY G111

Website: Brightspace (CHE 348). All course materials will be posted on Brightspace. It is your responsibility to keep up-to-date with all material posted online. All class announcements will be posted via Brightspace.

Required Text: H. S. Fogler, Elements of Chemical Reaction Engineering, **SIXTH or SEVENTH EDITION**, Prentice Hall, New York. ISBN 9780135486498.

E-text is also acceptable and is available for free via the Purdue Library: https://purdue.primo.exlibrisgroup.com/permalink/01PURDUE_PUWL/uc5e95/alma99171049791801081

Textbook companion website:
https://websites.umich.edu/~elements/7e/index.html
Contains extra problems, concept questions, interactive lessons, etc.

Course Description: Application of kinetic rate equations, mass balances and energy balances to the analysis and design of chemical reactors involving homogeneous and heterogeneous chemical reactions. Chemical equilibria, kinetic rate equations for homogeneous and heterogeneously catalyzed reactions, design of ideal isothermal reactors, effects of non-isothermal operation, effects of diffusion in porous catalysts and non-ideal mixing in continuous flow reactors.

Prerequisites: Chemical Engineering 211, Math Selective I, Chemistry 261 (concurrent)

Learning Outcomes: By the end of the course, students will be able to:

1. Apply fundamental material balances to derive the design equations for CSTR, PFR, PBR, and batch reactors.
2. Derive rate expressions from both elementary steps and reaction kinetics data for both homogeneous and heterogeneous reactions.
3. Use material and energy balances with kinetic data for both single and multiple reactions to design and analyze the behavior of isothermal and non-isothermal reactors.
4. Utilize effectiveness factors governing the coupling of reaction and diffusion in the description of heterogeneously catalyzed reactions.
5. Work professionally and ethically in teams to conduct reaction-based laboratory experiments.
6. Effectively report results in written form and practice safety as an integral part of laboratory work.
7. Apply appropriate computational tools for the solution of chemical reaction engineering problems.

Technology Requirement: Students are required to use computational software to solve reaction engineering problems for homework, project, and laboratory sessions. The TA will provide training and support for **Excel, Python,** and **Polymath** software. Other programs, such as MATLAB and Mathematica, may also be sufficient for solving the algebraic and ordinary differential equations encountered in this course, but the TA will not provide training for these methods. Some portions of the class will require the use of Excel (available in MS Office through your Purdue account). For other portions, students will have the option of using Python or Polymath. Both of these programs are available on any FRNY computer lab machine (FRNY 1014, FRNY 1022, FRNY 1033, FRNY G023). You can also download software to use Python or Polymath on your personal computer:

- Python: is open source, free software. The most convenient way to get started with Python is to download Anaconda software from Anaconda.com. Follow download/install instructions on the website. Once installed, you can select the environment to run

Python in. Spyder is a Python environment similar to MATLAB. Jupyter Notebooks is a Python environment in your web browser. Either will work.

- Polymath: is proprietary software developed specifically for the type of problems encountered in this course. You can access this software via AppsAnywhere by using your Purdue login credentials at this website: https://appsanywhere.ecn.purdue.edu/

Recitations:

There are two recitation sections held each week. **You may only attend the recitation section for which you are registered**. Recitation will not be held during the weeks of laboratory experiments.

Laboratory:

The Fundamentals Laboratory (FRNY G111) will be used to support this course. There are four weeks throughout the semester during which the lab periods, but not recitation, will be held. The lab period dates and the lab report due dates are listed in the calendar at the end of the syllabus. **These dates are set, and it is not possible to schedule makeup labs. Please make every effort to attend your designated lab time.**

Lab reports are due two weeks following the lab experiment, by 11:59pm eastern time (on the day of your recitation). One lab report per group must be uploaded to Gradescope.

The lab manual containing detailed information about the experiments and lab report guidelines can be found at the following link, and accessed using your Purdue career account login credentials: https://engineering.purdue.edu/Intranet/Groups/Schools/ChE/FundamentalsLabMaterials

If you need assistance gaining access to the Fundamentals Lab materials, more information can be found on Brightspace.

It is important that you read the lab manual one week in advance of your experiment.

Part of the recitation sessions one week before the lab will also include a pre-lab activity, to discuss and prepare for the upcoming lab. For each lab report, each team member will be required to fill out a peer evaluation form and submit this via Gradescope, which will be used to adjust the lab grades assigned to each team member.

A few reminders:

- Please read, sign, and bring the Fundamental Laboratory (FL) safety contract with you on the first day in the FL. You are required to complete the contract each time you start a new course in the FL.

- You are now required to bring your own safety glasses to the FL. The safety glasses should have side shields. You can use the

goggles purchased for chemistry labs. If you need to purchase safety glasses, Follett's (across from Mackey Arena on Northwestern) stocks them.

- No coats, backpacks, or large bags are allowed into the FL. Students will not be permitted to leave their coats and backpacks outside the FL door, as was permitted in the past. You should have received an e-mail from Sandy Hendryx with your locker assignment for the year and locker combination. If you did not receive an e-mail with this information, please contact Sandy Hendryx (hendryxs@purdue.edu).

- The Fundamentals Lab is fully scheduled during the semester and therefore, **we cannot conduct makeup lab sessions.** If you miss a lab period for a valid reason, then your grade will be based on averaged grades from the other periods. Please show up 5 minutes early to your lab session. If you show up late to your lab period, you will be dismissed, and there will be no chance to make up missed labs. Missed lab periods without a valid reason will result in a zero grade. If you miss more than two lab periods without a valid reason, then you will be given an I or F grade for the course.

Course Grading:

The final course grade will be determined by the following:

- Lab Reports (4): 15 points
- Exams (3): 50 points
- Homeworks (13)/participation: 25 points
- Final Project (1): 10 points

Individual assessments for each category are given equal weight (i.e. all 3 exams are weighted the same, all 13 homeworks are weighted the same, etc.). Individual assignments will be graded out of 100%, and the average percent for each category will determine the total class points for that category (e.g. an 80% average on exams yields 22.4/28 points).

Participation in in-class clicker question (using iClickerCloud on your phone), worksheets, and discussions will be recorded throughout the semester. Participating in more than 75% of these activities will earn you an additional 10/10 homework score (to make a total of 14 homework scores). Note that this **does not replace** any other homework score. Also note that you will not be penalized for not earning the participation points.

All grades will be available on Brightspace so that you can monitor your progress throughout the semester. Grades for individual homeworks, lab reports, and exams will **not** be adjusted by curving or scaling.

There is no preset distribution of final grades. The grading will reflect demonstrated student capability relative to an absolute performance standard that is expected of all Purdue ChE students, rather than a

scale or curve that compares students to a mean performance metric on any evaluation vehicle. In practice, this means that if all students in the class demonstrate a high level of mastery of the course content, then all course grades could be A marks.

If your final numerical grade is greater than or equal to the following percentages, your letter grade is guaranteed to be at least:

- A: ≥90%
- B: ≥80%
- C: ≥70%
- D: ≥60%

Final numerical grades for the entire class may be scaled up (but never down). **Plus and minus modifiers will be used to determine final grades.**

Exams:

Exam 1: Mon. Sep 29, 8:00pm – 9:15pm, MJIS 1001
Exam 2: Mon. Nov 10, 8:00pm – 9:15pm, MJIS 1001
Exam 3/Final: TBD

If students require approved accommodations for exams, these should be scheduled to be taken at the DRC in Stuart Hall. **Students requiring accommodations are responsible for scheduling with the DRC prior to exam dates to ensure DRC availability.**

Homework:

Homework will be assigned via Brightspace, and will be **due on Gradescope at 11:59PM on Thursdays**. Late homework submissions will be assigned a zero score. HW solutions will be posted to Brightspace when homeworks are graded (~1 week after due date).

Each HW problem will be graded on a scale of 2. 1 point will be earned for an honest attempt to solve the problem (beyond rewriting the problem statement). The remaining 1 point will be earned by correctly solving the problem, with partial credit given accordingly.

Scores on all HW assignments will be counted toward the course grade. **No HW grades will be dropped**.

HW 0 counts for 2 full HW grades and consists of course evaluations: mid-term, and final evaluations. Each one must be completed by their respective dates in the course schedule in order to receive full credit for HW 0. These evaluations are critical to the success of the course and should be taken seriously.

Many homework problems will be assigned from the textbook. **Use of the textbook solutions manual is not permitted.**

You may work on homework with other students in class, but you must submit your own individual assignment. **You must also list the names of each person with whom you collaborated on a homework assignment.**

Regrade Requests: You have one week after receiving a graded assignment to submit a regrade request. Requests must be made in-person to Prof. Tackett or Hibbitts before or after lecture, or during office hours. Email requests may also be made to schedule an in-person meeting about regrading, as long as it is within one week of receiving the graded item.

Official Purdue University Student Policies

Student Expectations: This is a 4 credit hour course, and it is expected that each student will spend 12 hours each week, including class time, on homework assignments, studying and reading the course textbook.

Student Conduct and Academic Integrity: University policy states that it is the responsibility of all students to attend all class sessions. Each student is expected to come to class on time and not disrupt the class. Each student is expected to follow Purdue's codes of student conduct and behave in a professional manner (https://www.purdue.edu/odos/academic-integrity). The rights of students in violation of the code of conduct are outlined. Each student is expected to exhibit consideration and respect towards the other students, the grader, the teaching assistant (TA), and the faculty. Each student is expected to exhibit a positive attitude. Your conduct will be a factor in awarding grades to students between two letter grades.

Purdue University's student conduct policy specifically addresses academic dishonesty and integrity (http://www.purdue.edu/odos/osrr/academicintegritybrochure.php). All incidents of academic dishonesty will be reported to the Dean of Students. **Such incidents *include*:**

i) possessing or accessing, in hardcopy or electronic form, the solution manual to the course text or to the exams,
ii) claiming credit for work (either HW or exam work) that is not your own original work, and
iii) enabling another student to create HW or exam work that is not their original work.

Instructors' Commitment: Your instructor will: 1) be courteous, punctual, well-organized, and prepared for lecture and other class activities; 2) answer questions clearly in class or arrange for detailed discussions out of class if in-class answers are not suitably clear; 3) be available during office hours or notify you beforehand if they are unable to keep them; 4) provide a suitable guest lecturer or a recorded video lecture when traveling; and 5) grade uniformly and consistently to the posted guidelines. I strongly encourage you to discuss academic or personal questions with the course instructor during office hours or via email. These discussions need not be limited to ChE 34800 content.

Use of Copyrighted Materials: Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. All materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such

presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor.

Accessibility and Accommodations: Purdue strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let Prof. Tackett know to discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Grief Absence Policy for Students: Purdue recognizes that a time of bereavement is very difficult for a student. Purdue therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

Please visit the University's website for additional information:
http://www.purdue.edu/studentregulations/regulations_procedures/classes.html

Mental Health Statement: If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack, https://purdue.welltrack.com/. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please see the Office of the Dean of Students, http://www.purdue.edu/odos, for drop-in hours (M-F, 8am- 5pm).

If you are struggling and need mental health services, Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Violent behavior policy: Purdue is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

Please visit the University's website for additional information:
http://www.purdue.edu/policies/facilities-safety/iva3.html

Nondiscrimination Statement: Purdue is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach their own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

Purdue prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services, and activities consistent with applicable federal, state, and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Purdue's Equal Opportunity, Equal Access and Affirmative Action policy which provides specific contractual rights and remedies. Additionally, the University promotes the full realization of equal employment opportunity for women, minorities, persons with disabilities and veterans through its affirmative action program.

Any question of interpretation regarding this Nondiscrimination Policy Statement shall be referred to the Vice President for Ethics and Compliance for final determination.

Please visit the University's website for additional information:
http://www.purdue.edu/purdue/ea_eou_statement.html

Campus Emergency: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. ***You are expected to read your @purdue.edu email on a frequent basis.***

ChE 348 – Fall 2025 - Tentative Course Schedule

Assignment Due	Date	Topics
		Ch. 1: Definitions and mole balance equations
	Aug. 25	Lecture (Introduction to Course)
	Aug. 26	
	Aug. 27	Lecture
	Aug. 28	Recitation
	Aug. 29	Lecture
		Ch. 2: Conversion and design equations
	Sep. 1	No Class (Labor Day)
	Sep. 2	
	Sep. 3	Lecture
HW 1	Sep. 4	Recitation
	Sep. 5	Lecture
		Ch. 3, 7, 10: Rate laws, kinetics, catalysis
	Sep. 8	Lecture
	Sep. 9	
	Sep. 10	Lecture
HW 2	Sep. 11	Recitation / pre-lab
	Sep. 12	Lecture
		Ch. 3, 7, 10: Rate laws, kinetics, catalysis
	Sep. 15	Lecture
	Sep. 16	
	Sep. 17	Lecture
HW 3	Sep. 18	Lab #1
	Sep. 19	Lecture
		Ch. 4: Stoichiometry
	Sep. 22	Lecture
	Sep. 23	
	Sep. 24	Lecture
HW 4	Sep. 25	Recitation / pre-lab
	Sep. 26	Lecture

Assignment Due	Date	Topics
		Ch. 5: Isothermal reactor design
Exam 1	Sep. 29	Exam 1 (evening) -- Ch. 1,2,3,7,10,4
	Sep. 30	
	Oct. 1	Lecture
Lab 1 report	Oct. 2	Lab #2
	Oct. 3	Lecture
		Ch. 6: Semi-batch and membrane reactors
	Oct. 6	Lecture
	Oct. 7	
	Oct. 8	Lecture
HW 5	Oct. 9	Recitation / pre-lab
	Oct. 10	Lecture
		Ch. 8: Multiple reactions
	Oct. 13	No Class (Fall Break)
	Oct. 14	
	Oct. 15	Lecture
Lab 2 report /HW 6	Oct. 16	Lab #3
	Oct. 17	Lecture
		Ch. 11: Energy balance and adiabatic reactors
	Oct. 20	Lecture
	Oct. 21	
	Oct. 22	Lecture
HW 0 / HW 7	Oct. 23	Recitation
	Oct. 24	Lecture
		Ch. 11/ Ch. 12: Steady-state reactors with heat exchange
	Oct. 27	Lecture
	Oct. 28	
	Oct. 29	Lecture
Lab 3 report /HW 8	Oct. 30	Recitation / pre-lab
	Oct. 31	Lecture

Assignment Due	Date	Topics
		Ch. 12: Steady-state reactors with heat exchange
	Nov. 3	Lecture
	Nov. 4	
	Nov. 5	Lecture
HW 9	Nov. 6	Lab #4
	Nov. 7	Lecture
		Ch. 13: Unsteady-state non-isothermal reactors
Exam 2	Nov. 10	Exam 2 (evening) – Ch. 5, 6, 8, 11, 12
	Nov. 11	
	Nov. 12	Lecture
	Nov. 13	Recitation
	Nov. 14	Lecture
		Ch. 14: Mass transfer in reactors
	Nov. 17	Lecture
	Nov. 18	
	Nov. 19	Lecture
HW 10 / Lab 4 report	Nov. 20	Recitation
	Nov. 21	Lecture
		Ch. 15 Diffusion and reaction
	Nov. 24	Lecture
	Nov. 25	
	Nov. 26	No Class (Thanksgiving Break)
	Nov. 27	No Recitation (Thanksgiving Break)
	Nov. 28	No Class (Thanksgiving Break)
		Ch. 15 Diffusion and reaction
	Dec. 1	Lecture
	Dec. 2	
	Dec. 3	Lecture
HW 11	Dec. 4	Recitation
	Dec. 5	Lecture

Assignment Due	Date	Topics
		Special topics (Bioreactors Ch. 9, electrochemical reactors Ch. 19, non-ideal reactors Ch. 16-18)
	Dec. 8	Lecture
	Dec. 9	
	Dec. 10	Lecture
	Dec. 11	Recitation
HW 0 / Take-home project	Dec. 12	Lecture

Exam 3/ Final	TBD	Ch 1-15

CHE 50200-001: Analytical Approach to Healthcare Delivery (Fall 2025)

A. Instructor. William R. Clark, M.D.

B. Course description. This course provides a "real world" overview of healthcare delivery in the United States (US). The biopharmaceutical industry as the leading medical technology sector is a significant focus - analyses of the discovery, development, manufacturing, and commercial operations of a typical company are performed. Another highlight of the course is an assessment of a series of critical medical conditions having the highest impact on the US healthcare system. Clinical cases illustrating these conditions along with case studies designed to provide practical examples of healthcare developments and challenges are included. A number of emerging healthcare developments, including precision medicine, artificial intelligence, digital health, and value-based care are addressed. In lieu of examinations, a team project consisting of two oral presentations and a final report is an important aspect of the course.

While the course is relevant to a broad spectrum of students, those planning a career in the healthcare industry may find it particularly useful. The course content is geared especially toward students interested in the biopharmaceutical field.

C. Course requirements. BIOL 23000 or equivalent course is recommended but not mandatory.

D. Instructor Biographical Information: Dr. Clark is a nephrologist (kidney specialist) and chemical engineer by training. He received his M.D. degree along with specialty and sub-specialty training in internal medicine and nephrology, respectively, at Indiana University School of Medicine. In addition, he received both his B.S and M.S. degrees in chemical engineering from Purdue University, at which he is now Professor of Engineering Practice in the Davidson School of Chemical Engineering. Before joining the Purdue faculty, Dr. Clark worked in the medical device (dialysis) industry for more than 20 years in a variety of positions. Dr. Clark continues to serve as a consultant in the medical device industry.

E. Recommended (NOT REQUIRED) Texts.

- *Jonas and Kovner's Health Care Delivery in the United States,* Edited by James R. Knickman and Brian Elbel, Springer, 2019, 12th ed, ISBN: 9780826172723
- *Guyton and Hall Textbook of Medical Physiology*, Edited by John E. Hall, Elsevier, 2016, 13th ed, ISBN: 978-1-4557-7005-2
- *Crowley's An Introduction to Human Disease: Pathology and Pathophysiology Correlations*, Edited by Emily Reisner, Howard Reisner, Jones and Bartlett Learning, 2017, 10th ed, ISBN 978-1284050233

F. Course Learning Outcomes.

- Evaluate the impact of the following conditions, from both a clinical and resource utilization (cost) perspective: coronary artery disease, heart failure, diabetes, cancer, obesity, Alzheimer's disease, chronic kidney disease, stroke, arthritis, sepsis, and acute kidney injury.
- For the biopharmaceutical industry, determine the major components of the drug development process and the manner in which drug pricing factors into the risk/reward equation.
- Assess US health economics by identifying the major cost drivers in the healthcare system (hospital care; physician costs; drugs and other medical products).
- Formulate a basic understanding of the sources of health insurance coverage in the US, including the differences between government-based (Medicare/Medicaid) and commercial payers.
- Explain several evolving trends which have the potential to influence healthcare substantially in the future, including precision medicine, artificial intelligence, digital health, and value-based care.

G. Course Meeting Schedule.

Lectures:	Tuesday/Thursday 3:00-4:15 PM; HAMP 2102
Presentation 1:	October 15: 7:00-9:00 PM (location: FRNY G124)
Presentation 2:	November 24: 7:00-9:00 PM (location: FRNY G124)
Final Report due:	December 12

Early in the semester, students will assemble into groups of 3 and choose a high-impact clinical condition to study. Each group will provide two progress updates (Presentations 1 and 2) during the course of the semester in lieu of formal examinations. A complete written summary of each group's assessment (Final Report) will be due at semester's end in lieu of a final examination.

H. Instructor Contact Information.

Professor William R. Clark – Email: clarkw@purdue.edu, Telephone: (765) 496-8647 (office); (317) 691-1438 (cell)
Office: FRNY 1055
Office Hours: By appointment

I. Assessment of Course Outcomes. A weighted average grade will be calculated as follows.

Homework assignments (4): 20% of total

#1: assigned September 12/due September 22
#2: assigned October 3/due October 16
#3: assigned October 17/due October 27
#4: assigned November 21/due December 3

Presentations (2): 40% total
Final report: 40% of total

The grading scale will be as follows.

A: 100 – 85% of the weighted points
B: 84.9 – 75% of the weighted points
C: 74.9 – 65% of the weighted points
D: 64.9 – 55% of the weighted points
F: Less than 55% of the weighted points

Note that students with grades within 3 weighted percentage points of either the upper or lower bounds of a grade range listed above will receive a "plus" or "minus" mark, respectively, after his/her score (*e.g.*, scores between 75% and 78% of the total weighted points would earn a B–). Marks of an A– will not be given.

Group projects

Student groups may assess a high-impact clinical condition from the list of those discussed in class or another one (with instructor approval). In either case, each group should plan to meet with Professor Clark before beginning work on the project to set expectations. The assessment will include the clinical characteristics of the disorder along with its causes, demographics, and current treatment – these topics will be presented in Presentation 1. With Professor Clark or another engineering faculty member serving as a mentor, an unmet clinical need for the disorder will be identified along with an engineering-based solution for the problem – these considerations will be the focus of Presentation 2. For a particular disorder, the engineering approach can have a direct clinical effect (e.g., improved medical device treatment) or indirect clinical effect (e.g., novel manufacturing approach for pharmaceuticals).

J. Course Schedule (subject to change)

Lecture	Topic
Lecture 1 (Aug 26)	Introduction and US healthcare system overview
Lecture 2 (Aug 28)	Cardiovascular disease
Lecture 3 (Sep 2)	Obesity
Lecture 4 (Sep 4)	Diabetes
Lecture 5 (Sep 9)	Kidney disease
Lecture 6 (Sep 11)	Clinical case 1
Lecture 7 (Sep 16)	Cancer
Lecture 8 (Sep 18)	Arthritis and autoimmune disease
Lecture 9 (Sep 23)	Neurologic disorders (Alzheimer's disease and stroke)
Lecture 10 (Sep 25)	Critical care medicine (acute kidney injury and sepsis)
Lecture 11 (Sep 30)	Clinical case 2
Lecture 12 (Oct 2)	Biopharmaceutical industry (1)
Lecture 13 (Oct 7)	Biopharmaceutical industry (2)
Lecture 14 (Oct 9)	Medical device industry
Lecture 15 (Oct 16)	Clinical research
Lecture 16 (Oct 21)	Healthcare delivery in the emergency department*
Lecture 17 (Oct 23)	Drug discovery*
Lecture 18 (Oct 28)	Drug development*
Lecture 19 (Oct 30)	Drug manufacturing*
Lecture 20 (Nov 4)	Healthcare spending/financing
Lecture 21 (Nov 6)	Health insurance
Lecture 22 (Nov 11)	Case study: technology in healthcare
Lecture 23 (Nov 13)	Emerging healthcare developments (1): digital health*
Lecture 24 (Nov 18)	Emerging healthcare developments (2): precision medicine
Lecture 25 (Nov 20)	Emerging healthcare developments (3): artificial intelligence
Lecture 26 (Nov 25)	Emerging healthcare developments (4): value-based care
Lecture 27 (Dec 2)	Case study: healthcare entrepreneurship*
Lecture 28 (Dec 4)	Case study: medical device industry*
Lecture 29 (Dec 9)	No class**
Lecture 30 (Dec 11)	No class**

*: guest lecturer
**: make-up for evening presentation session

K. Consulting with the Instructor. I encourage you to discuss academic or personal questions with me during my office hours or via email. These discussions need not be limited to CHE 50200 content.

L. Instructor's Commitment. Your instructor will: 1) be courteous, punctual, well-organized, and prepared for lecture and other class activities; 2) answer questions clearly in class or arrange for detailed discussions out of class if in-class answers are not suitably clear; 3) be available during office hours or notify you beforehand if I am unable to keep them; 4) provide a suitable guest lecturer when I am traveling; and 5) grade uniformly and consistently to the posted guidelines.

M. Academic Dishonesty. Academic dishonesty ***will not be tolerated*** in any form in this course. Specifically, Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Section B-2-a, Code of Student Conduct] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document

72-18, December 15, 1972] All incidents of academic dishonesty will be reported to the Dean of Students. **Such incidents include: i) possessing or accessing, in hardcopy or electronic form, the solution manual to the course text, or to the exams, ii) claiming credit for work that is not your own original work, and iii) enabling other students to create work that is not their original work. The punishment for the first offense is a grade of zero for the entire work (exam or homework), and the punishment for a second offense is an F mark for the class.**

N. Conduct. University policy states that it is the responsibility of all students to attend all class sessions (http://www.purdue.edu/studentregulations/regulations_procedures/classes.html). Each student is expected to come to class on time and not disrupt the class. Each student is also expected to follow Purdue's codes of student conduct (http://www.purdue.edu/studentregulations/student_conduct/regulations.html) and behave in a professional manner. The rights of students in violation of the code of conduct are outlined. Each student is expected to exhibit consideration and respect towards the other students, the graders, the teaching assistants (TAs), and the faculty member. Each student is expected to exhibit a positive attitude. Your conduct will be a factor in awarding grades to students between two letter grades. Purdue University's student conduct policy specifically addresses academic dishonesty.

O. Violent Behavior Policy. Purdue University is committed to providing a safe and secure campus environment for members of the University community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent behavior impedes such goals. Therefore, violent behavior is prohibited in or on any University Facility or while participating in any University activity.

P. Nondiscrimination. Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

Q. Bereavement Policy. Purdue recognizes that a time of bereavement is very difficult for a student. The University therefore provides rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS): http://www.purdue.edu/odos/services/griefabsencepolicyforstudents.php. Students who find themselves in need of assistance in a time of bereavement should contact Professor Clark privately to discuss specific needs.

R. Individual Learning and Testing Needs. Any student who feels he/she may need an accommodation with any aspect of the course based on a personal circumstance should contact Professor Clark privately to discuss his/her specific needs. If you are a student with any form of individual learning needs, please speak with the faculty instructors whether or not you seek an accommodation so that we are aware of your circumstance and can deliver course content in a manner that is most compatible with your situation.

S. Emergency Preparedness. Purdue University is a very safe campus and there is a low probability that a serious incident will occur here at Purdue. However, it is important to emphasize the emergency procedures for evacuation and shelter-in-place incidents. Preparedness will be critical if an unexpected event is to occur. Emergency preparedness is your personal responsibility. Purdue University is actively preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus.

The following is a review of the emergency procedures at Purdue University. The evacuation and shelter-in-place procedures for Hampton Hall are posted at the entrances to all classrooms and detailed in the Building Emergency Plan (https://www.purdue.edu/ehps/emergency_preparedness/bep/HAMP-bep.html.) Students are responsible for understanding and adhering to these procedures in the event of an emergency. Please see additional information on Brightspace.

1. For any emergency call 911.
2. There are nearly 300 Emergency Telephone Systems throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected to the PUPD.
3. If there is a fire alarm, we will immediately evacuate the building and proceed to in front of Hampton Hall (FRNY). Do not use the elevator.
4. If there is a Shelter-in-Place requirement for a tornado warning, we will shelter in the lowest level of this building away from windows and doors.
5. If there is a Shelter-in-Place requirement for a hazardous materials release, we will shelter in the classroom shutting any open doors and windows.
6. If there is a Shelter-in-Place requirement for a civil disturbance, we will shelter in a room that is securable preferably without windows.

Campus Emergencies. In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructors' control. ***You are expected to check your @purdue.edu email address frequently.***

T. Use of Copyrighted Material. Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

BME 595/CHE 521
Principles of Tissue Engineering
(3-Credit)

Instructor: Prof. Liu julieliu@purdue.edu Office: FRNY 1160 494-1935

Office Hours: Tuesday, 1:30 – 2:30 PM FRNY 1160
or by appointment

Lectures: Tues, Thurs 12:00 – 1:15 PM KNOY B033 (face-to-face)

TA Anna Alford alford12@purdue.edu

Course Description
This course is designed to provide background for the application of engineering principles with the life sciences to facilitate understanding of normal and pathological mammalian tissues. Applications of drug delivery, tissue and cell transplantation, bioartificial organs, tissue regeneration, disease models, and applications in clinical practice will be explored.

Learning Outcomes
By the end of this course, students will:
1. Understand the importance of cell sources, material properties, and mass transport on tissue structure and function
2. Be able to design a rational experiment and have improved understanding for how to characterize and analyze tissue engineered constructs
3. Improve their ability to present new concepts/ideas to a group of students and potential investors

Teaching Philosophy
Learning is an active process. Learning should not be passive, such as simply listening to lectures, making notes, and taking exams. The most effective leaning is through active participation, including asking questions, presenting opinions, and making suggestions. This course is designed to maximize students' participation in classes with free discussions, debates, and dialogues.

Prerequisites
This class is open to advanced undergraduate students and graduate students. Courses in organic chemistry, molecular biology, and mass transfer are preferred but not required. Because of the interdisciplinary nature of these topics, supplementary reading materials will be suggested for those students who may feel they are deficient in certain areas.

E-mail
Occasionally, important class announcements will be disseminated through the class e-mail list. It is your responsibility to regularly check your e-mail every day and to read the e-mails regarding BME 595/CHE 521 to receive important class information. E-mail is the preferred mode of contact. Please put BME 595 or CHE 521 in your subject line. Please allow a minimum of 24 hours for a response during the week (or a response by Monday evening if the e-mail is sent on the weekend).

Learning Resources, Technology, and Texts

All lecture Powerpoints and required readings will be made available through Brightspace. In-class activities (e.g., iClicker Cloud) will be used to evaluate student understanding of lecture concepts.

There is no required textbook for this class, but there are optional resources listed. The Brightspace module "Textbook Resources" also lists these textbooks and has direct links to them.

Recommended Textbooks:
Tissue Engineering, Clemens van Blitterswijk *et al.*, Academic Press Series in Biomedical Engineering, 2015. Available free as an electronic resource through the Purdue Library.

Tissue Engineering, Bernhard Palsson *et al.*, CRC Press, 2003. Available free as an electronic resource through the Purdue Library.

Principles of Tissue Engineering, Robert Langer *et al.*, Academic Press, 2014. Available free as an electronic resource through the Purdue Library.

Supplemental Textbooks:
Tissue Engineering, Bernhard O. Palsson and Sangeeta Bhatia, Prentice Hall, 2004. On reserve in Engineering and Science Library (WALC).

Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues, W. Mark Saltzman, Oxford University Press, 2004. Available free as an electronic resource through the Purdue Library.

Assignments

Students are expected to attend class, participate in discussions, read all handout materials, and turn homework in on time. It is possible that the whole homework assignment may be graded or that only specific problems on a homework assignment may be graded. *No late submissions will be accepted*, except if excused by the instructor in advance. Please include on the first page your name, assignment number, the date, and the names of the people with whom you worked on the homework. You may work in groups; the sharing of ideas is an excellent way to learn. Individual solutions, however, have to be turned in by each student. Thus, students should not copy others' homework assignments or assist others by making homework answers available.

As part of a team, students will drive the critical review of a primary journal article and will also teach topics related to the article to the class. Articles will be suggested by the instructor, but groups may choose their own article as long as it is approved by the instructor. The article presentation is designed to train students how to collect, analyze, and utilize information on a research topic and to improve their presentation skills.

Throughout the semester, students will work in teams to prepare an R21-based project proposal or business pitch. Students will turn in a written report and give a presentation at the end of the semester. The proposal will be critiqued by the instructor as well as by other students in the class. The proposal topic will be selected by the students and approved by the instructor.

Missed or late work will not be accepted. Any requests for regrade must be made in writing and within a week after the assignment was available to be handed back to students. For group activities, I will collect from each group member a peer evaluation on the degree of participation of all group members, the results of which will be used to adjust the grade you actually receive for that group activity. Examples of activities for which participation points will be awarded include engaging in in-class activities (e.g., iClicker Cloud), providing peer evaluations, etc.

Grading Scale

Assignments	Due	Weighting
Participation	Throughout the semester	5%
Homework assignments	Throughout the semester	15%
Article Presentation	Throughout the semester	30%
Final Project Report and Presentation	Presentations: 11/14, 11/19, 11/21, 11/26, 11/28, 12/3, 12/5 Report: December 5, 2024	50%

The final grades will be assigned based primarily on the absolute performance and secondarily on the relative performance. The following grading scale is guaranteed but may be modified based on relative student performance:

A+	98%-100%	C	74-76%
A	94-97%	C-	70-73%
A-	90-93%	D+	67-69%
B+	87-89%	D	64-66%
B	84-86%	D-	60-63%
B-	80-83%	F	<60%
C+	77-79%		

Course Evaluation

Toward the end of this semester, you will be provided with an opportunity to give feedback on this course and your instructor. Purdue uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site and will receive a prompt to complete the survey when you login to Brightspace. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system and will offer bonus points for completing the survey.

Academic Integrity

The highest standards of academic honesty are expected. The Purdue Honor Pledge is: "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue." Purdue University's policy on academic dishonesty states that "the commitment of the acts of cheating, lying, stealing, and deceit in any of their diverse forms (such as the use of ghost-written papers, the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest" (University Senate Document 72-18, December 15, 1972). In this course, cheating, plagiarism, or any act of dishonesty will not be tolerated.

Plagiarism means "to use and to pass off someone else's ideas, inventions, writings, etc. as one's own" (New Webster's Dictionary and Thesaurus, 1992). This course will use Turnitin to check for plagiarism and to detect the use of artificial intelligence (AI). In this course, you can use AI tools to correct spelling and grammar. Other uses for AI are prohibited unless the directions for that homework explicitly allow the use of AI on that assignment. It is expected that you generate new ideas and new writing for the homework, writing assignments, in class presentations, and final project. This course will consider it academically dishonest to submit work that has been submitted for a grade in another course. In addition, this course will consider it academically dishonest to submit work that has been used previously in a manuscript or for a graduate exam (e.g., qualifying or preliminary exam, qualifying literature assessment). Any participation in an academically dishonest practice such as plagiarism may result in an F on the pertinent homework assignment or group assignment.

Any incidents of academic dishonesty will be reported to the Office of Student Rights and Responsibilities where university penalties, including removal from the university, may be considered. The first offense will result in an F on the pertinent assignment. A second offense will result in an F grade for the course.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing or by calling 765-494-8778. While the information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Attendance Policy

This course follows the Academic Regulations: Attendance and Office of the Dean of Students: Class Absences policy posted in Brightspace under "University Policies and Statements." Students are expected to be present for every meeting of the classes in which they are enrolled. It is understood that, occasionally, you may miss lecture due to unforeseen circumstances (e.g., illness – please do not come to class if you are feeling ill), and, in these cases, you can ask any questions during office hours. Unless it falls under the University excused absence regulations (see below), any work due should be submitted on time. In cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent medical care. Any unexcused absences will negatively impact your class participation grade and result in a zero for scheduled presentations or assignments due during that class period.

Illness

If a student becomes sick (e.g., with flu-like symptoms), the student should seek prompt medical attention, and then not come back to class until the student has been symptom-free for more than 24 hours. That is, the student should utilize the resources at the Purdue University Student Health Center (PUSH) or another trained medical professional. Materials will be made available electronically to assist any students who are ill, and reasonable accommodations will be made on an individual basis to ensure that all students have the opportunity to learn. If possible, the student should let Professor Liu know as soon as possible such that she can aid in bringing the student up to speed in the course material as rapidly as possible. In the event of a severe outbreak of illness at Purdue that mandates class not meet, all attempts will be made to deliver the course online.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at drc@purdue.edu or by phone: 765-494-1247.

In addition to the University policy, the Davidson School of Chemical Engineering has established procedures for students seeking accommodations. These can be found online at the ChE Undergrad Office website. Only those accommodation requests that conform to both University and ChE policy guidelines will be implemented.

Some important points from the CHE policy include: Please give letters of accommodation to Prof. Liu and your academic advisor. If you have your letter at the start of the term, we strongly recommend you give it to us within the first two weeks of the semester.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructor. You are expected to read your @purdue.edu email on a frequent basis.

Emergency Procedures

In the event that the class would need to evacuate KNOY (e.g., in the event of a fire alarm), the class should proceed to exit the building and meet on the east side of KNOY near Northwestern Ave. In the case of inclement weather, meet near the Au Bon Pain inside of Dudley Lambertus. Do not leave the area as emergency responders will need to count to ensure that all persons have made it from the facility. In the event that we are required to shelter in place due to a tornado warning, we will stay in the basement of KNOY.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

Mental Health/Wellness Statement

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765) 494-6995 during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 am - 5 pm Monday through Friday.

Diversity, Inclusion, and Belonging

I strive for equity, providing equal access and opportunity, and working to maximize student potential. This requires both instructor and students to identify and remove barriers that may prevent someone from full access or full participation. You can help by:

- Contacting me, anonymously if needed, if you see a potential barrier for someone or yourself in participating fully in the class. This might be a physical barrier such as access to technology or a personal situation.
- Suggesting ways in which members of our class can support each other. Virtual study groups and discussion boards are examples, but I encourage you to be creative in your ideas.
- Getting to know each other as contributing members of our learning community. Everyone has something to contribute, and while I designed the course to take advantage of the wealth of knowledge, expertise, and experience we bring together, I cannot do it well without your participation. There are many opportunities built into this course for this type of work. It is important we do it together

Use of Copyrighted Materials

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Thus, these materials cannot be posted online (e.g., Chegg, Course Hero, etc.). Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally. Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

Disclaimer

This syllabus is subject to change. If any change occurs, it will be announced in the class and/or posted on Brightspace.

Tentative Course Schedule

#	Date	Lecture Content
1	8/20	Course Philosophy & History of Tissue Engineering
2	8/22	Microscopy Techniques
3	8/27	Developmental Biology
4	8/29	Cell Sources, Part 1
5	9/3	Cell Sources, Part 2 Lessons from Literature Example
6	9/5	The ECM, Integrins, and Cell Migration, Part 1
7	9/10	The ECM, Integrins, and Cell Migration, Part 2
8	9/12	Polymeric Matrices and Functionalization, Part 1
9	9/17	Polymeric Matrices and Functionalization, Part 2
10	9/19	**Groups 1,2, and 3:** Stem Cell Differentiation
11	9/24	Mechanical Properties of Tissues
12	9/26	**Groups 4, 5, and 6:** Polymers, ECM
13	10/1	Mechanotransduction
14	10/3	**Groups 7, 8, and 9:** Mechanotransduction
	10/8	**October Break**
15	10/10	Controlled Release Part 1
16	10/15	Controlled Release Part 2
17	10/17	**Groups 10, 11, and 12:** Controlled Release
18	10/22	Models of Mass Transport
19	10/24	Microvascularization and Organ on a Chip
20	10/29	Disease Models
21	10/31	**Groups 13 and 14:** Mass Transfer, Organoids
22	11/5	Tissue Engineering in Industry
23	11/7	**Groups 15 and 16:** Disease Models
24	11/12	Regulatory
25	11/14	Final Project Presentation
26	11/19	Final Project Presentation

	11/21	Final Project Presentation
27	11/26	Final Project Presentation
28	11/28	**Thanksgiving**
29	12/3	Final Project Presentation
30	12/5	Final Project Presentation

Purdue University CHE 54300 Polymer Reaction Engineering (Polymer Chemistry) Fall 2025 Syllabus

Instructor: Prof. Tayler Hebner, thebner@purdue.edu

Course Meeting Times: MWF 12:30-1:20 pm, 3 credits
Location: FRNY 1043

Office Hours: TBD

Textbook: George Odian, Principles of Polymerization, 4th edition, 2004

Other useful texts (not used for this class, but good for reference in practice):
Paul Hiemenz and Timothy Lodge, Polymer Chemistry, ISBN 9781466581647
Michael Rubinstein and Ralph Colby, Polymer Physics, ISBN 9780198520597

Course description
This course is an introduction to the chemistry used to create polymers – a foundation that will lead to students being able to synthesize materials with desired physical properties. Technical content will focus on organic chemistry concepts, kinetics of reactions, and molecular structure elements relevant to the design and synthesis of common classes of polymers. Emphasis will be placed on polymerization techniques that are commonly used in laboratory and commercial applications. Students will explore extensions of technical content through discussions of recent literature and completion of a project emphasizing scientific communication and understanding of the broader context of polymer chemistry.

Expected Learning Outcomes
Students will be expected to learn fundamental principles of polymer chemistry, polymer design considerations, and communication skills in this course. Development of understanding of relationships between synthetic methods and correlated polymer properties will be required for successful completion of this course. Students should be able to use the skills developed in this course to extend their knowledge to solving real-world problems through the following specific objectives:

- Select appropriate polymerization reactions and reagents for the synthesis of a polymer with specified properties
- Apply knowledge of reaction kinetics to design polymerization conditions for desired polymer properties
- Identify state-of-the-art and emerging challenges in polymer chemistry at the laboratory scale and industry scale
- Demonstrate fundamental understanding of polymer chemistry through analysis and critique of current literature
- Communicate topics relevant to synthesis and design of polymers to a broad audience via written and oral presentations

Grade Determination

20% Quizzes (10)
30% Project
20% Presentation
20% Literature reviews (10)
10% Participation (lectures and literature discussion)

Course Schedule & Topics Covered
The following topics will be covered in this course on a rolling schedule:

- Introduction to Polymers
- Step Growth Polymerization
- Radical Chain Growth Polymerization
- Emulsion Polymerization
- Cationic Polymerization
- Anionic Polymerization
- Chain Copolymerization
- Ring-Opening Polymerization
- Stereochemistry
- Sustainability of Polymers
- Bonus Topics (tbd based on class interest and as time allows)

Lecture notes will be posted to Brightspace *after* each day's class.

Quizzes: Following the completion of each of the 10 core course topics, quiz will be given at the start of the lecture period on the next day of class.

Literature Discussions/Review Assignments
Literature discussions will take place in class on Wednesdays for a portion of the lecture period. All students are expected to actively engage and participate in these discussions.

Students are expected to read the assigned journal articles and complete their literature reviews prior to discussions. A template and instructions for these reviews will be provided on Brightspace. Completed review assignments will be due on Brightspace at 12 pm on the day of the corresponding discussion.

Project
The course project will be assigned on the first day of class. Written components of the project will be due via Brightspace submission by 9 am on December 12th. Students will complete the course project on a chosen polymerization topic in groups of 3. Each group member is expected to contribute an equivalent amount of effort to the work products.

Presentations
Students will give presentations with their project groups on their chosen polymerization topic during the last week of classes. Each group member is expected to contribute an equivalent amount of effort to preparation and presenting. The tentative schedule for presentations based on polymerization topic will be as follows.This schedule may be adjusted depending on the number of project groups formed on the first day of class.

December 8: Step growth, radical, emulsion
December 10: cationic, anionic, living
December 12: radical copolymerization, ring opening

Late Assignments
Due to the emphasis on group discussions/presentations related to assignments, late assignments will not be accepted for this course. Failure to submit coursework on time will result in no credit for the assignment.

Group Work
Students are strongly encouraged to work with each other, more advanced students, and the instructor on assignments. However, each student is expected to turn in independent assignments that show evidence of individual thought with the exception of the group project, for which one project will be submitted and students will be asked to provide specific contributions as part of the grading criteria. Sources must be appropriately documented in all assignment submissions.

Accessibility
Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let us know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: (765) 494-1247. If you are a student with any form of individual learning needs, please speak with the professors whether or not you seek an accommodation so that we are aware of your circumstance and can deliver course content in a manner that is most compatible with your learning situation.

In addition to the University policy, the Davidson School of Chemical Engineering has established procedures for students seeking accommodations. These can be found online at the ChE Undergrad Office website. Only those accommodation requests that conform to both University and ChE policy guidelines will be implemented.

Some important points from the ChE policy include: Please give letters of accommodation to Prof. Hebner and your academic advisor. If you have your letter at the start of the term, we strongly recommend you give it to us within the first two weeks of the semester. If your accommodation involves exam conditions, we strongly urge you to provide a minimum of one week notice to ensure that the accommodations requested are available.

Campus Emergencies
In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. ***Here are ways to obtain information about changes in this course. You are expected to check your @purdue.edu email address frequently.***
Course Brightspace Page: Fall 2024 CHE 20500-003 LEC
Email from instructor: thebner@purdue.edu,

Nondiscrimination Statement
Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies and Statements.

Attendance
This course follows the Academic Regulations: Attendance and Office of the Dean of Students: Class Absences policy posted in Brightspace under "University Policies and Statements." This policy states that students are expected to be present for every meeting of the classes in which they are enrolled. It is understood that, occasionally, you may miss lecture due to unforeseen circumstances (e.g., illness – please do not come to class if you are feeling ill), and, in these

cases, you can ask any questions about missed concepts during office hours. Unless it falls under the University excused absence regulations (see below), any work due should be submitted on time. In cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent medical care.

Illness

If a student becomes sick (e.g., with flu-like symptoms), the student should seek prompt medical attention, and then not come back to class until the student has been symptom-free for more than 24 hours. That is, the student should utilize the resources at the Purdue University Student Health Center (PUSH) or another trained medical professional. Materials will be made available electronically to assist any students who are ill, and reasonable accommodations will be made on an individual basis to ensure that all students have the opportunity to learn. If possible, the student should let Professor Hebner know as soon as possible such that she can aid in bringing the student up to speed in the course material as rapidly as possible. In the event of a severe outbreak of illness at Purdue that mandates class not meet, all attempts will be made to deliver the course online.

Mental Health/Wellnes Statement

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765) 494-6995 during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 am - 5 pm Monday through Friday.

Use of Copyrighted Materials

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Thus, these materials cannot be posted online (e.g., Chegg, Course Hero, etc.). Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally. Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

Disclaimer
This syllabus is subject to change. If any change occurs, it will be announced in the class and/or posted on Brightspace.

Fall 2022 Course Syllabus – ChE 55100, IPPH 59000, ME 59700, ABE 59100, AAE 59000 – Principles of Pharmaceutical Engineering

Course Information

Course number and title: **ChE 55100, IPPH 59000, ME 59700, ABE 59100, AAE 49000 & 59000 Principles of Pharmaceutical Engineering**
CRN: 25128/30428-30431
Meeting time: **Tuesdays/Thursdays 1:30-2:45 PM**
Meeting location: **FRNY 1043**
Course credit hours: 3.000 CHE55100 also can be taken as a 3-credit special topics 49X/59Xin AAE/ABE/CHE/IPPH/ME
Prerequisites: STEM background

Information about Course Instructors

Instructor and Course Co-Coordinator: **Professor Gintaras V. Reklaitis (ChE)**
Email Address: reklaiti@purdue.edu

Instructor and Course Co-Coordinator: **Professor Zoltan Nagy (ChE)**
Email Address: znagy@purdue.edu

Instructor: **Professor Alina A. Alexeenko (AAE, ChE)**
Email Address: alexeenk@purdue.edu

Instructor: **Professor Elizabeth Topp (IPPH, ChE)**
Email Address: topp@purdue.edu

Instructor: **Professor Carl Wassgren (ME)**
Email Address: wassgren@purdue.edu

If you need to contact us by email, please include "ChE 55100" in the subject line.

Course Description

The course is designed to provide engineering, science and pharmacy students with an understanding of the structure, economic and regulatory context, product discovery and development pipeline dynamics, intellectual property considerations and common manufacturing technology of the global pharmaceutical industry. Course assessment will be based on team projects, three quizzes and participation.

Learning Resources, Technology & Texts

Required text:

- There is no required textbook for this course

Additional resources:

- Lecture powerpoint files and paper pdfs available on course site
- Course site will also contain:
    - Lecture schedule
    - Project assignments
    - Quiz information
    - Course news
    - Grades
    - Staff office hours
- Additional consultations via email

Software and Computing Resources

- N/A

Learning Outcomes

By the end of the course, you will be able to:

1. **Understand the "big picture" view of the Pharmaceutical Industry**
    - Structure and key players
    - Economic & Regulatory context
    - Product pipeline dynamics
    - Current manufacturing technology
2. Working vocabulary of domain concepts
3. Appreciation of technical challenges and opportunities
4. Foundation for specific follow-up courses such as:
    - API Process Development and Design
    - Particle Technology and Manufacturing
    - Pharmaceutical Materials and Dosage Form Design
    - Parenterals and Sterile Operations
    - Bioprocessing

Assignments and Grading

Four projects will be assigned over the semester. Projects may involve analysis of the pharmaceutical industry companies and products, critical assessment of the economics of the pharmaceutical business, evaluation of differences between the pharmaceutical industry sector, anaylysis of processes and products, etc. Each project will require the submission of a written report. Each group will give two oral

+-in-class presentations on projects. Projects will be executed in teacms of two students each. Three quizzes will be given during the course of the semester. There is no final examination.

Assignments	Due	Weight
Participation	Throughout the semester	10
4 Projects	As announced	15 points each
Quizzes		10 points each

- Participation grade includes 3 points for each presentation

Course Topics and Tentative Schedule*

Please check the Course Schedule posted on Brightspace for due dates for projects and other assignments.

Topics
• *Introduction, course mechanics* • *Major Companies, therapeutic categories, leading brand name drugs, generics, orphan, OTC* • *Industry overview: world markets, sales, trends* • *FDA history, enabling legislation, organization structure & functions, ICH* • *Product life cycle & healthcare economics; Cost & risks of pharma business* • *FDA Approval Processes: NME, NDA, ANDA, PAI, etc* • *Critical Quality Attributes (CQAs), QbD, SUPAC*
• *Pharmaceutical dosage forms I* • *Pharmaceutical dosage forms II (include drug-device combinations)* • *Basic Pharmaceutics I: GI Tract physiology; ADME, etc* • *Basic Pharmaceutics II; BCS, transporters* • *Batch process fundamentals: recipes, dynamics, batch size, cycle time, etc* • *Batch process operations (examples of campaigns)* • *IP & Patent Strategy*
• *Process Development* • *Solid Unit Operation* • *API manufacture – typical unit operations* • *Manufacure of solid oral dosage* • *Manufacture of biologics* • *Vaccines and their Manufacture* • *Parenterals sterile processing, lyophilization* • *Integrated Computational Materials Engineering Approach to Pharmaceutical Manufacturing* • *PAT: Process monitoring & control* • *Continuous manufacturing developments; Disruptive innovations in manufacturing*

* Schedule and assignments subject to change. Any changes will be posted on the course website.

Please consult Fall 2022 schedule in Purdue Academic Calendar. Key University dates for the Fall 2022 semester:

- Aug. 22 – Classes Begin

- Sep. 2 – Last Day to Drop/Add a Course
- Sept.5 – Labor Day
- Oct. 10-11 – October Break
- Mid-Semester Academic Progress Report – Oct. 25
- Nov. 23-26 – Thanksgiving Break
  (no classes – 23, 24, 25)
- Dec. 10 – Classes End
- Dec. 12 - 17 – Final Exams
- Dec. 17 – Commencement
- Dec. 20 – Grades Due

Attendance Policy

Students should stay home and contact the Protect Purdue Health Center (496-INFO) if they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus. The student still needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to take an exam. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, through Brightspace, or by phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu. Note that the policy ha been updated in February 2022 to include a **Medically Excused Abscence Policy.**

Academic Guidance in the Event a Student is Quarantined/Isolated

If you have any COVID19 health concerns, contact the Protect Purdue Health Center at 765-496-4636.

If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur.

Classroom Guidance Regarding Protect Purdue

The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their

instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

References Supporting Protect Purdue Compliance:

- Office of the Dean of Students Protect Purdue Compliance Plan: Ask, Offer, Leave, Report
- Office of the Dean of Students Managing Classroom Behavior and Expectations

Academic Integrity

Purdue's Honor Pledge: "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Course notes are "considered to be 'derivative works' of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials." As such, they cannot be sold or bartered without your express written permission.

Nondiscrimination Statement

Purdue's nondiscrimination policy is included in the Brightspace and can also be found here.

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on our course Brightspace table of contents, under University Policies.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

Mental Health Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

1. If you experience any symptoms of COVID-19 or suspect you may have been exposed to someone with COVID-19 stay home and call the Protect Purdue Health Center at 765-496-INFO.
2. Keep your cell phone on to receive a Purdue ALERT text message.
3. Log into a Purdue computer connected to the network to receive any Desktop Popup Alerts.

ChE 554: Smart Manufacturing in the Process Industries

Course Information

- **ChE 554: Smart Manufacturing in the Process Industries**
- **CRN:** 18317/18322
- **Instructional Modality**: *Asynchronous-Online*
- **Meeting day(s) and time(s)**. *This course starts on January 8 and runs until April 27.* However, there are no formal class meeting times since this is considered an **Asynchronous-Online** course. This means that you will independently watch the recorded lectures in Brightspace to complete assignments.
- **Course credit hours:** *3*
- **Prerequisites (if any**): A basic understanding of Python Programming

Instructors Contact Information

- **Professor J. Pekny (Course Coordinator)**
  - **Email:** pekny@purdue.edu
  - **Office** Location: FRNY
  - **Office Number:** G027C
- **Professor G V Reklaitis**
  - **Email:** reklaiti@purdue.edu
  - **Office** Location: FRNY
  - **Office Number:** G027B
- **Professor Z. Nagy**
  - **Email:** znagy@purdue.edu
  - **Office Location:** FRNY
  - **Office Number:** G027D
- **Student Consultation hours, times, and location:** *Each week, a different instructor will present content, asynchronously. Please email the instructor in question for specific questions about the content they presented. For administrative questions including grades, and other please email Dr. Pekny, the course coordinator. You should hear a response from your instructors within 24-48 hours in most cases.*

Course Description

This course surveys the tools and techniques which are relevant to support the multiple levels of technical decisions that arise in modern integrated operation of manufacturing resources in the chemical, petrochemical and pharmaceutical industries. The real time generation and sharing of associated data and knowledge via relevant IT methodology and the effective use of this information in the various levels of the process operations management hierarchy are currently termed **Industry 4.0** (Europe) and **Smart Manufacturing** (US). The topics covered in the course span all the technical components and decision levels in the operations decision hierarchy. Topics include the role of on-line and at-line process measurements, elements of sensor network design, information systems to support process operations, plant data reconciliation, detection and diagnosis of process faults, condition-based monitoring of plant assets, plant wide control, real time process optimization, production planning and scheduling, and supply chain management. Each topic will be addressed by first summarizing the basic role and scope of that component, then discussing the elements of the decision problem, and outlining some representative tools available to address that decision problem. Each major topic will include a lecture given by an industrial practitioner who will offer a perspective on the state of industrial practice.

Learning Resources, Technology & Texts

- **There is NO required textbook for this course.**
  - There will be readings available within Brightspace.
- **Software**
  - MatLab (which can be accessed via ECN). For more information about accessing Matlab, click **here.**
  - We will also be analyzing data using "Anaconda," (a popular Python distribution), click **here** to learn more about how to download it and get started.
- **Hardware requirements**
  - A laptop that can connect to the internet and run the **Microsoft Office Suite** (available free to all Purdue Students)
- **Brightspace learning management system**
  - Access the course via Purdue's Brightspace learning management system. Begin with the Start Here tab, which describes how the course Brightspace is organized. It is strongly suggested that you explore and become familiar not only with the site navigation but with the content and resources available for this course. See the Student Services widget on the campus homepage for resources such as Technology Help, Academic Help, Campus Resources, and Protect Purdue.

Learning Outcomes

1. Explain the key decisions that are made at each level of the operational hierarchy of an integrated process system.
2. Define what the various types of manufacturing and enterprise data are, how they are generated and managed and what their functions are in supporting these decisions.
3. Explain the role of models in supporting the decisions made at each level of the operational hierarchy.
4. Evaluate and improve a plant wide control system for a given manufacturing system.
5. Identify condition-based monitoring of a manufacturing system, how it is performed and what its outcomes should be.
6. Explain the nature and role of planning and scheduling models and tools as applied at the plant and supply chain levels.

Assignments

Assignment	Description	% Of Grade
HW/Labs	The goal of these labs is to give you real-world problems to solve using the information presented. More information about each of the homework/labs can be found in Brightspace.	60%
Final Project	While we encourage you to choose the "scope" of your project based on your interest level towards specific topics presented in the course and the application to your current or future career, **your topic still needs to be approved.**	40%
		Total: 100%

Grading Scale

In this class grades reflect the sum of your achievement throughout the semester. You will accumulate points as described in the assignments portion above, with each assignment graded according to a rubric. At the end of the semester, final grades will be calculated by adding the total points earned and translating those numbers (out of the maximum available) into the following letters (there will be no partial points or rounding).

A: 93.5%-100%
A-: 89.5%-93.49%
B+: 86.5%-89.49%
B: 82.5%-85.49%
B-: 79.5%-82.49%
C+: 76.5%-79.49%
C: 72.5%-75.49%
C-: 69.5%-72.49%
D+: 66.5%-69.49%
D: 62.5%-65.49%
D-: 59.5%-62.49%
F: 49.4%-below

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Nondiscrimination Statement

A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Accessibility

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to contact the course coordinator to discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Course Schedule

Week	Topics	Assignments
Week 1	Introduction to Smart Manufacturing	
Week 2	Sensors and Plant Data Reconciliation	HW/Lab 1 - Data Reconciliation
Week 3	Error Detection and Information Systems	
Week 4	Statistical Methods and Monitoring/Diagnosis Applications	HW/Lab 1
Week 5	PLS Models and Applications and Review of Diagnostic Methods	HW/Lab 2 - Process Analytics using Multivariate Methods
Week 6	Condition Based Monitoring	
Week 7	ML and AI Models	
Week 8	Data Analytics	
Week 9	Optimization	
Week 10	State Estimation	HW/Lab 3 - Optimization
Week 11	Plant Wide Control	
Week 12	Scheduling and Planning Introduction	HW/Lab 4 - Plant Wide Control
Week 13	Scheduling and Planning Methods	
Week 14	Industrial Application	HW/Lab 5 - Scheduling and Planning
Week 15	Supply Chain Management	
Week 16	Final Group Projects	Final Presentation

* Schedule and assignments subject to change. Any changes will be posted in the learning management system.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack**.** Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

CHE 558 RATE CONTROLLED SEPARATIONS Fall 2025

INSTRUCTOR: Professor N.-H. Linda Wang
Office: FRNY 1015, Phone 494-4081
Email: wangn@purdue.edu
Office Hours: Wed. 4:30 pm, FRNY 1015

LECTURE: MWF 12:30 am – 1:20 pm, FRNY 1142

TEXT 1 (W1): Wankat, P. C., Separation Process Engineering, Prentice Hall, Fourth Edition. 2017.

TEXT 2 (W2): Wankat, P.C., *Rate Controlled Separations*, Blackie Academic & Professional, New York, 1990, Reprinted 1994.

COURSE OBJECTIVES:

1. To develop in-depth understanding of the fundamental concepts and quantitative theories in three important rate-controlled separation techniques: chromatography, membrane separations, and solvent extraction (or crystallization);
2. To develop abilities to learn from reading and discussion, and to give presentations and to lead discussions during class;
3. To develop abilities for critical review of key articles in the literature;
4. To develop abilities to use computer simulations to understand complex chromatography processes (optional);
5. To develop abilities in literature search and independent case studies of a separation process with potential applications in producing an important chemical or biochemical, and to present your results in class and in a term paper.

IMPORTANCE: This course covers important separation methods not normally taught in undergraduate or graduate courses.

GRADING:

4 Home works (5% each)	20%
1 Exam (Take-home)	35%
In-Class Discussion/Teaching	15%
1 Oral Presentation	10%
1 Group Project & Term Paper	20%
TOTAL	100%

Group Project: A team of two or three students will work on a separation project of their choice. An oral presentation of each team will be done during the last week of the class. A written report will be submitted on the Wednesday of the final week. The oral presentation and written report grades will be based on the quality of the solution, the presentation, and the writing. Students will turn in a peer evaluation of team members' contributions during the last week of the semester. Peer evaluation and professional behavior will be considered in the final grading for the course, especially for borderline grade cases.

Professional Behavior: Students in CHE 558 are expected to behave ethically and professionally.

GRADING SCALE:

Grade	GPA Value	Range (%)
A+	4.0	97-100
A	4.0	93-96.9
A-	3.7	90-92.9
B+	3.3	86-89.9
B	3.0	83-85.9
B-	2.7	80- 82.9
C+	2.3	77-79.9
C	2.0	73-76.9
C-	1.7	70-72.9
D+	1.3	66-69.9
D	1.0	63-65.9
D-	0.7	60-62.9
F	0.0	<60

REFERENCE ARTICLES: Lists of key papers on various topics will be posted in Brightspace for review and discussion.

REFERENCE BOOKS:

1. Guiochon, G., S.G. Shirazi, A.M. Katti, *Fundamentals of Preparation and Nonlinear Chromatography,* Academic Press, Boston, 1994. (Most comprehensive text on nonlinear chromatography)
2. Wankat, P.C., *Large Scale Adsorption and Chromatography*, Vol. I and Vol. II, CRC Press, 1986. (Most comprehensive engineering analysis of adsorption and chromatography)
3. Giddings, J.C. *Unified Separation Science*, Wiley, 1991. (Unified treatment of chromatography, electrophoresis, and field-flow fractionation)
4. Bailey, J.E. and D.F. Ollis, *Biochemical Engineering Fundamentals*, 2nd Ed., McGraw Hill, 1979. (Good chapters on biochemical separation)

5. Snyder, L.R. and J.J. Kirkland, *Introduction to Modern Liquid Chromatography*, 2nd Ed., Wiley, 1979. (Most comprehensive treatment of analytical chromatography)
6. King, C.J., *Separation Processes*, 2nd Ed., McGraw Hill, 1980. (In depth discussion on key separation processes; many good problems)
7. Helfferich, F.G. and G. Klein, *Multicomponent Chromatography*. *Theory of Interference*. Marcel Dekker, New York (available from University Microfilms International, Ann Arbor, MI, #2050382) (1970). (The first book on multicomponent chromatography, analyzed using local equilibrium theory (no mass transfer effects).)
8. Aris, R. and N.R. Amundson, *Mathematical Methods in Chemical Engineering, Vol. 2, First Order Partial Differential Equations with Applications*, Prentice-Hall, 1973. (Rigorous mathematical analysis of adsorption/chromatography systems)
9. Ruthven, D.M., *Principles of Adsorption and Adsorption Processes*, Wiley, 1984. (Most comprehensive book on gas phase adsorption)
10. Sherwood, T.K., R.L. Pigford, and C.R. Wilke, *Mass Transfer*, McGraw Hill, 1975. (Good book on mass transfer)
11. Tanford, C., *The Physical Chemistry of Macromolecules*, Wiley, 1961. (Best book on the physical properties of macromolecules)
12. Asenjo, J.A., (ed) *Separation Processes in Biotechnology*, Marcel Dekker, N.Y., 1990. (Comprehensive discussion on biochemical separations).
13. Tien, Chi, Adsorption Calculations and Modeling, Butterworth-Heinemann, Boston, 1994.
14. Committee on Separation Science and Technology, National Research Council, Separation & Purification, Critical Needs and Opportunities, National Academy Press, Washington, D.C., 1987.
15. Nicoud, Roger-Marc, Chromatographic Processes-Modeling, Simulation, and Design, Cambridge University Press, 2015. (Comprehensive discussion on SMB).
16. A. K. Karamalidis and R. Eggert (ed) Rare Earth Element, Sustainable Recovery, Processing, and Purification, Wiley, 2025

Tentative Schedule

**Reading Notation: §: Chapter; W1: Text1 by Wankat; W2: Text 2 by Wankat 1; R3:

Reference 3; R7: Reference 7.

Period	Date	Day	Topic	Reading**	Homework Due
1	08/25	M	Course Introduction	W1 §1	

			Overview of Separations & Chromatography	W2 §1, 14	
2	08/27	W	Chromatography Dynamics & Applications	W1 §19.0	
3	08/29	F	Introduction of Elution, Displacement, and Simulated Moving Beds and Application Examples	W2 § 6 W1 §19.1-19.2	
	09/01	M	**Labor Day (No Class)**		
4	09/03	W	Basics of Sorption/Adsorption Sorbents, Adsorption Isotherms Shock Waves & Diffuse Waves Solute Movement Theory Method of Characteristics	W1 §19.2 W2 §7	
5	09/05	F	Linear Theories & Peak Shapes Effects of Changing Thermodynamic Variables	W1 §19.2 W2 §7 R1 §1-3, 5-6	
6	09/08	M	Peak Focusing by pH or Temperature	W1 §19.2.2 W1§19.4; W2 §6	**HW#1**
7	09/10	W	Nonlinear Theories- Shock Waves	W2 §6,8	
8	09/12	F	Nonlinear Theories-Diffuse Waves	W1 §19.6	
9	09/15	M	Linear Theories for Non-ideal Systems Linear Dispersion Model	W2 §7	
10	09/17	W	Linear Theories-Equilibrium Stage Model &Applications		
11	09/19	F	Van Deemter Eq. & Rosen's Model		
12	09/22	M	Non-linear Theories; Mass Transfer Zone Length; Bed Utilization; Constant Pattern Solutions	W2 §8	**HW #2**
13	09/24	W	Non-linear Theories for Displacement		
14	09/26	F	General Design Method for Affinity Chromatography	Lecture Notes	
15	09/29	M	Ion Exchange and Applications	W1§19.4, 19.7-19.9, W2§9	
16	10/01	W	Design of Ion Exchange Processes	W1§19.5	

17	10/03	F	General Rate Equations		
18	10/06	M	Aspen simulations	Handouts	**HW# 3**
19	10/08	W	Aspen Simulations	Handouts	
20	10/10	F	SMB Principles	Handouts	
October Break (Oct. 13-14) No Class					
21	10/15	W	SMB-Solute Movement Analysis		
22	10/17	F	SMB Design-Standing Wave Theory	W1 §19.3.3 W2 §10	
23	10/20	M	SMB	Handouts	
24	10/22	W	SMB		
25	10/24	F	Membrane Separations-Intro		
26	10/27	M	Membrane Separations	W1 §18	**HW#4**
27	10/29	W	Membrane Separations	W2 §12	
28-29	**10/31**	**F**	**Take-home Exam (Due M, Nov. 3)**		
30	11/03	M	Membrane Separations		
31	11/05	W	Membrane Separations		
32	11/07	F	Membrane Separations	W2 §13	**Paper Outline Due**
33	11/10	M	Solvent Extraction or Crystallization		
34	11/12	W	Solvent Extraction or Crystallization		
35	11/14	F	Solvent Extraction or Crystallization		
36	11/17	M	Solvent Extraction or Crystallization		
37	11/19	W	Solvent Extraction or Crystallization		
38	11/21	F	Solvent Extraction or Crystallization		
	11/24	M	**No Class**		
Thanksgiving Vacation (Nov. 24-27)					
	11/28	F	**No Class or Make Up Class**		
39	12/01	M	Term Paper Presentations		**Pre. slides due**
40	12/03	W	Term Paper Presentations		
41	12/05	F	Term Paper Presentations		
42	12/08	M	**No Class** (Finals Week)		
43	12/10	W	**No class**		**Term paper due**
44	12/12	F	**No class**		

*Instead of make-up lectures, we will have a take-home exam (2 hours). Any additional make up lectures, if needed, will be scheduled.

**Reading Notation: §: Chapter: W1: Text1 by Wankat; W2: Text 2 by Wankat 1; R3: Reference 3; R7: Reference 7.

Copyright:

"Students may not copy, reproduce or post to any other outlet (e.g., YouTube, Facebook, or other open media sources or websites) any work in which they are not the sole or joint author or have not obtained the permission of the author(s)."

Disclaimer:

This syllabus is subject to change. You will be notified of any changes as far in advance as possible via an announcement on Brightspace. Monitor your Purdue email daily for updates.

Course Logistics:

All assignments are due in the beginning of the class on the due date listed in the Course Schedule.

To encourage you to stay on schedule, 20% of the total points will be deducted for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points.

An assignment file should be appended by your username, such as "1-kim53.doc." This will make it easier for me to manage assignment files.

CHE 59700* - Industrial Chemical Technology Spring 2026 Public Syllabus

***course number changed to CHE 57000 starting Fall 2026**

Course Information and Description

a. **Catalog description:** This course traces the historical development of the chemical and related process industries and describes the principal products that are made and the evolution of the raw materials, chemistries, and processes by which they have been made. The scope includes natural products, inorganics, fuels, and commodity and specialty organics. The course also covers topics of current interest including the impacts of modern catalysis, digital computation, and systems engineering on process technology, issues of sustainability, resource conservation, environmental responsibility, product stewardship, and carbon management, and the likely impacts of recently more abundant and less expensive shale gas and oil on the chemical industry.
b. **Prerequisites:** None
c. **Course Status:** Elective
d. **Credits:** 3
e. **Contact Hours:**
Lecture 2 times per week for 75 minutes

Instructor

J. J. Siirola

Textbook

a. **Required:** None
b. **Other supplemental materials:**
Kirk-Othmer Encyclopedia of Chemical Technology (5th Ed and On-line, Wiley)
Ullmann's Encyclopedia of Industrial Chemistry (5th Ed and On-line, Wiley)
Shreve's Chemical Process Industries (5th Ed, McGraw-Hill Special Reprint Edition)
Handbook of Chemical Technology and Pollution Control (Robert Myers, 3rd Ed, Elsevier)
Handbook of Petroleum Refining Processes (Martin Hocking, 2nd Ed, McGraw Hill)

Learning Outcomes

At the completion of this course the student should have a basic understanding of the history and structure of the chemical and allied process industries and the major classes of products it produces including Natural Products (animal and vegetable products and wood derivatives), Inorganics (ceramics, metals, bases and acids, and industrial gasses), Fuels (coal, gas, oil, petroleum refining, synthetic and biofuels), and Organics (historical wood and coal derivatives, modern basic chemical building blocks, intermediates, polymers, specialty chemicals, pharmaceuticals, and biotechnology). Students should also have an appreciation of Technical Impact Factors (catalysis, digital computation, and structured innovation) that have significantly altered the process industries in recent years, and Current Issues (environmental protection, health and safety, sustainability, carbon dioxide emissions, and shale gas and oil) that are likely to significantly impact process industry operations over the next few decades.

Course Content

History and structure of the chemical and allied process industries
Natural Products (animal and vegetable products; wood derivatives)

Inorganics (dehydration (calcining), reduction (smelting), bases and acids, commodities)
Fuels (fossil, petroleum refining, synthetic and biofuels)
Organics (wood and coal derivatives, basic building blocks, commodity intermediates and solvents, commodity monomers and polymers, plastics fibers and coatings, fine chemicals, biotechnology)
Technical Impact Factors (catalysis, computers, innovation)
Current Issues (environmental protection, health and safety, sustainability, carbon dioxide management, shale gas and oil)

Grading Policy

Attendance and class participation	20%
Homework Reports (Report 7 counts double)	80%
Bonus Report:	Up to +10%

There are no quizzes, midterm, nor final examinations.

Course grades are based on a straight scale: 90%+ is an A, 80%+ is a B, 70%+ is a C, 60%+ is a D, and below 60% is an F. Pluses and minuses are not awarded.

Homework Reports

Homework reports are designed primarily to help students explore selected course material in greater depth. Reports have neither a minimum nor maximum page requirement, limit, nor format, but several typewritten pages are typical (except Report 7 which coverers more material and counts double). Homework reports will be individual and will be graded and returned as quickly as possible at a subsequent lecture session. Solutions may be available subsequently on the course Brightspace.

Report 1 - Industry Structure and Statistics (Week 2)
Report 2 - Reaction Path Synthesis: Solvay Process (Week 4)
Report 3 - Block Flow Diagram: Petroleum Refining (Week 6)
Report 4 - Process Supply Chain: Polyethylene Terephthalate (Week 8)
Report 5 - General Purpose Batch Processing: Fine Chemical Manufacture (Week 10)
Report 6 - Safety and Environmental Protection: Methyl Isocyanate (Week 12)
Report 7 - Sustainability: Carbon Management (Week 15)
Bonus Report - Process Narrative: Major Chemical Intermediate (Week 15)

Academic Honesty

Students are individually responsible for each homework report. Cheating will not be tolerated. While discussions of homework among classmates are to be expected, students are responsible for submitting their own work. Copying without attribution is plagiarism and is considered a form of cheating.

Accommodation

Purdue University strives to make learning experiences as assessable as possible. If students anticipate or experience physical or academic barriers based on disability, they are welcome to let the instructor know so that options may be discussed. Students are also encouraged to contact the Disability Resource Center at drc@purdue.edu or by phone at 765-494-1247.

ChE 575
Syllabus: Catalytic Industrial Processes

Instructor: Jeff Miller (mill1194@purdue.edu; FRNY 2152)

Short description: A survey course on the process design of major catalytic processes in the refining and petrochemical industries for production of transportation fuels and commodity chemicals.

Rationale: Energy in the form of natural gas, coal and oil are utilized to produce more than 80% of today's energy. This course will discuss the current supply and demand of global energy production. Catalytic process are used primarily to produce transportation fuels and chemicals from petroleum. This course will discuss the chemical composition and specifications for fuels and chemicals and how these are produced at an industrial scale. The process design, catalyst composition and reaction chemistry of the major refining and petrochemical processes will be emphasized. Additionally, the latest catalyst characterization methods, research innovations and industry trends of these processes will be covered. This course is an elective that will benefit those seeking a chemistry or chemical engineering career in the energy and chemical industries.

Course Content

Energy Overview
- Overview of the major energy sources
- Estimates of the energy demand worldwide and regionally and how are these expected to change in the next 25-50 years
- Discussion of developing changes and opportunities in the energy sector

Transportation Fuels
- Molecular compositions of gasoline, diesel and jet fuels
- Overview of the fuel properties of molecular compounds in fuels
- Overview of the regulatory requirements for fuel compositions

Refining Technology Processes (Transportations Fuels Production)
- Overview of petroleum refinery and how these individual process are interconnected
- Overview of Naphtha Reforming, process, chemistry and catalysts
- Overview of Fluid Catalytic Cracking, process, chemistry and catalysts
    - In-depth discussion of zeolite fundamentals and catalytic properties
- Overview of Hydrotreating, process chemistry and catalysts

Auto-Exhaust and Emission Control Catalysts
- Overview of auto emission three-way catalysts
- Overview of diesel emission three-way catalysts
- Regulatory requirements for vehicle exhaust emissions

Petrochemical Processes (Chemical Feedstock Production)
- Overview of Propylene production, process, chemistry and catalysts
- Overview of Aromatics production, process, chemistry and catalysts
- Overview of Ethylene production, process and chemistry

Emerging Technology Developments

- Production of chemicals from biomass
- Production of fuels and chemicals from shale gas

Additional Topics: Catalyst Synthesis and Fundamentals

- Fundamentals of catalyst synthesis
- Commercial Catalyst manufacturing methods
- Single site alkane dehydrogenation catalysts
- Metal alloy catalysts
- Catalyst characterization by MAS NMR, TEM, X-ray spectroscopy, and others
    - Characterization under reaction conditions
- Invited lectures by leading industrial experts, generally senior managers, in 1-2 process technologies covered in this class

Learning Objectives:

1. Understand and analyze the historical, current and potential future roles that hydrocarbons play in the economy for energy, fuels, and chemicals.
2. Understand and compare the ways that energy is used in society, especially the breakdown between electricity/power and fuels. Understand the basic fuel properties of liquid transportation fuels (LPG/LNG, gasoline, diesel and jet).
3. Understand the regulatory requirements, technical specifications and molecular composition of fuels and chemicals.
4. Understand the major refining and petrochemical processes by which hydrocarbons are produced. Additionally, understand the reaction chemistry and role of the catalyst in these chemical transformations.
5. Understand the chemical principles and industrial processes for catalyst manufacture.
6. Understand the structure of the catalytically active site and methods for its determination.
7. Understand the future demands for fuels and chemicals and potential opportunities for changes to the current processes.

ChE 59700-024: Applied Marketing for Chemical Engineers

Fall 2025, First 8 weeks (8/25/2025-10/12-2025)

Course Information

- Course number and title: CHE 59700-024: Applied Marketing for Chemical Engineers
- Meeting time: Class meets 1:30 to 3:20, Monday, Wednesday and Friday
- Course credit hours **3 credit hours**
- Course information and materials will be available through Brightspace
- Prerequisites: none

Textbook: "Marketing Management" – Phillip Kotler, Kevin Lane Keller, and Alexander Chernov 16th ed.

Instructor Contact Information

Michelle Chutka

Phone: 765-418-1524 (cell)

Email: mchutka@purdue.edu

Office Hours: TBD, or arranged through email

About the Instructor

MICHELLE CHUTKA, M.S. Chemical Engineering

Following a 19-year career in medical devices, Michelle founded SymbioSIS Consulting LLC and is actively supporting medical device companies and other industries, in areas of new product development, manufacturing, and continuous improvement.

In her most recent role at Cook Biotech, Michelle was responsible for strategic direction of the product engineering branch. These teams included early-stage biotechnology platform development, first-generation products seeking clinical trial or FDA clearance, sustaining engineering including support for EU-MDR, as well as device labeling design and regulatory compliance.

Michelle is also passionate about sharing industry experiences and has partnered with Purdue University in a Continuing Lecturer role to design graduate-level coursework for Purdue's Professional Master's Program for Chemical Engineering. Currently, Michelle supports courses related to financial analysis and project management, medical device design and development, and applied marketing principles. She also is the instructor in a section of the Senior Lab ChE 435.

Beyond medical devices, Michelle has experience in the pharmaceutical and automotive industries. She received a Master of Science (M.S.) degree and Bachelor of Science (B.S.) degree in Chemical Engineering from the University of Michigan. She holds US patents 9,827,271 and 10,973,856. Michelle also serves on the Research Review Committee for LittleStar ABA, and volunteers in leadership roles throughout her local community.

Course Description

This course focuses on formulating and implementing marketing management strategies and policies, a task undertaken in most companies at the strategic business unit level. The marketing management process is important at all levels of the organization, regardless of the title applied to the activity. Typically, it is called corporate marketing, strategic marketing, or marketing management. For our purposes, they all involve essentially the same process, even though the actors and activities may differ. The course will provide you with a systematic framework for understanding marketing management and strategy.

Marketing is about identifying and meeting human and social needs. Marketing can also be defined as meeting needs profitably. Marketing management is the science and art of choosing target markets and getting, keeping, and growing customers through creating, delivering, and communicating superior customer value. This course will explore marketing concepts with the goal of helping company executives and managers make decisions. The course will review elements of a marketing strategy, culminating in preparing a marketing plan for a product. The course will enable interaction with several industry representatives with experience in industrial marketing and product management.

The class format will be predominantly case based supported by textbook readings and discussion covering topics listed in the course schedule. Students are expected to read and be familiar with the assigned chapters and supplemental readings before each class and **be active participants in discussion – this point cannot be emphasized enough**. For some classes, a guest speaker will present and lead discussion focused on their experiences and topics that are relevant for marketing management.

Learning Resources, Technology & Textbook

Required Textbook

“Marketing Management” – Phillip Kotler, Kevin Lane Keller, and Alexander Chernov 16th edition

Brightspace Page

You must access the course via Brightspace. It is strongly suggested that you explore and become familiar with the site navigation if you have not already done so.

Instruction

This course will be offered in a live format. There will be times as deemed necessary by the instructor when the class will convene remotely via Teams in order to host remote guest speakers, etc. Attendance will be monitored for all scheduled classes. There may be times where the instructor requires a conversion to a synchronous online or an asynchronous online format, at which point a lecture will be provided via Teams or pre-recorded.

Course Goals

The goal of this course is to develop the knowledge and skills in the essential aspects of marketing management, marketing strategy, and emerging marketing applications, with a focus on the development and execution of programs, audits, and plans. The student should come away with an understanding and appreciation of the concepts of marketing as it pertains to engineering careers and the intersection of marketing and engineering roles.

Objectives

This course is concerned with the development, evaluation, and implementation of marketing management in complex environments. The course deals primarily with an in-depth analysis of a variety

of concepts, theories, facts, analytical procedures, techniques, and models. The course addresses strategic issues such as:

- What business should we be in?
- What are our long-term objectives?
- What is our sustainable marketing competitive advantage?
- Should we diversify?
- How should marketing resources be allocated?
- What marketing opportunities and threats do we face?
- What are our marketing organizational strengths and weaknesses?
- What are our marketing strategic alternatives?

To ensure that students have a solid foundation of the fundamental marketing decision-making tools and management of all the elements of the marketing plan, students will be provided the opportunity to apply marketing planning and decision-making skills through an in-depth semester-long project.

Assignments and Grading Scale

The final grade will be based on:

• Participation (100 points). While participation is of course required and expected in all aspects of this course - preparation for and participation during in-class discussion is paramount to success in this course!!!

• Team evaluations (100 points). Teamwork is critical in business and there will be a group evaluation

• Writing assignments/Quizzes (200 points) Individual work; quizzes are auto-graded

• Marketing Plan and Team Presentation (200 points) These are group exercises

• Final Paper (100 points) – individually written; original work only!

All assignments will be shared and collected/uploaded to Brightspace as instructed. Due dates will be shared on Brightspace.

Grades will reflect the sum of your achievement of learning outcomes throughout the semester. You will be graded and accumulate points proportionally as described above, with each assignment graded accordingly. At the end of the semester, final grades will be calculated by adding points earned and translating those into the following letters (there will be no partial points or rounding).

A range: 90 – 100% of the weighted grade

B range: 80 – 89% of the weighted grade

C range: 65 – 79% of the weighted grade

D range: 50 – 64% of the weighted grade

F Less than – 50% of the weighted grade

For the marketing plan and team presentations, members of the class will be divided into groups of four-people who will collaboratively work on a plan as assigned. Each group will prepare team presentations to be given during the last week of classes. More details about the expectations for the plan and presentations will be provided in class. Teamwork is an important element of the grade. Each student will have the opportunity to evaluate and to be evaluated by peers. Even if a team earns the maximum grade for the report, if a teammate's contribution is evaluated by its peers to be inadequate, that student will not earn the maximum grade.

Students are expected to read the chapters and articles assigned for every lecture. There will be regular quizzes/written assignments through Brightspace.

The final write-up assignment will be brief but will be reflective of each individual's work. This is also where you may freely comment and reflect on your team's work styles and improvement opportunities. This write up must be your own work and plagiarism will result in a zero points grade for both the original work author and all individuals involved in the plagiarism event.

Missed or Late Work

All work is expected to be completed and submitted on time. Late submissions will be penalized by 50% of the grade for each day it is late. Failure to complete an assignment after 48 hrs will result in a zero score, even for final papers or other large portions of the grade.

Academic dishonesty will be dealt with accordingly as per university policy, with escalations through the department as deemed appropriate.

Course Schedule

The course will start on August 25 and end on Oct 10th. Labor Day holiday is observed as a non-lecture day. A separate document is available with the course schedule and assignment due dates via Brightspace.

Attendance

This course follows Purdue's academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to the instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted **by ODOS** for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent or urgent care medical care.

Classroom Guidance Regarding Protect Purdue

The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Nondiscrimination Statement

A link to Purdue's nondiscrimination policy is included in Brightspace and can also be found here.

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect

among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

Mental Health Statement

If you need support and information about mental health options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructor via email. You are expected to read your @purdue.edu email on a frequent basis.

Related Considerations and Guidelines

1. For Guidelines on Academic Integrity that have been shared with the instructor – Please see (Appendix A)

2. A supplement (see Appendix B) at the end of this document provides resources to communicate or engage with students in case of unexpected emergencies that affect the West Lafayette campus. Emergency notification is vital!

Appendix A - Guidelines for Academic Integrity

In a society that increasingly questions the value of higher education, upholding academic integrity takes on added significance. The time and effort necessary to champion high expectations of academic integrity are well understood, and the University is in full support of faculty and instructors who uphold these standards. Please consider these five steps for your class.

1. Define academic dishonesty for your class in your syllabus and emphasize it on the first day of class. The OSRR website offers a faculty guide on responding to academic dishonesty. Revisit your expectations at key junctures of the semester (e.g., before an exam or term project).

2. Provide greater clarity to students about what is acceptable and unacceptable. Some classes routinely use team assignments and encourage collaboration for projects, labs, or homework. Yet at other times of the term, students are expected to work independently. Be very clear about your expectations for each assignment.

3. Students should be told prior to – and as part of – the instructions on each test what is acceptable in terms of notes, phones, calculators, etc. From class to class our practices vary widely so, here again, it's important to be very clear in your expectations.

4. Define penalties that will be enforced for academic dishonesty. One example might be:

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered.

5. At a minimum, if you penalize a student's grade by deducting points, report the instance of scholastic dishonesty using the OSRR reporting form. Reporting all incidents helps to ensure consistent treatment both at the course level and across the institution. Staff members from OSRR are available to consult on an individual basis. Their phone is 765-494-1250.

6. While faculty and instructors have raised concerns about student academic integrity, students have indicated that some instructors appear reluctant to uphold academic standards. Be clear in your syllabus on the steps you will take in your class to uphold academic integrity. In addition, students should be made aware that they can report issues of academic integrity that they observe, and may do so anonymously, through the OSRR by calling 765-494-8778 or emailing integrity@purdue.edu.

Appendix B: Emergency Preparedness Face-to-Face

1. Prior to the first day of class, obtain a copy of the building emergency plan for each building in which you will be teaching. Note the evacuation route and assembly area, as well as the shelter in place locations. BEPs are located on the Emergency Preparedness website.

2. On the first day of class, the following information is required to be presented to students:

1) As we begin this semester, I want to take a few minutes and discuss emergency preparedness. While COVID-19 is currently a major focus of our campus health and safety preparations, we must also take time to be prepared for other possible emergencies as we would in any semester. Purdue University is a very safe campus and there is a low probability that a serious incident will occur here at Purdue. However, just as we receive a "safety briefing" each time we get on an aircraft, we want to emphasize our emergency procedures for evacuation and shelter-in-place incidents. Our preparedness will be critical IF an unexpected event occurs!

2) Emergency preparedness is your personal responsibility. Purdue University is actively preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. Let's review the following procedure

• For any emergency text or call 911.

• There are more than 300 Emergency Telephones (aka blue lights) throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected right away.

• If we hear a fire alarm, we will immediately evacuate the building and proceed to the space outside. Do not use the elevator. Go over the evacuation route (see specific Building Emergency Plan).

• If we are notified of a Shelter in Place requirement for a tornado warning we will stop classroom activities and shelter in the lowest level of this building away from windows and doors. Our preferred location is the basement.

• If we are notified of a Shelter in Place requirement for a hazardous materials release, we will shelter in our classroom shutting any open doors and windows.

• If we are notified of a Shelter in Place requirement for an active threat such as a shooting, we will shelter in a room that is securable preferably without windows.

Course Information

- Course Number: CHE 59700
- Course Name: Introduction to the Upstream Oil and Gas Industry
- Course Reference Number (CRN): 31061

Course Learning Objectives and Outcomes.

- Describe the history of the oil and gas industry.
- Identify the geological origins of petroleum reservoirs and reservoir fluids.
- Describe the components and processes involved in the drilling, completion, and production of oil and gas reservoirs.
- Explain exploration, production, and operations concepts associated with the oil and gas industry.
- Demonstrate and apply terminology and skills necessary to gain employment in the oil and gas industry.
- Demonstrate an understanding of safety and compliance standards and regulations applicable to onshore upstream production and completions.
- Discuss the role of environmental stewardship in the petroleum engineering profession.

Course Description.

- This course provides a practical overview of current engineering technologies and practices to identify, drill and complete hydrocarbon bearing reservoirs. The oil and gas (O&G) industry seeks to achieve long-term energy security with a balanced, diversified, and sustained investment in both traditional energy sources and lower-emission solutions throughout the energy transition in this century. Access to reliable and affordable energy is essential to our daily lives and is a major underpinning of social and economic progress in the U.S. This course incorporates practical examples and applications to progressively give the student an introduction to advanced knowledge of upstream O&G exploration and production.
- This course is relevant to a broad base of students in engineering, geology, and chemistry, especially those planning a career in energy or more specifically in the oil and gas industry. The course content is designed especially for those students interested in upstream oil and gas topics including but not limited to exploration, drilling, production, hydraulic fracturing, and recent advances in each.

Learning Resources/Texts list

- No required or recommended textbooks for this course, but online readings and topical articles will be provided throughout the course for reading/understanding.

Types of Assignments/Assessments

- Assignments – Readings will be assigned to be completed before classes and these readings will be discussed during classes.
- Assessments are as follows:

Assessments	Points (%)
Quiz #1	20 (10%)
Quiz #2	20 (10%)
Quiz #3	20 (10%)
Quiz #4	20 (10%)
Quiz #5	20 (10%)
Individual Project	100 (50 %)

Grading Scale

In this class grades reflect the sum of your achievement throughout the semester. You will accumulate points as described in the assignments portion above, with each assignment graded according to a rubric. At the end of the semester, final grades will be calculated by adding the total points earned and translating those numbers (out of 200) into the following letters (there will be no partial points or rounding).

• A+: 193 - 200
• A: 188 - 192
• A-: 180 - 187
• B+: 173 - 179
• B: 168 - 172
• B-: 160 - 167
• C+: 153 - 159
• C: 147 - 152
• C-: 140 - 146
• D+: 133- 139
• D: 127 - 132
• D-: 120 - 126
• F: 119 or below

Purdue University ChE 597: Process Synthesis, Fall 2025

Instructor: Prof. Cornelius Masuku (cmasuku@purdue.edu)

Teaching Assistants: None

Lecture Hours: Mon/Wed/Fri, 8:30 am – 9:20 am (Masuku: synchronous, in-person)
Hampton Hall of Civil Engineering: 2102.

Office Hours: Wed/Fri, 9:30 am – 10:20 am.

Office Hours will be held in-person or via zoom if required and by appointment.

Website: Brightspace (CHE 597). All course material will be posted on Brightspace. It is your responsibility to keep up-to-date with all material posted online. All class announcements will be e-mailed via Brightspace.
You are expected to check/read your @purdue.edu e-mail frequently.

Text (Recommended): D. Ming, D. Glasser, D. Hildebrandt, B. Glasser, M. Metzger, Attainable Region Theory, Wiley, 2016.

D. F. Rudd, G. J. Powers, J. J. Siirola, Process Synthesis, Prentice-Hall, 1976.

Course Objectives: An introduction to the application of process synthesis concepts to design problems. An overview of methodologies that permit the evaluation and design of new processes from a very early stage. This course will discuss the role that design plays in the chemical process industry and in particular the techniques for flowsheet alternatives generation that have potential for industrial applicability.

Course Topics: Topics include alternative paradigms for process synthesis, practical methods for heat exchanger network synthesis, kinetic rate equations for catalyzed reactions, design of ideal isothermal reactors and effects of non-isothermal operation, chemical equilibria, systematic identification of designs which exploit distillation, azeotropic distillation, extractive distillation, reactive distillation, and related separation technologies, techniques for coordinating the specification of separation conditions in a

way to minimize energy requirements and equipment costs, separation synthesis for mixtures with very nonideal solution thermodynamics, reaction network or supply chain network synthesis, and the interaction of process synthesis with control system synthesis.

Prerequisites: ChE 348 – Chemical Reaction Engineering or Equivalent.

Lesson Plan: This course is designed for in-person/synchronous learning, supplemented by various synchronous discussions, and office hour meetings. The lesson plan for each week will be uploaded to Brightspace in advance. This document will summarize information about the topics covered and learning objectives for that week, and any assignments/projects due that week. Please review the lesson plan before each week starts.

Lectures: The course will be broken up into modules (each lasting 1 or 2 weeks). These modules are listed in the Tentative Course Schedule.

Discussion Forum: On Brightspace, we have created a discussion forum. Please start a new discussion thread for any question you may want to ask. We encourage each student to participate in all discussions and reply. The instructor will also read this forum and reply on a frequent basis.

Course Grades: The final course grade will be determined by the following:

Homework Problems:	20%
Project 1:	25%
Project 2:	25%
Final Project:	30%
Bonus Activities and Class Participation:	≤10%

All grades will be available on Brightspace so that you can monitor your progress throughout the semester. Grades for individual homework, and projects will **not** be adjusted by curving or scaling.

There is no preset distribution of final grades. The grading will reflect demonstrated student capability relative to an absolute performance standard that is expected of all Purdue ChE students, rather than a scale or curve that compares students to a mean performance metric on any evaluation vehicle. In practice, this means that if all students in the class demonstrate a high level of mastery of the course content, then all course grades could be A marks.

If your final numerical grade is greater than or equal to the following percentages, your letter grade is guaranteed to be at least:

A: ≥90%
B: ≥80%
C: ≥70%
D: ≥60%

Final numerical grades for the entire class may be scaled up (but never down). Plus, and minus modifiers will be used to determine final grades.

Projects:

Project 1: Monday, September 29, 9:20 am
Project 2: Monday, November 3, 9:20 am
Final Project: Monday, December 8, 9:20 am

There is no Final Exam for this course. This is a Projects-Based course.

Homework:

Homework will be assigned via Brightspace, and will be due electronically on Mondays by 8:30 am Eastern time. Late homework submissions will be assigned a zero score.

You may discuss the homework assignments and projects with other students, but **the final product must be entirely your own work.**

Regrade Requests:

You have one week after receiving a graded assignment to submit a regrade request, which must be made to the instructor.

Computer Use:

You are expected to use numerical methods programs, such as Python, or Matlab, for graphical representation and to solve systems of equations. Any of these programs should be sufficient for the types of problems addressed in this course, but you may use other suitable computer programs of your choice.

Simulation software packages such as Aspen Plus may also be used for Projects Flowsheet Simulations.

Official Purdue University Student Policies

Student Expectations: This is a 3-credit hour course, and it is expected that each student will spend 9 hours each week, including class time, on homework assignments, studying and reading the course textbook.

Student Conduct and Academic Integrity: University policy states that it is the responsibility of all students to attend all class sessions. Each student is expected to come to class on time and not disrupt the class. Each student is expected to follow Purdue's codes of student conduct and behave in a professional manner (https://www.purdue.edu/odos/academic-integrity). The rights of students in violation of the code of conduct are outlined. Each student is expected to exhibit consideration and respect towards the other students, the graders, the teaching assistants (TAs), and the faculty. Each student is expected to exhibit a positive attitude. Your conduct will be a factor in awarding grades to students between two letter grades.

Purdue University's student conduct policy specifically addresses academic dishonesty and integrity (http://www.purdue.edu/odos/osrr/academicintegritybrochure.php). All incidents of academic dishonesty will be reported to the Dean of Students. **Such incidents *include*:**

i) possessing or accessing, in hardcopy or electronic form, the solution manual to the course text or to the exams,
ii) claiming credit for work (either HW or exam work) that is not your own original work, and
iii) enabling another student to create HW or exam work that is not their original work.

Instructors' Commitment: Your instructors will: 1) be courteous, punctual, well-organized, and prepared for lecture and other class activities; 2) answer questions clearly in class or arrange for detailed discussions out of class if in-class answers are not suitably clear; 3) be available during office hours or notify you beforehand if they are unable to keep them; 4) provide a suitable guest lecturer when they are traveling; and 5) grade uniformly and consistently to the posted guidelines. We strongly encourage you to discuss academic or personal questions with the course instructor during office hours or via email. These discussions need not be limited to ChE 597 content.

Use of Copyrighted Materials: Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. All materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor.

Accessibility and Accommodations: Purdue strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let Prof. Masuku know to discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Grief Absence Policy for Students: Purdue recognizes that a time of bereavement is very difficult for a student. Purdue therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

Please visit the University's website for additional information:
http://www.purdue.edu/studentregulations/regulations_procedures/classes.html

Mental Health Statement: If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack, https://purdue.welltrack.com/. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please see the Office of the Dean of Students, http://www.purdue.edu/odos, for drop-in hours (M-F, 8am- 5pm).

If you are struggling and need mental health services, Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Violent behavior policy: Purdue is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

Please visit the University's website for additional information:
http://www.purdue.edu/policies/facilities-safety/iva3.html

Nondiscrimination Statement: Purdue is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach their own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

Purdue prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services, and activities consistent with applicable federal, state, and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Purdue's Equal Opportunity, Equal Access and Affirmative Action policy which provides specific contractual rights and remedies. Additionally, the University promotes the full realization of equal employment opportunity for women, minorities, persons with disabilities and veterans through its affirmative action program.

Any question of interpretation regarding this Nondiscrimination Policy Statement shall be referred to the Vice President for Ethics and Compliance for final determination.

Please visit the University's website for additional information:
http://www.purdue.edu/purdue/ea_eou_statement.html

Campus Emergency: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. ***You are expected to read your @purdue.edu email on a frequent basis.***

ChE 597 – Fall 2025 - Tentative Course Schedule

Week	Date	Topic	Comments
1	8/25	Introduction to Process Synthesis	
1	8/27	Mass Balance as a Synthesis Tool	
1	8/29	Mass Balance as a Synthesis Tool	
2	-	Labor Day	
2	9/3	Mass Balance as a Synthesis Tool	
2	9/5	CISTAR Meeting	
3	9/8	Technology Assessment	
3	9/10	Process Design	
3	9/12	Process Design	
4	9/15	Energy Balance as a Synthesis Tool	**HW1 due on Mon, 8:30 am**
4	9/17	Energy Balance as a Synthesis Tool	
4	9/19	Energy Balance as a Synthesis Tool	
5	9/22	Entropy & Gibbs Energy	
5	9/24	Entropy & Gibbs Energy	
5	9/26	Entropy & Gibbs Energy	
6	**9/29**	**Project 1**	**P1 Due on Mon, 9:20 am**
6	10/1	Systematic Methods of Obtaining Targets: Graphical Techniques	
6	10/3	Mathematical Techniques	
7	10/6	Graphical and Mathematical Techniques	**HW2 due on Mon, 8:30 am**
7	10/8	Entropy & Temperature	
7	10/10	Entropy & Temperature	
8	10/13	Entropy & Temperature	
8	10/15	Reactor Design	
8	10/17	Reactor Design	
9	-	Fall Recess	
9	10/22	Classifying Chemical Processes	
9	10/24	Classifying Chemical Processes	
10	10/27	Classifying Chemical Processes	**HW3 due on Mon, 8:30 am**
10	10/29	Solvay Clusters	
10	10/31	Solvay Clusters	
11	**11/3**	**Project 2**	**P2 Due on Mon, 9:20 am**
11	11/5	AIChE Annual Meeting	
11	11/7	Work Addition by Heat Engines	
12	11/10	Work Addition by Heat Engines	
12	11/12	Work Addition by Compression	
12	11/14	Work Addition by Compression	
13	11/17	Work Addition by Compression	**HW4 due on Mon, 8:30 am**
13	11/19	Separation & Separation Equipment	
13	11/21	Separation & Separation Equipment	

14	11/24	Integrated Process Synthesis	
14	-	Thanksgiving Break	
14	-	Thanksgiving Break	
15	12/1	Integrated Process Synthesis	
15	12/3	Integrated Process Synthesis	
15	12/5	Integrated Process Synthesis	
16	**12/8**	**Final Project**	**P3 Due on Mon, 9:20 am**

SYLLABUS

Course Information

Process Safety Management & Analysis - 2026; CHE 59700
Instructor: Dr. Ray Mentzer
Phone: (936) 443 5579
e-mail: rmentzer@purdue.edu
Class: TuTh 9:00 – 10:15; FRNY G140

Course Description

The critical importance of Chemical Process Safety is widely recognized after many significant world-wide industrial incidents, such as train derailment and chemical spill in Ohio winter 2023, the massive fertilizer explosion in Beirut, and numerous incidents in the last few years claiming lives, harming the environment, with significant loss of property. All aspects of chemical process safety and loss prevention are addressed in this course. Process safety is concerned with the identification of potential hazards and risks associated with equipment and chemical processing across a variety of industries: oil & gas, chemicals, pharmaceuticals, agriculture, etc. It includes methods for predicting the possible severity of incident scenarios and preventing or mitigating them. The material is thus different from personnel safety, which addresses slips, trips and falls.

As such, it is necessary to understand the operation of these processes and equipment, and to apply sound engineering fundamentals to the analysis and prediction of performance, under adverse circumstances. Thus, the course emphasizes quantitative engineering analysis, and in a broader context critical thinking, complex reasoning and written communication. This is based on the application of mass and energy balances, fluid mechanics of liquid / gas / two-phase flow, heat transfer and the conservation of energy, mass transfer, reaction kinetics, process control, and diffusion & dispersion under highly variable conditions.

Techniques for performing process hazard analysis, risk assessment, and accident investigations are covered, including the review of numerous significant industrial incidents. All students will perform an incident investigation of a significant industrial incident. CHE 597 graduate students have additional homework problems and a research project with a written report.

Learning Resources, Technology & Texts

Course topics follow those in the text: Daniel A. Crowl and Joseph F. Louvar, **'Chemical Process Safety: Fundamentals with Applications'**, Prentice Hall (4th edition), which will be supplemented with other pertinent materials, such as videos of incident investigations by the US Chemical Safety Board. Pertinent class materials will be posted on Brightspace.

Types of Assignments / Assessments

Teams: Students will be grouped into teams of ~3 by the CATME system, and work on homework assignments and project(s) as a team. **Every student will submit homework,** which will **not** be identical among teammates**.** The purpose of working in teams is not to 'spread the work around' but to capture the synergies of teamwork, benefiting from each member's perspective. Team members will periodically evaluate each other in terms of their contribution to homework and team project(s), which will be reflected in course grades.

Homework: Homework will generally be assigned each week and **due at noon ET on Friday's**. Late homework will **not** be accepted, except with prior approval. Homework will be submitted,

graded and solutions posted on Brightspace. Copying from a Solutions Manual or classmates will not be tolerated, with a zero given on homework assignments for infractions.

Attendance: Class attendance is important. Class participation is encouraged, material will be covered in class beyond the text, including several videos and there will be unannounced quizzes. Notify the instructor **in advance** for all excused absences (e.g., job interviews).

Incident Investigation: Each team will investigate a major incident and prepare a report (selected from a list of incidents provided or another of their choice). Topics will be distributed during the 3rd week of class, teams will submit their top three choices by September 22, with the final topic confirmed by the Instructor on September 24. The report will be due on October 27. Grading of the report is based on the written report and teammate evaluations of individual contributions.

Project: ***For 597 students only.*** Each team will prepare a research project (selected from a list of topics provided or another of their choice) and submit a formal report. Topics will be distributed the 6th week of class, teams will submit their top three topics by October 8, with the final topic confirmed by the Instructor on October 15. An abstract is due on November 10 and the report due on December 8, both electronically and as a hard copy. Grading of the project is based on the abstract, written report, and teammate evaluations.

Exams & Quizzes: There will be three exams and three quizzes during the term, all given during scheduled class time in G140. **All exams will be open-book and thus it is imperative that each student have access to a hard copy of the text (no xeroxed or on-line copies).** Exam III will not be comprehensive. Missing a quiz / exam results in a zero, unless arrangements were made with the Instructor in advance. Regrade requests for exams / quizzes and homework should be made to the party who did the initial grading, the TAs for the former and Graders for the latter. Any such requests must be made within two weeks of the posting of the graded work product in Brightspace.

Grading Criteria:

	CHE 420	CHE 597
Homework	20%	20%
Incident Investigation	15%	10%
Project Report	0%	10%
Quizzes	10%	5%
Exams	55%	55%

Grades:

90-100	A
80-89	B
70-79	C
60-69	D
<60	F

Grading may also include +/- for each grade level.

Support: Professor Ray Mentzer (rmentzer@purdue.edu)

TAs –

Graders –

The TAs will conduct two one-hour weekly help sessions in FRNY with times TBD.

Academic Integrity

It is tantamount that students reflect on and adhere to the **Purdue Honors Pledge**, *"As a Boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."* Integrity / ethics violations such as plagiarism, copying from others work, or use of unauthorized online services (e.g., Chegg) will not be tolerated. Penalties include up to a failing grade and notifying the Dean of Students. While students may use AI tools for research, written material from ChatGPT, etc may not be incorporated within class submissions.

Specifically, Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Section B-2-a, Code of Student Conduct] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972] All incidents of academic dishonesty will be reported to the Dean of Students. Such incidents include: i) possessing or accessing, in hardcopy or electronic form, the solution manual to the course text, or to the exams, ii) claiming credit for work that is not your own original work, and iii) enabling other students to create work that is not their original work.

Non-Discrimination Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach their potential.

Accessibility Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let the instructor know and to discuss options. You are also encouraged to contact the Disability Resource Center at drc@purdue.edu or by phone: 765-494-1247.

Mental Health / Wellness If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell.

Emergency Preparation For a fire alarm evacuate and assemble near the Awards Tower in the Engineering Mall. For a shelter in place, per outside siren, move to the basement of FRNY.

CHE 420 / 597 Chemical Process Safety (Fall 2026)

Course Schedule

Date		Topics	Note
August	Wk1a-8/25	Why study process safety? Syllabus & Chapter 1	Piper Alpha video

	Wk1b – 8/27	Chapter 1. Introduction – cont'd	
_____	Wk2a-9/1	Chapter 1. Introduction – cont'd	
	Wk2b -9/3	Teamwork; Chapter 2. Toxicology	Bhopal disaster
	Wk3a-9/8	Incident Investigations	Incident investigation project introduced
	Wk3b – 9/10	Chapter 3. Industrial Hygiene	**Quiz 1**
September	Wk4a-9/15	Chapter 4. Source Models – I	BP TX City video; teammate evaluations
	Wk4b – 9/17	Ch #4 Source Models II	
	Wk5a-9/22	Regulations & Mgmt Systems	Fatal Exposure – DuPont Incidents; Teams select incidents
	Wk5b – 9/24	Regs – cont'd	Instructor confirms projects
	Wk6a-9/29	**Exam I**	
_____	Wk6b – 10/1	Chapter 5. Toxic Releases	MGPI, Mixed Connection, Toxic Result video; *597 Project topics distributed*
	Wk7a-10/6	Toxic Releases	
	Wk7b – 10/8	Chapter 6. Fires & Explosions - I	Imperial Sugar video; *597 Teams select topics*
October	Wk8a-10/15	Chapter 6. Fires & Explosions – II	**Quiz 2;** Static Electricity; video *Instructor confirms 597 project topics*
	Wk 9a– 10/20	Chapter 7. Designs to Prevent Fires & Explosions	
	Wk9b-10/22	Chapter 8. Chemical Reactivity	T-2 Incident video
	Wk10a -10/27	Safe Designs & Operations	Teams submit incident investigation reports & team member evaluations;
	Wk10b-10/29	Safe Designs & Operations – cont'd	Blast Waves in Danvers video
_____	Wk11a -11/3	**Exam II**	
	Wk11b-11/5	Chapter 9. Intro to Reliefs	'Without Safeguards Pressure Vessels can be Deadly' CSB video
	Wk12a – 11/10	Chapter 10. Relief Sizing	*597 Project abstract due*
November	Wk12b-11/12	Chapter 10. Relief Sizing -cont'd	Univ Laboratory Safety video
	Wk13a- 11/17	Chapter 11. Hazards Identification – I	West Explosion video
	Wk13b-11/19	Chapter 11. Hazards Identification – I I	**Quiz 3**
	Wk14a- 11/24	Chapter 11. Hazards ID – II – cont'd **Thanksgiving Break**	DeRidder Pulp & Paper video
	Wk15a-12/1	Chapter 12. Risk Assessment - I	
December	Wk15b-12/3	Chapter 12. Risk Assess. – II	ExxonMobil Torrance Refinery video
	Wk16a – 12/8	Emergency Response	Emergency Preparedness video; *597 Project reports due*
	Wk16b–12/10	**Exam III**	

Learning Outcomes

Our graduates will be able to (**bold** are specific to 420):

1	***Apply principles of engineering, science, and mathematics to solve complex chemical engineering problems.***

2	***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.***
3	Communicate effectively with a range of audiences.
4	***Recognize ethical and professional responsibilities in chemical engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.***
5	Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6	Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7	***Acquire and apply new knowledge as needed, using appropriate learning strategies.***

ABET Syllabus

1. **CHE 42000: Process Safety Management and Analysis**

2. **Credits and contact hours:**
   3 credits
   Lecture – 2 days per week at 75 minutes each for 16 weeks

3. **Instructor's or course coordinator's name:** Professor Ray Mentzer

4. **Textbook(s):**
   a. Daniel A. Crowl and Joseph F. Louvar, **'Chemical Process Safety: Fundamentals with Applications'**, Prentice Hall (4th edition)

5. **Specific course information**
   a. **Catalog description:** Develop knowledge of process safety management and analysis in the process industries – including hazard identification, hazard analysis and risk management.
   b. **Prerequisites:** CHE 34800, 37800 (both concurrent)
   c. **Course Status:** Required

6. **Specific goals for the course**
   a. **Specific outcomes of instruction**
   - Demonstrate knowledge and understanding of the elements of process safety management (→45000)
   - Apply the techniques, analytical skills, and modern computational tools necessary for performing process safety calculations in the design of safety equipment (20500, 21100, 34800, 37700, 37800→); (→45000)
   - Demonstrate an understanding and appreciation of the need for professional integrity and ethical decision making to promote safety in the workplace (20000, 30000, 40000→); (→45000)
   - Be able to pro-actively identify and analyze safety hazards (→45000)
   - Demonstrate an understanding of the detrimental effects of the unsafe operation of chemical facilities on environmental, health, and safety issues and other public interests. Our graduates will be aware of the wide-reaching effects that engineering decisions have on society, our global

community and our natural environment (20000, 30000, 34800, 37700, 37800, 40000→); (→45000)

- Demonstrate knowledge and understanding of risk management tools, programs and processes associated with process safety. (→45000)

b. Student outcomes addressed by the course:

1) Apply principles of engineering, science, and mathematics to solve complex chemical engineering problems.

2) 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.

4) Recognize ethical and professional responsibilities in chemical engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

7) Acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Topics

Process Safety Management and Hazard Identification

Regulations – 29 CFR 1910.119

People, Technology, Facilities

Management/Leadership, Required Management Systems

Analysis of Hazards

Numerous Case Studies (14): Piper Alpha, Bhopal, BP TX City, Imperial Sugar, T2 Laboratories, West Explosion, ...

What If, Checklist, Hazard and Operability (HAZOP) Study

Hazard vs. Risk, Qualitative & Quantitative Risk Assessment

Failure Mode and Effects Analysis

Fault Tree Analysis

Risk Management

Safety Culture

Regulations and Audits, Ethics and Safety

Operating Procedures, Safe Work Practices

Asset Integrity

Training, Management of Change

Contractor Management

Operations: Start-up/Shutdown/Unsteady State

Emergency Management

Incident Investigation

Process Safety Calculations and Design

Toxicology and Industrial Hygiene

Liquid & Gas Source Models

Toxic Releases & Dispersion Modeling

Flammability and Explosions & Designs for Prevention

Chemical Reactivity

Sizing Relief Valves

Knockout Drums & Flares

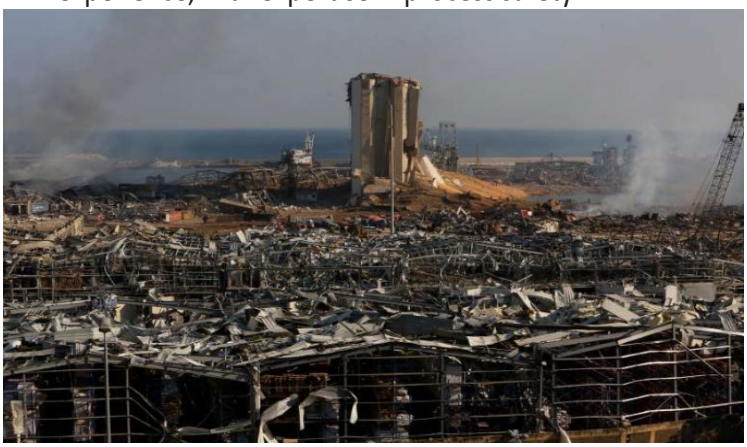
PURDUE UNIVERSITY | Davidson School of Chemical Engineering

CHEMICAL PROCESS SAFETY

CHEN 420/597 (3 CREDITS)

FALL 2026 – TuTh 9:00 – 10:15 am

This course is required for all seniors in the Davidson School of Chemical Engineering and is taught each fall at Purdue. Open to Masters and PhD students, the course addresses how to prevent industrial incidents that can result in significant loss of life, environmental, and facility damage. Several case studies are reviewed and analyzed in a variety of industries, which form the basis for many industry best practices and regulations. Few universities offer this course, and many companies value those who have taken it. The instructor, Dr. Ray Mentzer, has over 30 years of industry experience, with expertise in process safety.



Beirut, Lebanon ammonium nitrate (fertilizer) explosion August 4, 2020 that led to 192 fatalities; ~6,000 injuries; 300,000 left homeless and economic damage estimated at $10 - $15 billion.

February 3, 2023 freight train derailment in East Palestine, Ohio. 38 rail cars derailed, 11 with hazardous material, including toxic & flammable vinyl chloride.

THE COMPREHENSIVE COURSE ADDRESSES:

- How does one design, maintain and operate a facility safely in a variety of industries – oil, pharma ..?
- How does one reduce the chance of fires, explosions, runaway reactions, toxic releases ...?
- What regulations exist to foster safe operations?
- How does one conduct hazard and risk analyses?

The Davidson School of Chemical Engineering is well-grounded in process safety with its Purdue Process Safety & Assurance Center (P2SAC) conducting research. Dr. Mentzer serves as Executive Director. Students funded by the Center are encouraged to enroll. Professional Master's students will benefit from this training, since typically over half of the capstone research projects are process safety related and mentored by P2SAC industry sponsors.

DO YOU WANT TO KNOW MORE?

Dr. Ray Mentzer
rmentzer@purdue.edu
Forney Hall of Chemical Engineering 1148
(936) 443-5579

PURDUE UNIVERSITY

ChE 632: Linear Operators in Engineering (3 credit hours): Fall 2024 (TR)

Instructor: Professor Doraiswami Ramkrishna

This course will introduce engineering students to the rudiments of functional analysis, the study of functions as elements of a linear space and linear transformations (operators) on such a space. Engineering problems cast as partial differential equations along with boundary and initial conditions may be viewed as operator equations in which the transformation of an unknown vector (function) is specified in terms of a known vector. When the operator properties are known the solution of the problem is facilitated by the methods of linear operator theory.

The course will focus on the class of so-called self-adjoint operators (analogize with real symmetric matrices) and their powerful properties which help in the solution of equations featuring them. Many engineering problems belong in this category. Thus problems in transport and reaction processes, elasticity, vibrations and so on are examples.

The unique feature of this course is that it identifies many "non-self-adjoint" problems that can be converted into self-adjoint problems by a proper choice of Hilbert space and inner product. Applications abound in heat and mass transport in laminated media, multicomponent diffusion and reaction problems, fluid mechanics, problems in elasticity, mechanical vibrations and many others.

An attempt will be made to introduce students to mathematical concepts without belaboring proofs of theorems. However, some proofs will be included to cultivate mathematical argument.

Exams Although there will be no exams for the course, students will be called upon

- To discuss potential applications of linear operator theory in their own thesis work by meeting with me individually, which could evolve into a term paper.
- To present papers published in the literature on the application of linear operators.

Course grade is decided upon either option above.

Text: *Linear Operator Methods in Chemical Engineering*
D. Ramkrishna and N. R. Amundson, Prentice-Hall, 1985

Although the book is out of print, copies will be available with Jason Thorp in the ChE Office.

Course Layout

Week of August 19, 2024:	Introduction to course. Motivation and goals. Fields, Algebraic features of linear spaces. (RA Ch.0 & 1), Bases.
Week of August 26, 2024:	Linear functionals and transformations. Bilinear functionals. Direct sums and tensor products of linear spaces.

Week of September 2, 2024: Metric spaces. Sets, Compact sets, Completeness, Fixed point theorem for contractions. Introduction to Riemann and Lebesgue integration.

Week of September 9, 2024: Normed linear and Banach spaces, Compact operators. Bounded linear functionals and operators, Unbounded operators.

Week of September 16, 2024: Inner product spaces. Cauchy-Schwartz inequality. Bessel's inequality. Orthonormal bases. Gram-Schmidt orthogonalization.

Week of September 23, 2024: Hilbert Space theory. Spectral Theory of Compact, Self-Adjoint operators in finite and infinite dimensional spaces.

Week of September 30, 2024: Spectral theorem of Unbounded operators with Compact inverse.

Week of October 7, 2024: Applications in Finite Dimensional Space. (Class only on October 10).

Week of October 14, 2024: Applications in Infinite Dimensional Space.

Week of October 21, 2024: Applications in Infinite Dimensional Space.

Week of October 28, 2024: B. Friedman's Theory of Separable operators.

Week of November 4, 2024: Boundary Value Problems with Mixed and Oblique derivative boundary conditions.

Week of November 11, 2024: Application to Low Peclet number heat transfer problems.

Week of November 18, 2024: Class only on November 19). Thanksgiving break.

Week of November 25, 2024: Conjugated Boundary Value Problems.

Week of December 2, 2024: Non-Self Adjoint Problems.

Since I am on a collaborative visit to India (ICT and IISc.) my lectures will be zoomed in live in Room FRNY 1043 from 9AM to 10.15AM on Tuesdays and Thursdays.

Students enrolled in the course are requested to provide their thesis titles in writing to me during the first week of the course.

Purdue University ChE 662: Catalysis, Fall 2024

Instructor: Rajamani Gounder (rgounder@purdue.edu)
Office Location: 2160 Forney Hall
Office Phone: 765-496-7826
Office Hours:* Thursday, 4:30 pm-5:30 pm, FRNY 2160

Teaching Assistant: None (times are tough)
*Instructor office hours subject to change. Also available by appointment.

Class Hours: TR, 10:30 am-11:45 am, HAMP 2102 (3 credit hours)

Website: Brightspace (CHE 662). All course materials and important and time-sensitive class announcements will be posted on Brightspace. It is the student's responsibility to keep up-to-date with all material posted online. ***You are expected to read your @purdue.edu e-mail frequently.***

Gradescope (CHE 662). All graded assignments (e.g., homework sets, exams) will be submitted and graded using Gradescope.

Textbook: [1] M. Boudart and G. Djéga-Mariadassou, *Kinetics of Heterogeneous Catalytic Reactions*, Princeton University Press, ISBN 0691083479

[2] I. Chorkendorff and J. W. Niemantsverdriet, *Concepts of Modern Catalysis and Kinetics*, Wiley-VCH, Weinheim ISBN 978-3-527-31672-4

[3] M. Albert Vannice, *Kinetics of Catalytic Reactions,* Springer, 2005 ISBN-10: 0387246495

[4] B. C. Gates, J. R. Katzer, G. C. A. Schuit, *Chemistry of Catalytic Processes*, McGraw-Hill, 1979, ISBN 0-07-022987-2

Undergraduate-level:

[1] H. S. Fogler, *Elements of Chemical Reaction Engineering*, 4th edition, Prentice-Hall, 2005. (Note: *Essentials of Chemical Reaction Engineering* by H. S. Fogler is available online through the Purdue Libraries website: http://proquestcombo.safaribooksonline.com/9780132317191?uicode=purdueu)

[2] M. E. Davis and R. J. Davis, *Fundamentals of Chemical Reaction Engineering*, 1st edition, McGraw-Hill, 2003. (Note: Available online for free at http://resolver.caltech.edu/CaltechBOOK:2003.001)

[3] C. G. Hill, Jr. and T. W. Root, *Introduction to Chemical Engineering Kinetics and Reactor Design*, 2nd edition, Wiley, 2014.

Additional texts will be distributed throughout the semester and should be reviewed before the lecture in which their contents will be covered.

Catalog Description: Analysis of the kinetics of heterogeneous catalytic reactions, including the application of collision and transition state theories to the estimation of rate constants and calculation of rates over energetically non-uniform surfaces. Discussion of the chemical and physical properties of solid surfaces that influence catalytic reactions, and illustration of concepts of catalytic behavior with specific examples from catalytic processes. We will cover: kinetics of catalytic reactions, properties of catalytic materials, and specific catalytic processes.

Prerequisites: ChE 348 – Chemical Reaction Engineering (or equivalent)

Course Grades: The final course grade will be determined by the following:

Homework Sets (4):	100%

There is no preset distribution of final grades. Plus and minus modifiers will be used in assigning final grades.

Student Policies: Please see the syllabus addendum document on the Brightspace website for an abridged list of official Purdue University student policies. This includes student expectations, student conduct and academic integrity, use of copyrighted materials, grief absence policies, individual learning and testing needs, illness, and campus emergency preparedness.

Course Topics: A list of the major course topics will be provided as the semester progresses. The course will be comprised of modules (typically 1-2 lectures long) on topics related to the fundamental theories of chemical kinetics, reaction mechanisms and catalytic phenomena.

0. Introduction and Overview (1)
1. Basic Concepts in Reactor Design and Chemical Kinetics (2)
    a. Reaction Rates and Stoichiometry
    b. Mole Balances and Ideal Reactor Types
    c. Chemical Equilibrium, Chemical Kinetics
2. Kinetics of Complex Reactions (2)
    a. Pseudo-Steady-State Hypothesis
    b. Perturbation Theory for PSSH
3. Mechanisms of Homogeneous and Free Radical Reactions (1)
4. Adsorption and Reaction on Uniform and Non-Uniform Surfaces (2)
5. Non-Equilibrium Thermodynamic Treatments of Kinetics (3)
    a. DeDonder Relations
    b. Degree of Rate Control
    c. Kinetic Coupling
    d. Virtual Pressure
6. Theoretical Estimates of Rate Parameters (3)
    a. Collision Theory
    b. Transition State Theory
    c. Linear Free Energy Relationships
7. Approximate Methods and Molecular Simulation Techniques, DFT and Quantum Mechanical Methods (1)
8. Coupled Transport and Reaction Phenomena (5)
    a. Interparticle Mass/Heat Transfer Restrictions in Catalysts
    b. Structural Models of Porous Solids and Effective Transport Coefficients within Pore Networks
    c. Intraparticle Mass/Heat Transport Effects in Porous Catalysts
    d. Generalized Thiele Modulus, Effectiveness Factor Concepts
    e. Combining Internal and External Transport Resistances
9. Catalytic Processes: Acid/Base (3)
    a. Acid/Base I: Cracking
    b. Acid/Base II: Zeolites
    c. Acid/Base III: Zeolites
10. Catalytic Processes: Transition Metals (2)
    a. Wacker Process
    b. Vinyl Acetate Synthesis
    c. Hydroformylation
    d. Methanol Carbonylation
    e. Ziegler-Natta Polymerization
11. Catalytic Processes: Reforming (1)
12. Catalytic Processes: Hydrodesulfurization (1)

ChE 662 - Fall 2024 - Tentative Course Schedule

* Dates on which homework is due at 5PM eastern time on Gradescope.
** Date on which take-home exam is due at 5PM eastern time on Gradescope.

Week	Date	Lecture	Topic	Module
1	8/20	1	Introduction, Reaction Rates and Stoichiometry, Nomenclature	0
	8/22	2	Mole Balances and Ideal Reactor Types, Nomenclature	1
2	8/27	3	Chemical Equilibrium, Chemical Kinetics, Nomenclature	1
	8/29	4	Kinetics of Complex Reactions, Pseudo-Steady-State Hypothesis	2
3	9/3	5	Pseudo-Steady-State Hypothesis, Regular Perturbation Theory	2
	9/5		CLASS CANCELLED (RG Seminar)	
4	9/10	6	Mechanisms of Homogeneous Reactions, Unimolecular Decomposition	3
	9/12	7	Mechanisms of Homogeneous Reactions, Free Radical and Thermal Cracking	3
5	9/17 *	8	Adsorption and Reaction on Uniform and Non-Uniform Surfaces	4
	9/19	9	Adsorption and Reaction on Uniform and Non-Uniform Surfaces	4
6	9/24	10	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (DeDonder)	5
	9/26	11	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (DeDonder)	5
7	10/1	12	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (DRC)	5
	10/3	13	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (Kinetic Coupling, Virtual Pressure)	5
8	10/8		NO LECTURE (FALL BREAK)	
	10/10		CLASS CANCELLED (CISTAR Fall Meeting)	
9	10/15 *	14	Theoretical Estimates of Rate Parameters (Collision Theory)	6
	10/17	15	Theoretical Estimates of Rate Parameters (Transition State Theory)	6
10	10/22	16	Theoretical Estimates of Rate Parameters (Linear Free Energy Relationships)	6

	10/24	17	External Mass and Heat Transfer Restrictions in Catalytic Systems	8
11	10/29		NO LECTURE (AIChE Meeting)	
	10/31	18	Intraparticle Mass and Heat Transport Effects in Porous Catalysts	8
12	11/5 *	19	Generalized Thiele Modulus and Effectiveness Factor Concepts	8
	11/7	20	Combining Internal and External Transport Resistances	8
13	11/12	21	Catalytic Processes (Acid/Base I: Cracking)	9
	11/14	22	Catalytic Processes (Acid/Base II: Zeolites)	9
14	11/19	23	Catalytic Processes (Transition Metals: Wacker Process, Vinyl Acetate Synthesis, Hydroformylation)	10
	11/21	24	Catalytic Processes (Transition Metals: Methanol Carbonylation, Ziegler-Natta Polymerization)	10
15	11/26 *		NO LECTURE (Thanksgiving)	
	11/28		NO LECTURE (Thanksgiving)	
16	12/3	25	Catalytic Processes (Reforming)	11
	12/5	26	Catalytic Processes (Hydrodesulfurization)	12

CHE 69700 S Statistical Methods and Modeling for Chemical Engineers

Fall 2025

Class Times: Lectures Tues and Thurs

Instructors: Kendall Thomson (Instructor)

thomsonk@purdue.edu

Graduate Teaching Assistant:

Praatik Gupta,

Course Objective

Introduce the mathematical basis for statistical analysis and develop and apply statistical methods, including designing experiments and building models from experimental data for use in engineering and science research. This course is offered as part of the required graduate chemical engineering curriculum.

Required Text: *Introduction to Mathematical Statistics, 7th Ed,* Hogg, McKean and Craig; Pearson (Boston). **ISBN-10: 0-321-79543-1**

Software: During this class, students will utilize mathematical tools (Mat Lab, Mathematica, etc.)

Grading Policy:

Homework Assignments	35 pts
Two 1-hour Exams	200 pts
Final Exam (Take home)	150 pts
Total	385 pts

Course Grading

Final grades for this class will be assigned using the +/- system (A+, A, A-, B+, B, etc…)

Homework:

Assignments will be handed out most Thursdays during lecture and are due in completed form in two weeks, on Thursday, beginning of lecture. Late homework will not be accepted. While you may find it helpful to discuss problem sets with one another, *what you turn in must be your own work.*

Course Topics:

Part I

- Set theory and measure theory
- Measure spaces and probability spaces
- Probability theory
- Random variables
- Sample spaces, outcomes, and events
- Conditional probabilities
- Probability theorems
- Bayes' theorem

Part II

- Discrete probability distributions
- Continuous probability distributions
- Probability mass functions and density functions
- Expectation value and variance
- Properties and theorems of distributions
- Moment generating functions
- The Bernoulli process and the binomial distribution
- The Poisson distribution
- The gamma function and the gamma distribution
- Multivariate and joint probability distributions
- Marginal distribution functions
- Bivariate transformations
- Gaussian integrals
- The normal distribution
- Single and multivariable analysis of variance
- Covariance and correlation
- The central limit theorem and Student's theorem
- The Student T-distribution and chi-square distribution
- The beta distribution
- The F-ratio distribution
- Matrices and the eigenproblem
- The spectral resolution theorem
- The multivariate normal distribution

Part III

- Introduction to statistical inference
- Hypothesis testing
- Biased and unbiased estimators
- Type I and type II errors
- Simple hypotheses on the mean and variance
- Hypotheses on difference of two means
- Hypotheses on variance ratios.
- Analysis of Variances (ANOVA)
- Maximum likelihood methods

- Maximum likelihood estimators
- Fisher's information
- Scores function
- Rao-Cramèr Lower Bound and efficient estimators
- Likelihood ratio tests
- Wald type and Scores type tests
- Multiparameter hypotheses testing

Part IV

- Introduction to Bayesian statistics
- The prior and posterior distributions
- Likelihood and marginal likelihoods
- Conjugate priors
- Improper priors
- Future predictions
- Marginal posterior distributions
- The Bayesian estimator
- Confidence intervals and Bayesian coverage
- Binomial distribution example
- Poisson distribution example
- The inverse gamma distribution
- Bayesian analysis on the normal distribution
- Exponential family of distributions
- The Gibbs sampler
- The Jefferies and uniform priors
- Bayesian statistical inference
- Hypothesis testing
- Prior and posterior odds and the Bayes factor
- Advanced Bayesian methods