PURDUE UNIVERSITY

DAVIDSON SCHOOL
OF CHEMICAL ENGINEERING

Fall 2024

Course Syllabi Packet

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

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

Purdue University CHE 20500: Chemical Engineering Calculations, Fall 2023

A. Instructor. Professor Liu (julieliu@purdue.edu) and Professor Morgan (jamorgan@purdue.edu)

B. 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.

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

D. 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

E. 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.

F. 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)

G. **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.**

H. **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, reading the course text, and completing assessment questions. 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.

I. **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.

J. **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.

K. **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, 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; and (iv) collaborating with other students (or getting other outside help) during an exam. 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.**

L. **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.

M. **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.

N. **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.

O. **Key Course Dates.**

Lectures (face-to-face):	Wednesday and Friday	10:30 a.m. – 12:30 p.m.	WALC 3087
Exam 1	Thursday, September 21, 2023	8:00 p.m. – 9:30 p.m.	UC 114
Exam 2	Monday, October 23, 2023	8:00 p.m. – 9:30 p.m.	UC 114
Exam 3	Monday, November 20, 2023	8:00 p.m. – 9:30 p.m.	UC 114
Final Exam	To Be Announced, **As Set by the University**		

No Class	9/4	Labor Day
	9/13, 11/8, 12/8	Make-up for Hour Exams
	11/22, 11/24	Thanksgiving Break

Class Drop Deadline with a Withdrawal (W): Monday, November 27

P. **Emergency Procedure for the Wilmeth Active Learning Center (WALC).** In the event that the class would need to evacuate WALC (e.g., in the event of a fire alarm), the class should proceed to exit the building and meet on the southeast corner of Potter Engineering Center (POTR). In inclement weather, meet in the lounge inside of the southeast corner of POTR. 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 (e.g., due to a tornado warning), we will proceed to the appropriate shelter in place area within the basement level of WALC.

Q. **Office Hours**

a. **Professor Liu (**julieliu@purdue.edu, Office: FRNY 1160)
Office Hours (Location: FRNY 3062A): Tuesday, 11:00 am – 12:00 pm

b. **Professor Morgan** (jamorgan@purdue.edu, Office: FRNY 1053)
Office Hours (Location: FRNY 2142): Monday, 11:30 am – 12:30 pm

c. **Zachary Beickman** (zbeickma@purdue.edu)
Office Hours (Location: FRNY 1043): Monday, 6:30 pm – 8:30 pm

d. **Bryan Cruz Delgado** (bcruzdel@purdue.edu)
Office Hours (Location: PHYS 223): Tuesday, 5:00 pm – 7:00 pm

e. **Marisa Egan** (egan18@purdue.edu)
Office Hours (Location: HAMP 3153): Wednesday, 5:00 pm – 7:00 pm

R. **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.

S. **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.

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

Concept Quizzes: 2%	Examinations: 20% each = 60% total
Homework: 13%	Final Examination: 25%

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

If an exam or homework 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.

U. **Concept Quizzes.** There will be concept quizzes assigned through Wiley Plus. The quizzes are open notes and open book but must be done on your own. You cannot work with others on the quizzes.

V. **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.**

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

X. **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. **Your lowest scaled homework score will be dropped**.

Y. **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 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.

Z. **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.***

AA. **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 calculator. All other electronic devices are forbidden, including cell phones and pagers. These must be turned off 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 Prof. Liu or Prof. Morgan, and if possible, speak to one of the instructors *before* the exam takes place. Travel plans do not constitute extenuating circumstances.

BB. **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.

CC. **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. Liu, Prof. Morgan, and your academic advisor (and not the graduate TA 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.

DD. 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 2023 CHE 20500-003 LEC
Instructors' email addresses: julieliu@purdue.edu, jamorgan@purdue.edu

EE. 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.

FF. 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.

GG. 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 and Professor Morgan 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.

HH. 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.

II. 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.

JJ. 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.

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

LL. 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

MM. Course Material as Listed by Text Chapter.

Chapters 1, 2, and 3 (self-taught)
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 2023

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:

Yen-Chun Lu
Zhichen Nian
Gabriel Perez Schuster

Office Hours: Mondays 2:20- 3:50, Room Forney 2142

C. Importance. Separation processes constitute 50% to 90% of the cost (capital and operating) of most chemical plants with distillation being the most commonly 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)
9780137921324: Wankat: Separation Process Engineering 5e (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 14, October 17 and November 14, 50 minutes long all evening exams, the first two in PHYS 112 and the third split into RAWL 1086, KRAN G016 AND KRAN 250.

Occasionally students will have to miss an intra-semester 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 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 in front of the WALC 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) 12:30 – 1:20, RHPH 172
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 recitation periods. (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 Blackboard.

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 2023 Syllabus

Instructor: Brian Tackett
Assistant Professor
Chemical Engineering
Email: bmtacket@purdue.edu
Office: FRNY 2158
Phone: 765-496-7235
Office Hours: Mondays 4:30 – 6:00 pm, FRNY 2158

Teaching Assistants: Sarah Gustafson (gustaf14@purdue.edu),
Hwiyoon Noh (noh27@purdue.edu)
Office Hours: TBA

Lecture Hours:
Mon/Wed/Fri
10:30 – 11:20 AM
ARMS 1010
Synchronous, in-person

Recitation Hours:

Recitation Section 1:	Thu. 9:30 – 10:45 AM, SC G064
Recitation Section 2:	Thu. 11:30 AM – 12:45 PM, CL50 129

Laboratory Hours:

Lab Section 1 (9/14, 9/28, 10/12, 11/2):	Thu. 9:30 – 11:20 AM, FRNY G111
Lab Section 2 (9/14, 9/28, 10/12, 11/2):	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 EDITION**, Prentice Hall, New York. ISBN 9780135486498.

Companion Website: http://websites.umich.edu/~elements/5e/

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 TAs will provide training and support for **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. So it is recommended to use either Python or Polymath. Both 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 following instructions on this website: https://engineering.purdue.edu/ECN/Support/KB/Docs/UsingAppsAnywhere.1 .

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. These 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:

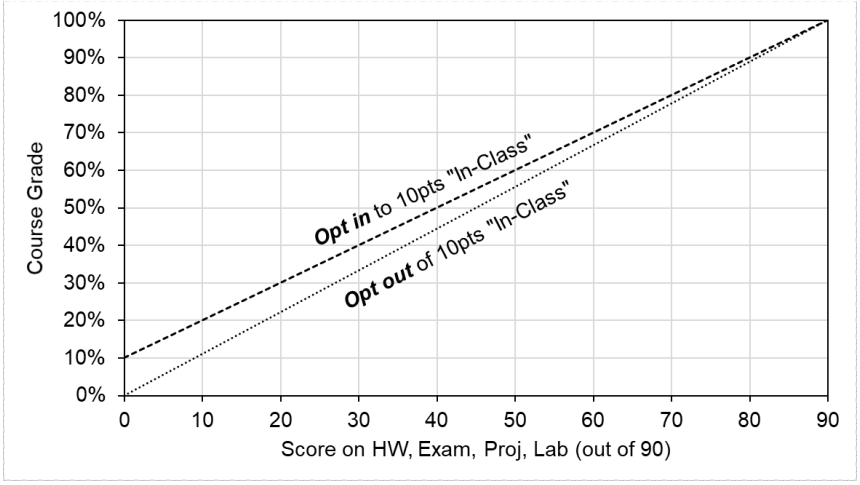
The final course grade will be determined by the following:

- Lab Reports (4): 24 points
- Exams (3): 27 points
- Homeworks (14): 28 points
- Final Project (1): 11 points
- In-class: (10 points)

Individual assessments for each category are given equal weight (i.e. all 3 exams are weighted the same, all 14 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 21.6/27 points).

10 Point In-class Option: This 10 points is for participating in "in-class" quizzes, clicker questions, and discussion. Credit is earned based on participation in these activities, and you can only earn the full 10 points by participating in >75% in-class activities. If you earn the 10 points, your grade will be calculated as the ***opt in*** scenario below. If you participate in <75% in-class activities, you will not be penalized, and your grade will be calculated as the ***opt out*** scenario below. You will automatically earn the 10 opt in points if you meet the >75% requirement (you do not have to request it). This grading scheme is meant to accommodate various learning styles.

Opt in: course grade = [(x + 10)/100] * 100%
Opt out: course grade = [x/90] * 100%
x = cumulative score on HW, Exams, Project, and Lab Reports



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: Weds. Oct 4, 6:30pm – 7:30pm, KRAN G016
Exam 2: Mon. Nov 13, 6:30pm – 7:30pm, KRAN G016
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 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 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 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 2023 - Tentative Course Schedule

Assignment Due	Date	Topics
		Ch. 1: Definitions and mole balance equations
	Aug. 21	Lecture (Introduction to Course)
	Aug. 22	
	Aug. 23	Lecture
	Aug. 24	No Recitation (first week)
	Aug. 25	Lecture
		Ch. 2: Conversion and design equations
	Aug. 28	Lecture
	Aug. 29	
	Aug. 30	Lecture
HW 1	Aug. 31	Recitation
	Sep. 1	Recorded Lecture
		Ch. 3: Rate laws
	Sep. 4	No Class (Labor Day)
	Sep. 5	
	Sep. 6	Lecture
HW 2	Sep. 7	Recitation / pre-lab
	Sep. 8	Lecture
		Ch. 7: Experimental evaluation of rate parameters
	Sep. 11	Lecture
	Sep. 12	
	Sep. 13	Lecture
HW 3	Sep. 14	Lab #1
	Sep. 15	Lecture
		Ch. 4: Stoichiometry
	Sep. 18	Lecture
	Sep. 19	
	Sep. 20	Lecture
HW 4	Sep. 21	Recitation / pre-lab
	Sep. 22	Lecture

Assignment Due	Date	Topics
		Ch. 5: Isothermal reactor design
	Sep. 25	Lecture
	Sep. 26	
	Sep. 27	Recorded Lecture
Lab 1 report /HW 5	Sep. 28	Lab #2
	Sep. 29	Recorded Lecture
		Ch. 6: Semi-batch and membrane reactors
	Oct. 2	Lecture
	Oct. 3	
Exam 1	Oct. 4	Exam 1 (evening) -- Ch. 1,2,3,4,5,7
	Oct. 5	Recitation / pre-lab
	Oct. 6	Lecture
		Ch. 6: Semi-batch and membrane reactors
	Oct. 9	No Class (Fall Break)
	Oct. 10	
	Oct. 11	Lecture
Lab 2 report /HW 6	Oct. 12	Lab #3
	Oct. 13	Lecture
		Ch. 8: Multiple reactions
	Oct. 16	Lecture
	Oct. 17	
	Oct. 18	Lecture
HW 0 pt 1 /HW 7	Oct. 19	Recitation
	Oct. 20	Lecture
		Ch. 11: Energy balance and adiabatic reactors
	Oct. 23	Lecture
	Oct. 24	
	Oct. 25	Lecture
Lab 3 report /HW 8	Oct. 26	Recitation / pre-lab
	Oct. 27	Recorded Lecture

Assignment Due	Date	Topics
		Ch. 12: Steady-state reactors with heat exchange
	Oct. 30	Lecture
	Oct. 31	
	Nov. 1	Lecture
HW 9	Nov. 2	Lab #4
	Nov. 3	Lecture
		Ch. 13: Unsteady-state non-isothermal reactors
	Nov. 6	Recorded Lecture
	Nov. 7	
	Nov. 8	Lecture
HW 10	Nov. 9	Recitation
	Nov. 10	Lecture
		Ch. 10: Catalysis and catalytic reactors
Exam 2	Nov. 13	Exam 2 (evening) – Ch. 6, 8, 11, 12, (13)
	Nov. 14	
	Nov. 15	Lecture
Lab 4 report/ HW 11	Nov. 16	Recitation
	Nov. 17	Lecture
		Ch. 9: Mechanisms and bioreactors
	Nov. 20	Lecture
	Nov. 21	
	Nov. 22	No Class (Thanksgiving Break)
	Nov. 23	No Recitation (Thanksgiving Break)
	Nov. 24	No Class (Thanksgiving Break)
		Ch. 9 / Ch. 14: Mass transfer in reactors
	Nov. 27	Lecture
	Nov. 28	
	Nov. 29	Lecture
HW 12	Nov. 30	Recitation
	Dec. 1	Lecture

Assignment Due	Date	Topics
		Ch. 15 Diffusion and reaction
	Dec. 4	Lecture
	Dec. 5	
	Dec. 6	Lecture
	Dec. 7	Recitation
HW 0 pt 2 / Take-home project	Dec. 8	Lecture

Exam 3/ Final	TBD	Ch 1-15

BME 595/CHE 597
Principles of Tissue Engineering
(3-Credit)

Instructor:	Prof. Solorio	lsolorio@purdue.edu	496-1956	Office: MJIS 3019
	Prof. Liu	julieliu@ecn.purdue.edu	494-1935	Office: FRNY 1160

Office Hours: By appointment

Lectures Tues, Thurs 10:30 AM – 11:45 AM FRNY G124

Objectives
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 and 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.

Learning Resources, Technology, and Texts
All lecture materials will be made available through Blackboard Learn (https://mycourses.purdue.edu/), and Kahoots! will be used in class to evaluate the students understanding of concepts presented in lectures.

Recommended Textbooks:
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.*, CRC Press, 2014. Available free as an electronic resource through the Purdue Library.

Tissue Engineering, Clemens van Blitterswijk *et al.*, Academic Press Series in Biomedical Engineering, 2015. 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 Library of Engineering and Science.

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.

Grading

Students are expected to attend class, participate in discussions, read all handout materials, and do homework (due at the beginning of lecture). It is possible that the whole homework assignment may be graded or that only specific problems on a homework assignment may be graded. As part of a 3-4 member 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 instructors, but students may choose their own article as long as it is approved by the instructors. 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 instructors. 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, we 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.

Assignments	Due	Weighting
Participation in class discussion	Throughout the semester	5%
Homework assignments	Throughout the semester	15%
Article Presentation	Throughout the semester	30%
Final Project Report and Presentation	Presentations: April 23, 28, & 30, 2020 Report: April 30, 2020	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%		

Attendance Policy

Students are expected to attend all classes. Sometimes an unavoidable situation may occur and excuse a student from attending the class. In that situation, please consult with the instructors before class or, if due to an emergency, immediately afterwards. 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.

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 597 to receive important class information. If you e-mail Profs. Solorio or Liu 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 evening if the e-mail is sent on the weekend).

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 SafeAssign to check for plagiarism. In this course, 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 homework assignment, recitation activity, project, exam, or lab report. 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.

Students with Disabilities

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 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.

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. Solorio, 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.

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/studentregulations/regulations_procedures/classes.html. Students who find themselves in need of assistance in a time of bereavement should contact Profs. Liu and Narsimhan privately to discuss specific needs.

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. Purdue's nondiscrimination policy can be found at: https://www.purdue.edu/purdue/ea_eou_statement.php

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.

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 instructors' control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors. You are expected to read your @purdue.edu email.

Mental Health Statement

- If you find yourself beginning to feel some stress, anxiety, 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 see the Office of the Dean of Students for drop-in hours (M-F, 8 am- 5 pm).
- 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, 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.

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.

Course Evaluation

During the last two weeks of the course, students will be provided with an opportunity to evaluate 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. You will have up to two weeks to complete this evaluation. 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.

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. 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.

Emergency Procedures

In the event that the class would need to evacuate FRNY (e.g., in the event of a fire alarm), the class should proceed to exit the building and meet in front (i.e., on the fountain side of the MSEE Building) or, in the case of inclement weather, inside of MSEE. 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 (e.g., due to a tornado warning), we will proceed to the appropriate shelter in place area within the lower levels of FRNY (i.e., immediately outside of B124).

Disclaimer

This syllabus is subject to change. If any change occurs, it will be announced in the class.

CHE 544 Fall 2022

Structure and Physical Behavior of Polymeric Materials

Instructor: Professor You-Yeon Won; Room 2031 Forney
Tel: 4-4077; e-mail: yywon@purdue.edu
Office hours: T 10:30 – 11:30 AM (WebEx URL to be announced)

Classes: M, W, F 11:30 AM – 12:20 PM, Hampton (HAMP) 2102

Teaching Assistant: No graduate TA has been assigned for this course this year.

Prerequisites: Undergraduate physical chemistry

Text:
P. G. Hiemenz and T. P. Lodge, "Polymer Chemistry", 2nd ed., CRC Press, New York, 2007

Supplemental Text:
M. Rubinstein and R. H. Colby, "Polymer Physics", Oxford University Press, New York, 2003

Additional References:
R. J. Young and P. A. Lovell, "Introduction to Polymers", 2nd ed., 1991, reprinted by Nelson Thornes
P. J. Flory, "Principles of Polymer Chemistry", Cornell University Press, Ithaca, 1953
P.-G. de Gennes, "Scaling Concepts in Polymer Physics", Cornell University Press, Ithaca, 1979
U. W. Gedde, "Polymer Physics", Chapman & Hall, London, 1995
G. Strobl, "The Physics of Polymers", Springer-Verlag, Berlin, 1996

Course Objectives:
1. Develop a broad understanding of the underlying principles and concepts relating to the structural and physical behavior of polymers (see the course outline below for topics that will be covered).
2. Learn about current topics in polymer science (see the guidelines for oral presentation on a recent paper for details).

Tentative Course Outline: (subject to minor changes)

Week of	Topics (Reading Assignments)
8/22,8/29	Introduction: history of polymers; basic definitions; classes of polymers; average molecular weights; synthesis; stereochemistry; common polymers (Ch 1; notes) (**No class on 8/24: ACS Fall Meeting)**

8/29,9/5,9/12 Chain conformations: freely-jointed chain; freely-rotating chain; hindered rotation; characteristic ratio; persistence length; wormlike chain; radius of gyration; Gaussian distribution; excluded volume; solvent quality; expansion parameter (Ch 2 & 3; notes)
(No class on 9/5: Labor Day)

9/19,9/26,10/3 Thermodynamics of polymer mixtures: regular solution theory; Flory-Huggins theory; osmotic pressure; second virial coefficient; theta temperature; solubility parameter; concentration regimes in polymer solutions; phase separation (Ch 4 & 5; notes)

10/3,10/10,10/17 Scattering: static light scattering; form factor; Zimm plot; small-angle neutron/X-ray scattering (Ch 1; notes)
(Midterm exam: 10/12, 6:30 – 7:30 PM, FRNY B124)

10/17,10/24 Characterization based on polymer solution dynamics: intrinsic viscosity; gel permeation chromatography; dynamic light scattering (Ch 1; notes)

10/31,11/7,11/14 Rheology of polymer melts and solutions: basic concepts; models for viscoelasticity; dynamic mechanical spectroscopy; time-temperature superposition; entanglement; plateau modulus; relaxation time; reptation model; bead-spring model (Ch 7, 8 & 9; notes)

11/14,11/21 Amorphous polymers: Gaussian conformation; glass transition; free volume; α, β-relaxations; thermal analysis of polymers (notes)
(Guest lectures on 11/16 & 11/18: AIChE Annual Meeting)
(**No class on 11/23 & 11/25: Thanksgiving Vacation)**

11/28 Crystalline polymers: hierarchical structure; crystallography; thermodynamics of crystallization and melting; crystallization kinetics (notes)

12/5 Student presentations
(Final exam: Date/room TBA)

Grades:

The course grade will be based on homework (25%), one midterm (30%), one final (35%), and oral presentation/class participation (10%). Attendance is required. For every unexcused absence, your final grade will be reduced by one point (out of 100). This course will use a +/- grading system.

Homework:

There will be 3 – 4 homework sets, due about 3 weeks after assigned. *On each homework assignment, students are required to do all problems, but only part of the assigned problems will be graded*. Graded homework will be returned in class. Homework solutions will be announced through Brightspace. General discussion between students is encouraged, but homework should be done independently, unless directed otherwise. Copying will result in heavy penalty for all involved.

Exams:

The midterm exam will take place on the evening of Wednesday 10/12 (6:30 – 7:30 PM, Room B124 FRNY). The final exam will take place during the final exam week (12/12 – 12/17); the final exam date and location will be announced later in the semester. All exams

will be closed book and closed notes, but students will be allowed to have one double-sided 3" × 5" note card with information on it.

Oral Presentation:

Each student is required to give an oral presentation in front of the class on a recent paper published in the literature since 2017. Each talk will be composed of a 12-minute presentation and a few minutes of question and answer afterwards; questions will be asked by the audience. A PowerPoint presentation is the format of presentation. Students should submit their paper selection to the instructor for approval via e-mail; in the e-mail, please include the title, author(s)' name(s) and abstract of the paper, journal name, volume number, page numbers, year published. *The choice of paper should be approved by the instructor no later than Saturday 11/12/2022.* The subject of the paper should be relevant to the topics of this course. Review or perspective articles are not allowed; only original research papers are allowed for this presentation. The followings are examples of recommended journals from which you can choose an article: Macromolecules, ACS Macro Letters, ACS Polymers Au, ACS Applied Polymer Materials, Nature Materials, Physical Review Letters, Science, Nature, Advanced Materials, Polymer, Journal of Polymer Science B (Polymer Physics Edition), Langmuir, etc. The presentations will be scheduled in the week of 11/28. The exact dates and presenters will be announced later. Each student should email an electronic (PPT) copy of his/her final slides to the instructor no later than 11:59 PM on the day before the presentation date. The filename should be in the following format: "CHE 544 Presentation <Your Last Name>.pptx". The grades will be given based on the choice of paper (i.e., quality and potential impact), clarity of presentation, depth of understanding, and ability to answer questions.

Campus Emergency:

In the event of a major campus emergency (e.g., a pandemic situation), course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. During such a disruption, information about changes in this course will be communicated by email.

8/22/2022

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

Course Information Instructor/TA Contact Information Course Description Learning Resources, Technology & Texts Learning Outcomes Assignments Grading Scale Course Schedule Academic Integrity	Attendance Policy during COVID-19 Academic Guidance in the Event a Student is Quarantined/Isolated Classroom Guidance Regarding Protect Purdue Nondiscrimination Statement Accessibility Mental Health Statement Emergency Preparation

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.

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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
Instructor(s) Contact Information
Course Description
Learning Resources, Technology & Texts
Learning Outcomes
Assignments
Grading Scale
Course Schedule
Academic Integrity
Nondiscrimination Statement
Accessibility
Mental Health/Wellness Statement
Basic Needs Security
Emergency Preparation

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.

Course Information

ChE 59700- Introduction to Energy Storage Systems

Meeting day(s) and time: TBD

Instructor(s) Contact Information

- **Name of the instructor(s):** Prof. Vilas G. Pol
- **Office Location:** FRNY 2146
- **Office Phone Number:** 765-494-0044
- **Purdue Email Address:** vpol@purdue.edu

Office/Consultation hours, times, and location: TBD

Course Description

Introductions to Energy Storage Systems course is designed to introduce fundamentals of electrochemistry and electrochemical engineering of primary and rechargeable batteries to undergraduate and graduate students. The course will be reviewing working principles of various batteries. Strong emphasis will be given on the Li-ion battery technology, primary batteries, nanotechnology implementation and the materials design. Beyond conventional Li-ion systems and Pb-acid batteries, next generation Na-ion, K-ion, Solid-state and Li-S batteries will be discussed. Students will be understanding energy density calculations, fabrication and testing mechanism of batteries utilizing engineered electrodes, electrolytes and separators. Broader perspectives on sustainable, cost effective, longer lasting battery manufacturing will be provided.

MAJOR TOPICS COVERED:

- Introduction to Energy Storage Systems: Overview, definitions, history, market, theory, thermodynamics, kinetics and safety.
- Challenges of Li-ion Battery Technology, Selection criteria for commercial batteries
- Experimental techniques, Promising cathode materials, Anode materials, Electrolytes, current distribution and related issues
- Electrode slurry preparation, lamination, drying, pressing, manufacturing of coin cell batteries and testing for rate capabilities and long cycle life testing
- Kinetics and thermodynamics of electrochemical reactions
- Beyond Li-ion battery technologies, next generation Li-S batteries, Sodium ion batteries, K-ion batteries will be reviewed.
- Lead acid batteries, Ni-MH batteries
- Primary batteries (Carbon-zinc, Zinc-air, Mg/MnO_2, Zn/HgO, Cd/HgO, Zn/Ag_2O, Zn/O_2, Li-solid cathode, $Li-O_2$ batteries)

Learning Resources, Technology & Texts

- ***Recommended:***

Handbook of Batteries. 3rd edition Linden and Reddy
Lithium-Ion Batteries: Science and Technologies, Masaki Yashio, Ralph Brodd, Akiva Kozawa

- **Brightspace learning management system**

Learning Outcomes

This course will provide detailed understanding of battery science, technology and engineering background making next generation researchers ready to handle the upcoming challenges related to LIBs. Such background could provide job opportunities in numerous industries including Apple, Google, Tesla; national labs as well as faculty positions to create next generation scientific and advanced intellect. This course applies to various disciplines including MSE, Chemistry, ChE, ME, AAE, Physics, Technology and EE. Taking this advanced elective course on rechargeable batteries will not only provide theory background but also hands on experience to the undergraduate and graduate students.

Sample language:

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

1. Identify the battery technologies, *understand the basic physical concepts,* fundamental operating principles, needs and its social impact.
   - *Methods of Evaluation: Quizzes, Participation in weekly discussions, assigned homework*

2. Demonstrate the ability of topics understanding and articulation of ideas
   - *Methods of Evaluation: Scientific 19 minutes presentations to the class*

3. Critique- be able to critically evaluate the utility and viability of technological claims in popular and scientific literature
   - *Final exam/research proposal writing skills*
   -

Assignments

"Your learning will be assessed through a combination of participation, homework, mid-term written exam, scientific presentation, and a final exam/report spread throughout the academic period. Details on these assignments and exams, including a schedule of due dates, rubrics to guide evaluation, and guidelines on discussion participation and evaluation will be posted on the course website.

Assignments	Due	Points
Participation	Throughout the semester	10
Homework	Twice a week	20
Mid-term written Exam	TBD	25
Scientific 19 minutes presentations to the class	See updates on Brightspace	20
Final Exam / Research Proposal	TBD	25
		Total: 100

Purdue University ChE 597: Organic Electronic Materials and Devices, Spring 2022

A. Instructor. Professor Letian Dou

B. Course Description. This course introduces the synthesis, optoelectronic properties, transport physics, and device operation of organic and hybrid electronic materials and devices. This course will review how the molecular architecture of small molecule and polymer semiconductors can be tuned to alter the optoelectronic properties of the materials in solution and in the solid state. A number of relevant materials interactions will be covered, including: photoexcitation and recombination, intermolecular charge transport mechanisms, and energy transfer processes. Additionally, we will observe how these processes are relevant to applications such as organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), organic photovoltaic (OPV) devices, and organic memory elements. Finally, a new type of organic-inorganic hybrid material called hybrid halide perovskite will be introduced.

C. Prerequisites. CHM 261 (Organic Chemistry I), or equivalent; or permission from the instructor. Physical Chemistry (CHM 372) and Structure and Properties of Materials (MSE 230) are very helpful for this course (optional).

D. Recommended (NOT REQUIRED) Texts.

1. *WSPC Reference on Organic Electronics, The: Organic Semiconductors,* Edited by Seth R Marder and Jean-Luc Bredas, World Scientific Publishing, 2016, ISBN-13: 978-9814699228
2. *Organic Radical Polymers: New Avenues in Organic Electronics*, Sanjoy Mukherjee and Bryan W. Boudouris, Springer, 2017, ISBN: 978-3-319-58574-1
3. *Organic Field-Effect Transistors*, Edited by Zhenan Bao and Jason Locklin, CRC Press, Inc., 2007, ISBN: 978-0849380808

E. Course Learning Objectives. As this course is designed to link the concepts regarding organic electronic materials from "molecules through modules," the students should be able to perform the following learning objectives, as classified by one of the three major sections.

- **Synthesis of Organic Semiconductors.** Identify common mechanisms for the synthesis of small molecule and polymer semiconductors; describe the mechanism of controlled polymerization techniques for macromolecular semiconductors; interpret spectroscopic, chromatographic, and molecular characterization data in order to predict the structure of the organic semiconductor; explain how the molecular structure of an organic semiconductor will affect its thermal, structural, and optoelectronic properties.
- **Microstructural Characterization of Organic Semiconductors.** Explain how x-ray scattering can be utilized to determine the Angstrom and nanometer length scale structural features of the organic semiconductors; apply principles of electron microscopy to comprehend how to image soft materials; determine the domain spacing and microstructural architecture of organic semiconductors given a scattering pattern
- **Charge Generation and Transport, Optoelectronic Characterization, and Device Application of Organic Semiconductors.** Explain how molecular orbital levels are related to the optoelectronic properties of organic semiconductors; distinguish between different models for charge transport in organic semiconductors; describe clearly the difference between charge generation and transport in organic and inorganic semiconductors; explain how organic electronic devices operate and how apply known equations to evaluate device performance; critique the potential for organic electronic materials to supplement or replace inorganic semiconducting devices

F. 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.

G. 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 59700 content.

H. 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.**

I. 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.

J. Student Professionalism. The highest standards of professionalism and ethics are expected in CHE 59700. 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 and the faculty member. Each student is expected to exhibit a positive attitude. Expectations for each student include (but are not limited to):

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

K. 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.

L. Attendance policy during COVID-19. It is the responsibility of all students to attend all class sessions either in person or via online platform. Note, online version of this course is not live. You are required to watch the video records after each lecture. In-person meetings of a course is not a factor in final grades.

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. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, but 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.

M. 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 Blackboard.

N. Academic Guidance in the Event a Student is Quarantined/Isolated. 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.

O. 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. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask in classrooms and campus building, at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

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 (e.g., not wearing a mask) 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.

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 Dou 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 Dou 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.

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 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. This location is between FRNY G140 and FRNY B124.
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. This location is FRNY 1051.

T. 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.***

U. 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.

V. Course Meeting Schedule.

Lectures:	Tuesday and Thursday	10:30a – 11:45a	FRNY 1042
Examination 1:	02/22 (Tuesday)	10:30a – 11:45a	FRNY 1042
Examination 2:	04/07 (Thursday)	10:30a – 11:45a	FRNY 1042
Oral Presentation:		10:30a – 11:45a	FRNY 1042

If you have a scheduled class or other reasonable issue (e.g., religious observance) that conflicts with a scheduled exam, please tell Professor Dou as soon as possible so that plans may be made for you to take the exam at an alternate time.

W. Instructor Contact Information.

Professor Letian Dou – Email: dou10@purdue.edu, Telephone: (765) 494-4194
Office: 3053B Forney Hall
Office Hours: Thursday 9:30am – 10:30am or by appointment

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

Examinations: 35% each = 70% total
Semester Presentation: 30%

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

Examinations

There will be three examinations during the course of the semester. These examinations will occur during the regularly-scheduled class time. It is recommended that you arrive early to class on these days as the exam will begin and end promptly at the start and conclusion of the period. 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 is the examination booklet, the notes pages provided, the paper on which you are writing solutions, something with which to write, and a calculator. All other electronic devices are forbidden, including cell phones and pagers. These must be turned off and may not be handled at any time during the examination. Students caught with other materials during an examination will be assumed to be cheating. If an examination was too difficult (as judged by the instructor), the final grade may be scaled upwards (i.e., points will be added to an examination score). Grades will never be scaled downward. There is no preset distribution of final grades. A student has one week after an exam has been returned to discuss any grading, after which grading errors will not be discussed. If a student believes work was graded incorrectly, it must be resubmitted. The resubmission must be accompanied by a separate sheet of paper that documents the error in question. **This is the only mechanism for addressing work that was potentially marked down in error.**

Semester Presentation

Each student will be required to give a 20 min presentation at the end of the semester regarding a topic within the realm of "organic electronics" of his/her choice. The presentation will include a review of the relevant literature and a proposed plan of future research that the student believes could lead to interesting results in the field. Exact details

of the assignment will be outlined thoroughly later in the semester. Before beginning work on this, it is ***highly recommended*** that the student meets with the instructor in order to outline a planned topic of study. The final presentation ppt files must be sent to the instructor by the end of the semester.

Course schedule

Introduction and chemistry of organic semiconductors	1 week
Structures of organic semiconductors	1 week
Basic quantum mechanics in molecules	1 week
Molecular orbital theory	1 week
Band theory	1 week
Basic semiconductor physics	1 week
Optical properties of organic semiconductors	1 week
Electrical properties of organic semiconductors	1 week
Principles of organic field-effect transistors	1 week
Principles of organic light-emitting diodes (OLEDs)	1 week
Principles of organic photovoltaics (OPV)	1 week
Principles of organic thermoelectrics (OTE)	1 week
Principles of organic electrochromic devices	1 week
Novel materials systems: open-shell materials, organic-inorganic hybrid materials, etc.	1 week

CHE 59700-H02/CHE 49700-H01
Analytical Approach to Healthcare Delivery (Fall 2024)

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 research and 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
Presentation 1:	TBD
Presentation 2:	TBD
Final Report due:	TBD

At the approximate mid-point of the semester, students will assemble into groups of 3-4 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: TBD

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

Homework assignments (4): 20% of total
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.

<u>Group projects</u>

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 20)	Intro and US healthcare system overview
Lecture 2 (Aug 22)	Cardiovascular disease
Lecture 3 (Aug 27)	Obesity
Lecture 4 (Aug 29)	Diabetes
Lecture 5 (Sep 3)	Kidney disease
Lecture 6 (Sep 5)	Clinical case 1
Lecture 7 (Sep 10)	Cancer
Lecture 8 (Sep 12)	Arthritis and autoimmune disease
Lecture 9 (Sep 17)	Neurologic disorders (Alzheimer's disease and stroke)
Lecture 10 (Sep 19)	Chronic liver disease
Lecture 11 (Sep 24)	Critical care medicine (acute kidney injury and sepsis)
Lecture 12 (Sep 26)	Clinical case 2
Lecture 13 (Oct 1)	Medical device industry
Lecture 14 (Oct 3)	Case study: Cook Biotech*
Lecture 15 (Oct 10)	Emerging healthcare developments (1): digital health
Lecture 16 (Oct 15)	Biopharmaceutical industry (1)
Lecture 17 (Oct 17)	Biopharmaceutical manufacturing*
Lecture 18 (Oct 22)	Drug discovery
Lecture 19 (Oct 24)	Biopharmaceutical industry (2)
Lecture 20 (Oct 29)	Healthcare spending/financing
Lecture 21 (Oct 31)	Health insurance
Lecture 22 (Nov 5)	Case study: technology evolution in healthcare
Lecture 23 (Nov 7)	Clinical research
Lecture 24 (Nov 12)	Emerging healthcare developments (2): precision medicine
Lecture 25 (Nov 14)	Emerging healthcare developments (3): value-based care
Lecture 26 (Nov 19)	Emerging healthcare developments (3): artificial intelligence
Lecture 27 (Nov 26)	The business of medicine
Lecture 28 (Nov 28)	Case study: electronic medical record (EMR)*
Lecture 29 (Dec 3)	No class**
Lecture 30 (Dec 5)	No class**

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

Industrial Marketing Management
Fall 2023, Module 2

Course Information

- Course number and title: CHE 59700 Industrial Marketing Management
- Meeting time: Class meets in ARMS 1109 from 1:30 to 3:00, Monday, Wednesday and Friday
- Course credit hours **3 credit hours**
- Course information and materials will be available through Brightspace
- Prerequisites: none

Instructor Contact Information

Bob Brown
Phone: 765-494-0027 (office)
Email: bobbrown@purdue.edu
Office Hours: Tuesdays, from 12:00 to 1:00, or by arrangement through email.

About the Instructors

Bob Brown is the Managing Director for the National Science Foundation (NSF) Engineering Research Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR), led by the Purdue University Chemical Engineering Department. CISTAR, funded by a 10-year $40 million NSF grant, researches and develops technologies for responsible conversion of light hydrocarbons from shale gas into fuels and chemicals using a network of portable, modular processing plants. Before going to CISTAR, Mr. Brown was the Managing Director for the Center for Science of Information (CSoI) at Purdue, an NSF Science and Technology Center (operating from a ten-year $50 million research grant). He has over 25 years of experience in higher education administration with responsibilities for marketing, finance/budget, development, corporate and public relations, and grant/project management. He has consulted other similar research enterprises throughout the U.S and has represented Purdue and/or the National Science Foundation on multiple conference and research workshop panels. Previous to his career in Higher Education. Mr. Brown was the General Manager of retail operations for Crutchfield Corporation headquartered in Charlottesville, VA. Crutchfield is a North American retailer specializing in a wide range of consumer electronics serving both the United States and Canada. Mr. Brown has a BS in Business Management and an MBA, from Virginia Tech, Blacksburg, VA. He is a PhD candidate at Purdue University.

Assisting with this course is **Kim Underhill**. Ms. Underhill is an esteemed business executive with a broad-based background and extensive experience in domestic and international consumer products operations with particular strength in marketing, brand-building, strategic planning, and international business development. Following a 32-year career at Kimberly-Clark, Kim is now focused on board work, executive

coaching/leadership team effectiveness and business transformation. She continues to follow her passion of charitable work through the United Way and efforts focused on STEM. In her most recent corporate role as Group President of Kimberly-Clark North America, Kim Underhill was responsible for the company's nearly $8 billion North American Personal Care and Consumer Tissue Businesses, and some of the world's most recognized and trusted consumer brands, including Huggies®, Pull-Ups®, Kotex®, Depend®, Kleenex®, Cottonelle® and Scott®. Ms. Underhill had previously served as president of Kimberly-Clark Professional, a $3.5 billion B2B unit of Kimberly-Clark. She spearheaded the development of brand-led innovation through a focus segment approach, in addition to driving scalable customer-centric business strategies through an operational and commercial lens. Prior to that, she served as president of Kimberly-Clark's consumer business in Europe. Since first joining Kimberly-Clark, she held a variety of roles with increasing responsibility in research & engineering, supply chain, and marketing. She began her career at General Electric as a process engineer. Underhill sits on the board of directors for Foot Locker Inc. (Compensation Committee Chair), The Menasha Corporation, Glanbia PLC and Theda Care Regional Medical Center. She holds a bachelor's degree in chemical engineering from Purdue University and a master's degree in engineering management from the Milwaukee School of Engineering. She is an active volunteer for United Way and was the community campaign co-chair from 2019 – 2021. Kim splits her time between Georgia and Wisconsin and enjoys golfing, traveling and reading World War II fiction.

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 only. There will be times as deemed necessary by the instructor when the class will convene remotely via zoom in order to host remote guest speakers, etc. Attendance will be monitored for all scheduled classes.

Course Goals*

To further disseminate and 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.

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 (200 points). 33% of final grade. 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!!!
- Writing assignments /Quizzes/exams (200 points) 33% of final grade
- Marketing Plan and Team Presentation (200 points) 33% of final grade

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-five people who will collaboratively work on a plan as assigned. Each group will prepare a written plan that will also be summarized in a team presentation 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.

Missed or Late Work

All work is expected to be completed and submitted on time. Late submissions will be penalized by 10% of the grade for each day it is late. Failure to complete an assignment will result in a zero score.

Academic dishonesty will be dealt with accordingly as per university policy.

Course Schedule

The course will start on October 19 and end on December 10. 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. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

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 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 Armstrong Hall. 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 Armstrong Hall 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. Our preferred location is G124.

Purdue University
CHE 597 Industrial Chemical Technology
Spring 2024, Tue-Thu 1:30-2:45, FRNY G124

Instructor: Jeff Siirola, FRNY 1029A, 6-2125, jsiirola@purdue.edu or jjsiirola@gmail.com

Office Hours: Almost anytime; best to make appointment by email

Course 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, 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.

Course Content:

History and structure of the chemical and allied process industries (1 week)
Natural Products (animal and vegetable products; wood derivatives) (1 week)
Inorganics (dehydration (calcining), reduction (smelting), bases and acids, commodities) (2 weeks)
Fuels (fossil, petroleum refining, synthetic and biofuels) (1.5 weeks)
Organics (wood and coal derivatives, basic building blocks, commodity intermediates and solvents, commodity monomers and polymers, plastics fibers and coatings, fine chemicals, biotechnology) (4 weeks)
Technical Impact Factors (catalysis, computers, innovation) (1.5 weeks)
Current Issues (environmental protection, health and safety, sustainability, carbon dioxide management, shale gas and oil) (3.5 weeks)

Tentative course schedule (subject to change):

Tue 9 Jan	Course introduction; scope of the chemical and allied process industries
Thu 11 Jan	Historical technology development (alchemy, chemistry, processes, unit operations, transport phenomena, process systems); historical milestones (brewing, soap, salt, smelting, soda ash, distillation, electrolysis, high pressure, continuous controlled processes)
Tue 16 Jan	Natural Products 1 - Animal and vegetable fiber, leather, oils, fats, waxes, gelatin, dairy products, food processing
Thu 18 Jan	Natural Products 2 - Pulp and paper, naval stores, resins, turpentine, rosin, rubber (Report 1 Due)
Tue 23 Jan	Inorganics 1 - Chemistry of dehydration/hydration: ceramic pottery, tile, and brick, glass, plaster, cement, mortar, and concrete
Thu 25 Jan	Inorganics 2 - Chemistry of reduction: ore smelting, iron and steel, silicon, copper, brass, bronze, aluminum

Tue 30 Jan	Inorganics 3 - Bases and acids: soda ash, caustic soda, lime, mineral acids (nitric, sulfuric, phosphoric, hydrochloric)
Thu 1 Feb	Inorganics 4 - Commodity inorganics: water, hydrogen, oxygen, nitrogen, chlorine, fertilizers (ammonia, phosphates, potash), titanium dioxide, carbon black, carbon dioxide, phosgene, hydrogen peroxide (Report 2 Due)
Tue 6 Feb	Fuels 1 - Wood, coal, petroleum (gasoline, diesel, jet fuel, fuel oil), LPG, natural gas
Thu 8 Feb	Fuels 2 - Natural gas processing, petroleum refining processes and products
Tue 13 Feb	Fuels 3 - Synthetic fuels: town gas, F-T, SNG, MTG, biofuels
Thu 15 Feb	Organics 1 - Wood and coal chemicals and materials (Report 3 Due)
Tue 20 Feb	Organics 2 - Basic building blocks: acetylene, olefins (ethylene, propylene, butadiene) aromatics (BTX, Styrene), carbon monoxide
Thu 22 Feb	Organics 3 - Commodity intermediates and solvents: alcohols glycols and phenols, aldehydes and ketones, acids, esters, ethers
Tue 27 Feb	Organics 4 - Commodity monomers and polymers (PE, PP, PS, PET, PC, SBR)
Thu 29 Feb	Organics 5 - Adhesives, coatings, films, fibers, plastics (Report 4 Due)
Tue 5 Mar	Possible No Class
Thu 7 Mar	Organics 6 - Fine chemicals: dyes pigments and cosmetics, flavors and fragrances, soap and detergents, explosives, agrichemicals, pharmaceuticals
12-14 Mar	Spring Break
Tue 19	Organics 6 continued
Thu 21 Mar	Organics 7 - Fermentation and biochemical processes; biotechnology (Report 5 Due)
Tue 26 Mar	Technical Impact Factor 1 - Homogeneous and heterogeneous catalysis
Thu 28 Mar	Technical Impact Factor 2 - Engineering and operational digital computation
Tue 2 Apr	Current Issues 1 - Environmental protection: air, wastewater, land; personnel protection: health and safety
Thu 4 Apr	Current Issues 2 - Loss prevention and process safety (Report 6 Due)
Tue 9 Apr	Current Issues 3 - Sustainability: triple bottom line, life cycle analysis, industrial ecology, green chemistry and engineering
Thu 11 Apr	Current Issues 4 - Sustainability: population and economic growth, raw materials; energy and water resources
Tue 16 Apr	No Class
Thu 18 Apr	Current Issues 5 - Climate change
Tue 23 Apr	Current Issues 6 - Carbon dioxide management, capture, and sequestration
Thu 25 Apr	Current Issues 7 - Impact of shale gas and oil (Report 7 Due; Bonus Report Due)

Homework Reports:

Report 1 - Industry Structure and Statistics (Due 18 January)
Report 2 - Reaction Path Synthesis: Solvay Process (Due 1 February)
Report 3 - Block Flow Diagram: Petroleum Refining (Due 15 February)
Report 4 - Process Supply Chain: Polyethylene Terephthalate (Due 29 February)
Report 5 - General Purpose Batch Processing: Fine Chemical Manufacture (Due 21 March)

Report 6 - Safety and Environmental Protection: Methyl Isocyanate (Due 4 April)
Report 7 - Sustainability: Carbon Management (Due 25 April)
Bonus Report: Process Narrative: Major Chemical Intermediate (Due 25 April)

Grading:

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

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 the work of others, specifically including wholesale copying from electronic sources, is plagiarism and is considered a form of cheating.

Accommodation:

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

Protect Purdue:

The Protect Purdue Plan, which includes the Protect Purdue Pledge, is a campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center if you feel ill or know you have been exposed to the virus, wearing a mask in classrooms and campus buildings at all times, disinfecting workspace prior to and after use, maintaining proper physical distancing, and maintaining robust personal hygiene. Measures will be taken to provide alternative remote instructional experiences if the course had an on-line delivery option or if on-line delivery becomes mandated during the course of the semester.

References:

Kirk-Othmer Encyclopedia of Chemical Technology (5^{th} Ed and On-line, Wiley)
Ullmann's Encyclopedia of Industrial Chemistry (5^{th} Ed and On-line, Wiley)
Shreve's Chemical Process Industries (5^{th} Ed, McGraw-Hill Special Reprint Edition)
Handbook of Chemical Technology and Pollution Control (Robert Myers, 3^{rd} Ed, Elsevier)
Handbook of Petroleum Refining Processes (Martin Hocking, 2^{nd} Ed, McGraw Hill)

Purdue University
School of Chemical Engineering

ChE 530: Introduction to Chemical Engineering Mathematics*

May be listed in the Schedule of Classes as CHE 59700

Fall 2024

Instructor: Jim Caruthers (FRNY 2043C, caruther@ecn.purdue.edu)
Administrative Assistant – Jason Thorp – FRNY 2043
Virtual Office Hrs. Wednesday 2:30 via WebEx at xxxxx

TA : Grisha Medvedev (FRNY 1027, medvedev@purdue.edu)
Virtual Office Hrs. Wednesday 2:30 via WebEx at xxxxx

Class Format:
The lecture materials have been recorded and are available on Brightspace under ChE5979 Introduction to Engineering Mathematics. In addition, both Prof. Caruthers and Grisha Medvedev will have weekly office hours to answer questions.

Texts:

1. The initial part of the course will be a review of pre-calculus and calculus material, where any textbook will cover the necessary material – you can use your old undergraduate text.
2. "Elementary Differential Equations and Boundary Value Problems: 10th edition" W.E. Boyce and R.C. DiPrima, , Wiley, NY, 2012. Any edition of this test from the 6th edition on is acceptable; however, homework problems will be from the 10th edition (i.e. the material has been the same in all editions).

Supplemental Texts:

1. "Calculus and Analytic Geometry: any edition" G.B. Thomas (and in later editions with R.L Finney) Addison-Wesley.
2. "Calculus: any edition," H. Anton, I. Bivens and S. Davis, Wiley, NY.
3. "Linear Algebra and Its Applications: 4th Edition," G. Strang, Brooks Cole, 2005

Objectives

The intent of this course is to introduce the mathematical methods that are needed to solve a variety of chemical engineering problems. There will be an initial review of topics in algebra, differential calculus, integral calculus and vector math – topics that have been previously taken as an undergraduate. The course will then introduce differential equations that are the basis for analysis of many engineering processes and the methods for solving those differential equations. Finally, matrices will be introduced to address engineering problems where there are two or more variables. At the end of the course one should be prepared to take additional courses in Engineering at the 500 or 600 level that use differential equations or linear algebra to quantify the physical/engineering processes being analyzed.

The course is organized with two online lectures per week. The lectures are broken into a number of segments, where after each segment there are a number of short answer questions. The short answer questions should be done as the Lecture Note are completed and the question will be graded.

Homework problems will be assigned weekly. Homework constitutes an important part of the course and should be done conscientiously. Homework will be due in class on the date indicated on the Lecture Schedule. NO LATE HOMEWORK WILL BE ACCEPTED. Any adjustments to the homework grades should be requested within one week after the homework is returned. Solutions for the homework will be posted on Blackboard.

Although the course will not focus on numerical methods, it is important to be able to numerically solve more complex problems. On every homework set their will be one or more problems that will require a numerical solution. You can use Mathematica, MatLab, Maple or any other software package you choose – I use MatLab, but that is a personal choice. In order to encourage use of the numerical packages, there will be an explicit part of the grade that will be for performance on this part of the homework. The operation of the numerical packages is your responsibility (the online documentation/tutorials for the various software packages is excellent) – we will not discuss software syntax in class or in office hours. You need to online references, your classmates and senior graduate students to learn the numerical package of your choice.

Group discussions concerning the homework are encouraged, since the sharing of ideas is an excellent way to learn. However, you should eventually develop your own solution. Experience has shown that if you do not develop your own solution to the homework, your performance on the exams will suffer.

Graded homework/exams will be distributed in class. Those students that are unable to pick-up their homework/exams in class may pick-up their homework/exams from Ms. Jason Throp in FRNY 2043. These papers will be kept a reasonable amount of time (i.e. 3 weeks) and then will be discarded.

A lecture-by-lecture breakdown of the course is attached along with the required reading assignment. The reading assignment should be completed *prior* to coming to class in order obtain maximum education value from the lectures.

The final course grade will be weighted as follows:

2 - 1 hour examination	200 points
final examination	200 points
numerical solution	50 points
weekly homework	100 points
TOTAL	550 points

The dates for the 2 one hour examinations are given in the Lecture Schedule. THERE WILL BE NO MAKE-UP EXAMINATIONS. If a mistake has been made you should return your exam paper along with a *written* description of the error to myself within one week of the time the exam is returned. Any requests for regrades after the one week period following the return of the exam will not be accepted. We will regrade the whole exam, when you request a regrade; thus, your grade may go up or down.

There is a possibility that there may be a disruption during the semester if there is an outbreak of measles, bird flu, etc.. If the University closes for a period of time, we will attempt to continue ChE 630 through assigned reading, problem sets, etc. where I will try to provide lecture material over the web. Communication through email will be critical. If there is a disruption I except that each student will (i) take their textbooks and notes home and (ii) stay connected via your Purdue email account.

The highest standards of Academic Honesty are expected in CHE 630. You are expected to do your own work on all examinations. Any participation in an academically dishonest practice

such a copying on exams, etc. will result in an F in CHE 630 as well as forwarding your case to the Dean of Students for appropriate disciplinary action.

CHE 530 Lecture Schedule – 2024

	Date	Topic	Reading
Part 1: Review			
1	Aug. 20	Why study differential equations?	
2	Aug. 22	Algebra: single variable equations	Any algebra book
3	Aug. 27	Numerical solutions using MatLab	MatLab tutorial
4	Aug. 29	Differential calculus review	Undergrad text
5	Sept. 3	Partial differential calculus review	Undergrad text
6	Sept. 5	Integral calculus review	Undergrad text
7	Sept. 10	Vectors	BSL Appendix
8	Sept. 12	Exam 1. in class	
Part 2: Ordinary Differential Equations			
9	Sept. 17	Why Study Differential Equations	
9	Sept. 19	Classification of ODEs; 1st Order ODE – integrating factor	B&D 2.1-2.4
10	Sept. 24	Separable and Exact ODEs	B&D 2.5-2.7
11	Sept. 26	Introduction to numerical methods	B&D 8.1-8.4
12	Oct. 1	1st Order Difference Equations	B&D 2.9
13	Oct. 3	2nd Order ODEs: constant coefficients	B&D 3.1-3.2
	Oct. 8	Fall Break	
14	Oct. 10	2nd Order ODEs: Complex Root	B&D 3.3
15	Oct. 15	2nd Order ODEs: Repeated Roots	B&D 3.4-3.5
16	Oct. 17	2nd Order ODEs: Undetermined Coefficients	B&D 3.6
17	Oct. 22	Higher order ODEs	B&D 4.1-4.3
18	Oct. 24	Series solutions; ordinary points	B&D 5.1-5.2
19	Oct. 29	Series solutions; Regular singular Points; Euler equation	B&D 5.4
20	Oct. 31	Bessel's Equation	B&D 5.7
21	Nov. 5	Exam 2 in class	
Part 3: Systems of 1st Order Differential Equations			
22	Nov. 7	Basic matrix operations	B&D 7.1-7.2
23	Nov. 12	Vector space and simultaneous equations	B&D 7.3
24	Nov. 14	Eigenvalues and eigenvectors	B&D 7.4-7.5
26	Nov. 19	Systems of 1st order linear ODEs	B&D 7.6 & 7.8
28	Nov. 21	Numerical Methods for Systems of ODs	B&D 8.5
	Nov. 28	Thanksgiving No class	
29	Dec. 3	Nonlinear systems of 1st Order ODEs	B&D 9.3-9.4
30	Dec. 5	Review	

2 Hour Final Exam in Scheduled Final Exam Period Dec. 9 to Dec. 14

Purdue University ChE 597: Process Synthesis, Fall 2023

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

Teaching Assistants: None

Lecture Hours: Tue/Thu, 1:30 pm – 2:45 pm (Masuku: synchronous, in-person)
Max & Maileen Brown Hall: 236

Office Hours: Tue/Thu, 3:00 pm – 4:30 pm

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

Website: Brightspace (CHE 597). 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 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: Thursday, October 5, 3pm
Project 2: Thursday, November 2, 3pm
Final Project: Thursday, November 30, 3pm

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 Thursdays by 1pm 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 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. 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 2023 - Tentative Course Schedule

Week	Date	Topic	Comments
1	8/22	Introduction to Process Synthesis	
1	8/24	Objectives, Aims and Motivation	
2	8/29	Process Design	
2	8/31	Technology Assessment	
3	9/5	Mass Balance as a Synthesis Tool	
3	9/7	Mass Balance as a Synthesis Tool	
4	9/12	Energy Balance as a Synthesis Tool	**HW1 due on Tue, 1pm**
4	9/14	Energy Balance as a Synthesis Tool	
5	9/19	Entropy & Gibbs Energy	
5	9/21	Entropy & Gibbs Energy	
6	9/26	Systematic Methods of Obtaining Targets: Graphical Techniques	**HW2 due on Tue, 1pm**
6	9/28	Mathematical Techniques	
7	10/3	Graphical and Mathematical Techniques	
7	**10/5**	**Project 1**	**P1 Due on Thu, 3pm**
8	Break		
8	10/12	Entropy & Temperature	
9	10/17	Entropy & Temperature	
9	10/19	Classifying Chemical Processes	**HW3 due on Thu, 1pm**
10	10/24	Classifying Chemical Processes	
10	10/26	Solvay Clusters	
11	10/31	Work Addition by Heat Engines	
11	**11/2**	**Project 2**	**P2 Due on Thu, 3pm**
12	11/7	AIChE Annual Meeting	
12	11/9	AIChE Annual Meeting	
13	11/14	Work Addition by Compression	
13	11/16	Separation & Separation Equipment	**HW4 due on Thu, 1pm**
14	11/21	Separation & Separation Equipment	
14	Break		
15	11/28	Integrated Process Synthesis	
15	11/30	Integrated Process Synthesis	
16	12/5	**Final Project**	**P3 Due on Tue, 3pm**

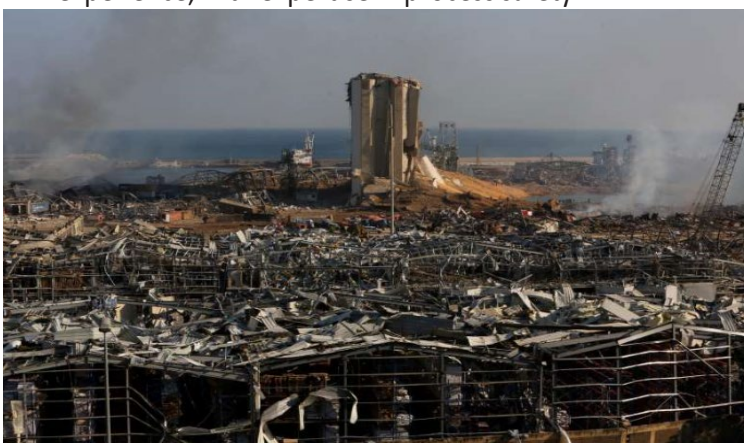
PURDUE UNIVERSITY | Davidson School of Chemical Engineering

CHEMICAL PROCESS SAFETY

CHEN 420/597 (3 CREDITS)

FALL 2024 – 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?
- How does one reduce the chance for 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 Associate Director. Students funded by the Center are encouraged to enroll. Professional Master's Students will benefit from this training, since typically over one third of the summer 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 3019
(936) 443-5579

PURDUE UNIVERSITY

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 632: Linear Operators in Engineering (3 credit hours): Fall 2021(TR12-1.15PM)

Instructor: Professor Doraiswami Ramkrishna

This course (offered online on Monday, Wednesday and Friday between 12.30 and 1.20PM) 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

Course Layout

Week of August 23, 2021:	Introduction to course. Motivation and goals. Fields, Algebraic features of linear spaces. (RA Ch.0 & 1), Bases.
Week of August 30, 2021:	Linear functionals and transformations. Bilinear functionals. Direct sums and tensor products of linear spaces.

Week of September 6, 2021: Metric spaces. Sets, Compact sets, Completeness, Fixed point theorem for contractions. Introduction to Riemann and Lebesgue integration.

Week of September 13, 2021: Normed linear and Banach spaces, Compact operators. Bounded linear functionals and operators, Unbounded operators.

Week of September 20, 2021: Inner product spaces. Cauchy-Schwartz inequality. Bessel's inequality. Orthonormal bases. Gram-Schmidt orthogonalization.

Week of September 27, 2021: Hilbert Space theory. Spectral Theory of Compact, Self-Adjoint operators in finite and infinite dimensional spaces.

Week of October 4, 2021: Spectral theorem of Unbounded operators with Compact inverse.

Week of October 11, 2021: Applications in Finite Dimensional Space. (Class only on October 10, *October Break*).

Week of October 18, 2021: Applications in Infinite Dimensional Space.

Week of October 25, 2021: Applications in Infinite Dimensional Space.

Week of November 1, 2021: B. Friedman's Theory of Separable operators.

Week of November 8, 2021: Boundary Value Problems with Mixed and Oblique derivative boundary conditions.

Week of November 15, 2021: Application to Low Peclet number heat transfer problems.

Week of November 22, 2021: Class only on November 22). *Thanksgiving break.*

Week of November 29, 2021: Conjugated Boundary Value Problems.

Week of December 6, 2021: Non-Self Adjoint Problems.

Purdue University ChE 662: Catalysis, Fall 2022

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, PHYS 111 (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:	50%
Exam:	50%

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 2022 - 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	8/23	1	Introduction, Reaction Rates and Stoichiometry, Nomenclature	0
	8/25	2	Mole Balances and Ideal Reactor Types, Nomenclature	1
2	8/30	3	Chemical Equilibrium, Chemical Kinetics, Nomenclature	1
	9/1	4	Kinetics of Complex Reactions, Pseudo-Steady-State Hypothesis, Regular Perturbation Theory	2
3	9/6	5	Kinetics of Complex Reactions, Pseudo-Steady-State Hypothesis, Regular Perturbation Theory	2
	9/8 *	6	Mechanisms of Homogeneous Reactions, Unimolecular Decomposition, Thermal Cracking	3
4	9/13	7	Adsorption and Reaction on Uniform and Non-Uniform Surfaces	4
	9/15	8	Adsorption and Reaction on Uniform and Non-Uniform Surfaces	4
5	9/20	9	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (DeDonder, Deg. of Rate Control)	5
	9/22 *	10	Non-Equilibrium Thermodynamic Treatments of Chemical Kinetics (Kinetic Coupling, Virtual Pressure)	5
6	9/27	11	Theoretical Estimates of Rate Parameters (Collision Theory)	6
	9/29	12	Theoretical Estimates of Rate Parameters (Transition State Theory)	6
7	10/4	13	Theoretical Estimates of Rate Parameters (Linear Free Energy Relationships)	6
	10/6	14	Approximate Methods and Molecular Simulation Techniques, Density Functional Theory, Quantum Mechanical Methods	7
8	10/11		NO LECTURE (FALL BREAK)	
	10/13 *	15	External Mass and Heat Transfer Restrictions in Catalytic Systems	8
9	10/18		NO LECTURE (CISTAR Fall Meeting)	
	10/20	16	Structural Models of Porous Solids and Effective Transport Coefficients within Pore Networks	8

10	10/25	17	Intraparticle Mass and Heat Transport Effects in Porous Catalysts	8
	10/27 *	18	Generalized Thiele Modulus and Effectiveness Factor Concepts	8
11	11/1	19	Combining Internal and External Transport Resistances	8
	11/3	20	Catalytic Processes (Acid/Base I: Cracking)	9
12	11/8	21	Catalytic Processes (Acid/Base II: Zeolites)	9
	11/10	22	Catalytic Processes (Acid/Base III: Zeolites)	9
13	11/15		NO LECTURE (AIChE Meeting)	
	11/17	23	Catalytic Processes (Transition Metals: Wacker Process, Vinyl Acetate Synthesis, Hydroformylation)	10
14	11/22	24	Catalytic Processes (Transition Metals: Methanol Carbonylation, Ziegler-Natta Polymerization)	10
	11/24		NO LECTURE (Thanksgiving)	
15	11/29	25	Catalytic Processes (Reforming)	11
	12/1	26	Catalytic Processes (Reforming)	11
16	12/6	27	Catalytic Processes (Hydrodesulfurization)	12
	12/8 **	28	Course Summary and Evaluation	

CHE 69700 S Statistical Methods and Modeling for Chemical Engineers

Fall 2023

Class Times: Lectures Tues and Thurs 12:00-1:15 (HAMP 1252)

Instructors: Kendall Thomson (Instructor)
Room 1152 Forney Hall
Tel: 496-6706
Office Hours: TBA
thomsonk@purdue.edu

Graduate Teaching Assistant:

Esra Ulgey eulgey@purdue.edu

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

Finance: Winter 2022-2023
Executive Master's of Business Administration
Professor Amanda M. Thompson
amthomps@purdue.edu

Overview

This course comprises a comprehensive introduction to finance. The objective of the course is to provide you with the conceptual framework necessary to appreciate and understand how to make decisions based on sound financial reasoning. Many of you may have others in the organization that 'run the numbers,' but in grasping the underlying concepts it is essential to understand the mechanics of the thought processes and get your hands dirty. At the same time, as a manager, you will need to understand the broader concepts and trade-offs involved with Finance and the course also has that goal in mind. The course will be devoted to the two basic problems that all companies face: (1) How should funds be spent (i.e., investment decisions)? and (2) How and at what cost should funds be obtained (i.e., financing decisions)?

In our first look at these concepts, we will focus on decision making based on the valuation of specific investment opportunities. To do so, we consider topics such as financial statement analysis, financial planning, stock and bond valuation, project analysis (i.e., capital budgeting), risk and return in capital markets and cost of capital. Your engagement in the material each week will begin with reading, followed by problem sets, while the videos will present more complex examples. We will also cover a detailed case for most topics in residency. Readings, case analysis, and problem sets focus on the basic tools used by financial decision makers.

The textbook is: *Corporate Finance* by Stephen Ross, Randolph Westerfield and Jeffrey Jaffe, Bradford D. Jordan. The textbook and online resources are hosted on McGraw-Hill Connect and may be reached by clicking a reading or practice assignment in Brightspace. Your product key is also available in Brightspace.

Course graded items are detailed in the separately provided excel sheet. In summary:

Grade %	Type	Description
15%	Small Group	Project Preliminary Analyses[1]
25%	Individual	Project Final Submission[1]
10%	Individual	LearnSmart Reading Questions
13%	Individual	Quizzes
15%	Individual	Midterm
12%	Team	Residency Cases
10%	Combination	Class participation

You are encouraged to work with group members on the available practice problems. Practice problems are not for credit. Quizzes and exams will be open book and open notes, but completed independently. That means you can refer to all your notes, the text, etc during the quizzes and final project. You will work in teams to complete residency assignments, but you should come to class prepared to discuss your solution independently.

[1] Please refer to detailed project specification document for more information.

Grading Policy: All assignments, readings and project submissions will receive a numeric point grade. The overall grade in the course will be based on program grading requirements. Late assignments incur a loss of 5% of the grade for each day up to a maximum penalty of 40% unless an extension is arranged for prior to the due date. For extra credit, no points will be available after the deadline.

Connect Quiz Policies:

1. Assignment will close on the due date, and be submitted as is
2. After the due date of the assignment, these questions will be available to practice/study but no points will be gained/lost during that period.
3. You may use your book and excel to solve the problems.
4. You will receive feedback 24 hrs following the due date.

Class Participation Policy:

The approach to grading individual class participation is as follows:

> At the end of each residency day, each student is scored 1 (present but not active), 2 (active), or 3(outstanding) with consideration of both the quality and quantity of each student's participation for the day. You are expected to attend every session.

What factors contribute to the overall quality of class participation?

1. Being prepared to respond to questions asked by the instructor or your colleagues.
2. Being able to support responses and submitted work. You personally should be able to explain how the group arrived at the solution.
3. Being willing and able to constructively and critically evaluate and respond to your classmates' contributions.

Peer Evaluation: At the end of the residency, submit an evaluation of each team member.

Class Schedule:

The attached excel outline gives goals of each of the topics to be covered with graded items and deadlines specified.[2] The recommended approach to the material is to 1) Read the text and handouts 2) Watch video example segments for additional guidance 3) Complete practice problems 4) Prepare deliverables as summarized below. See Brightspace for course resources, links, assignments and due dates.

Krannert and Purdue University Policies: Please see Brightspace and/or your Dropbox folder for resources and policies. These are all included herein via reference.

[2] 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 module calendar or other circumstances

MGMT 660: Operations Management
Fall 2023

Instructor

Suresh Chand
Office: Krannert 536
Phone: 765-494-4530; Email: suresh@purdue.edu

TA for the course:

Takdir; Email: ttakdir@purdue.edu

Synchronous zoom Sessions/ Office hours: Monday 8:00- 8:45 pm; Thursday 8:00 -8:45 pm, Saturday 8:00 to 8:45 pm, EST

Course Description

Operations Management is the process of organizing, planning and controlling the value adding transformation processes to meet the organization's goals. Some specific activities included in the operations function are: (i) choice of resources such as worker skills, technology, etc., and organization of resources, (ii) process execution to meet organizational goals, (iii) improving processes over time to remain competitive, (iv) managing information flows to coordinate the use of operations resources, and (v) managing inventories in supply chains.

Why is Operations Important to an Organization?

The operations function is an integral part of virtually every organization. The highly competitive nature of the global market place has brought the operations end of a business into the spotlight. The challenge now-a-days is to meet customers' diverse needs, offer value to customers and continuously improve on cost, quality, flexibility, and delivery. The shortening of product life cycles has made the ties between operations and other functional areas such as finance, marketing, accounting and human resources very important.

Course Outcomes

At the end of the course, students will be able to:

1. Consider the basic tradeoffs facing operations managers; for example, between fast delivery time and cost.
2. Be able to determine if a production system is appropriate for a firm's choice of the target market and competitive priorities.
3. Determine the capacity of a process. Understand how flowtime, flowrate and inventory are related.
4. Be able to differentiate between managing a bottleneck and managing a non-bottleneck.
5. Understand how to manage uncertainty and variability in a production/service system.
6. Determine the optimal inventory quantity and time to place an order.
7. Apply the philosophy of just-in-time manufacturing and lean thinking to improve a process.

Technical Requirements

The following information has been provided to assist you in preparing to use technology successfully.

- Internet access/connection: high speed recommended
- Headset/Microphone (if required for synchronous sessions)

Learning Resources & Texts

Optional Textbook
The Goal: A Process of ongoing Improvement, Eliyahu M. Goldratt, 2nd Edition or later

Cases/Readings (To be posted in Brightspace folder "Course Packet")
A Note on Process Analysis (UV0425)
Shouldice Hospital (HBS 683-068)
Designing, Managing, and Improving Operations (*HBS* 8012-PDF-ENG)
A Note on Process Fundamentals (by Chand and Chhajed)
Executive Shirts Case (HBS 9-696-071)
Manzana Insurance (HBS 692-015)
Benihana Simulation (HBS 7003-HTM-ENG)
Hank Kolb Director Quality Assurance (HBS)
Toyota Motor Manufacturing (HBS 693-019)
Managing Inventory (HBS 8016-PDF-ENG)
Flanders of Springfield (HBS)

Responding to Questions via Email:

I will respond to student questions as soon as I am available (generally 48 hours). Student inquiries made during the weekend may experience a delayed response time. When emailing me, please place the course number in the subject line of the email. This will help me tremendously in locating your emails quicker.

Virtual Office Hours

Every week, I will be offering three synchronous live sessions through Zoom. Students are encouraged to participate in the activity with their colleagues. For those students who are not able to attend, the sessions will be recorded and be available later.

Virtual Office Hours are a synchronous session (via Zoom) to discuss questions related to the course content, problem sets, and for case discussions. My virtual offices hours/synchronous sessions will be Monday 8:00 pm – 8:45, Thursday 8:00pm – 8:45 pm, and Saturday 8:00 – 8:45 pm. In total we will have about 20 synchronous zoom sessions. It is expected that at least one student from each study team will attend the session.

Assignments

You will have several individual and group assignments throughout the course. Details on these assignments will be posted on course website. The due dates for the assignments posted on the course website are in Eastern Standard Time (the local time zone of West Lafayette, Indiana).

Assignments Policies

Individual assignments can be discussed with others in class but the submission should be prepared (written) by you. Team assignments should not involve seeking help or giving help to anyone other than your assigned team members. For team assignments, only one submission per assignment is needed. It is the responsibility of every team member that the team assignments are submitted on time and every team member owns the content of the team submission. Please make sure to write your names on all submissions.

Late submission policies

Late submissions are not accepted. If there is a legitimate reason for delay then a late submission can be accepted with 10% penalty provided the work is submitted before we post solution key. We will target to publish solution key a submission within 2 days of its due date.

Feedback:

Timely feedback is very important for learning, and therefore, an important part of our job is to provide timely feedback to you on your work. We will use multiple channels to provide feedback. (1) We will write constructive comments on your answers while grading your work. Even if you get a full score on a question, there may be something to learn from these comments. (2) We will post solution key that you can use to compare your answer and to learn the correct answers. (3) We will also provide detailed feedback during zoom sessions. (4) We will welcome any questions you may have on our feedback and respond. Send us an email when you have questions/concerns/suggestions.

Grade Components and Weights

Submissions, Quizzes, Discussion Board, Final	Weight	
Individual Assignments	27%	7 submissions, the lowest one will be dropped, 6 best will be counted, each 4.5%
Team Assignments	25%	5 submissions, each 5%
Quizzes	10%	
Bottleneck Quiz	5%	
Discussion Board or participation in Zoom Session	3%	6 opportunities (one per week, see below), each ½%.
	You can get full score (½%) for a week by either attending one of the zoom sessions in the week or by participating in Discussion Board question of the week. We will keep track of this score separately, it will not be posted on Brightspace.	
Final Exam	30%	
Total	100%	

Krannert Grade Distribution Policy

The target grade distribution for all *core courses* is 35-40% A/A-, 50-55% B+/B's, 5-10% B-'s, 0-5% C+ or below resulting in approximately an average Grade Point Average (GPA) of 3.35 for each core course where the GPA is calculated as A = 4, A- = 3.70, B+ = 3.30, B = 3.00, B- = 2.70, C+ = 2.30, C = 2.00, C- = 1.70, D = 1.00 and F = 0.00.

Since grading is on a relative scale, there is no guarantee that earning a certain % of points will result in a certain grade.

Netiquette

You are encouraged to comment, question, or critique ideas. However, be mindful that sarcasm and humor can be easily misconstrued in online interactions. Please read the Netiquette rules for this course:

- Give other students the opportunity to join in the discussion.
- Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Keep an "open-mind" and be willing to express even your minority opinion.
- Think and edit before you share (e.g., post or email).

Course Evaluation/Feedback from you

During the last week of the course, you will be provided with an opportunity to evaluate this course and your instructor. Purdue now uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site. 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.

Academic Dishonesty

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] 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]

Emergency Statement

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 TA. You are expected to read your @purdue.edu email on a frequent basis.

Disability Statement

Students with disabilities must be registered with Disability Resource Center in the Office of the Dean of Students before accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with me as soon as possible to discuss your needs.

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. 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. 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.

Course Schedule

Week	Topic	Assignment	Due Date
1. 10/16	Introduction to Operations Management, Making Process Choice	Assignment WK1-1: Shouldice	Ind, 10/19
		Assignment WK1-2: Flow Diagram + Process Choice	Team, 10/22
2. 10/23	Process Analysis, Effect of Variability	Assignment WK2-1: WME + Executive Shirts	Team, 10/29
		Assignment WK2-2: Process Analysis Questions	Ind, 10/29
3. 10/30	Bottleneck Management, The Goal	Assignment WK3-1: Bottleneck Management	Ind, 11/5
		Assignment WK3-2: Benihana	Team, 11/5
4. 11/6	Capacity Management & Waiting Line Models, Quality Management	Assignment WK4-1: Manzana	Ind, 11/9
		Assignment WK4-2: Waiting Line problem Set	Ind, 11/12
		Assignment WK4-3: Process Example + Quality Management	Team, 11/12
5. 11/13	TPS, Inventory Management	Assignment WK5-1: Toyota	Ind, 11/16
		Assignment WK5-2: Inventory problems	Ind, 11/19
6 &7. 11/20	Inventory Control, Supply Chain Coordination, Course Review E-Beer Game Part 2 [Competition]	Assignment WK6&7-2: Beer Game Report	Team, 11/27
		Final Exam	12/2 to 12/4

Synchronous Zoom Sessions

Week	Date	Topic
Week 1: Intro and Process Choice	10/16 [M] 10/19 [TH] 10/21 [Sat]	1. About this course 2. Shouldice Hospital 3. Help Session
Week 2: Process Analysis, Variability	10/23 [M] 10/26 [TH] 10/28 [Sat]	1. Cancelled, P&T Meeting 2. Executive Shirts Case 3. Help Session
Week 3: Bottleneck, The Goal	10/30 [M] 11/2 [TH] 11/4 [Sat]	1. Clarifying Questions 2. Case discussion: The Goal 3. Help Session
Week 4: Waiting Lines, Quality Management	11/6 [M] 11/9 [TH] 11/11 [Sat]	1.?? (Likely to be out of town) 2. Case discussion: Manzana 3. E-Beer game Part 1
Week 5: Lean TPS, Inventory	11/13 [M] 11/16 [TH] 11/18 [Sat]	1. Clarifying Questions 2. Open 3. Help Problem
Weeks 6&7: Inventory Control, Newsvendor, Supply Chain Coordination, Course Review	11/20 [M] 11/23 [TH] 11/25 [Sat]	1. Clarifying Questions, 2. Thanksgiving Break 3. E-Beer Game Part 2
7. Supply Chain Coordination, Course Review	11/27 [M] 11/30 [TH]	1. Beer Game Discussion 2. Course review [Longer Session]

Note 1: Link for zoom sessions. We will use the same link for all sessions.

https://purdue-edu.zoom.us/j/5566017920

Note 2: List of topics is tentative. More details will be posted close to session times.

Submissions, Fall 2023; Tentative, subject to changes

Number	Topic	Ind/Team	Due
WK1-1	Shouldice Case	Ind	TH, 10/19
WK1-2	Flow Diagram + CoilCo	Team	Sun, 10/22
WK2-1	WME + Executive Shirts Case	Team	Sun, 10/29
WK2-2	Process Analysis Problems	Ind	Sun, 10/29
WK3-1	Bottleneck Management Problems	Ind	Sun, 11/5
WK3-2	Benihana Game	Team	Sun, 11/5
WK4-1	Manzana Case	Ind	TH, 11/9
WK4-2	Queuing problems	Ind	Sun, 11/12
WK4-3	Process Example + Quality Case	Team	Sun, 11/12
WK5-1	Toyota Case	Ind	TH, 11/16
WK5-2	Inventory Management Problems	Ind	Sun, 11/19
WK6&7-1	Newsvendor Problems	Practice	
WK6&7-2	Beer Game	Team	TH, 11/30

Purdue University
Krannert School of Management
MGMT 67000W Business Analytics
Weekend MBA Program
Fall 2023

A. Instructor: Professor Kwei Tang
Office: 209 Krannert Center
E-mail: ktang@Purdue.edu
Phone: TBA
Office Hours: We will use the (Brightspace) Discussion Forums for course content questions and email for personal matters. You can also make appointments with me.
Classroom: TBA

B. Book, Course Materials, and Software

1. Textbook: *Statistics for Business and Economics,* 15th edition by J. D. Camm, J. J. Cochran, M. J. Fry, J. W. Ohlmann, D. R. Anderson, D. J. Sweeney, and T. A. Williams, Cengage, 2024, ISBN: 978-0-357-71585-7. (SBE)
2. Class handouts – to be distributed in class
3. Supporting videos for online sessions

3. Minitab 21 (https://www.minitab.com/en-us/products/minitab/), a commercial statistics package, and Excel add-ons Solver will be used. Minitab is available on lab or Krannert Library machines. You are encouraged to use the software through Purdue Software Remote website. If you prefer having an individual copy of Minitab on your machine, a 6-month and 12-month academic rental would cost you $32.99 and $54.99, respectively (https://onthehub.com/). Minitab also offers a free trial for 30 days.

C. Course Objectives

The course emphasizes applications through the use of case analysis/data sets and presentations, and computer exercises. The focus of the course is as much on modeling and presenting solutions to business problems as on understanding statistical methods. Areas covered by the course include *descriptive statistics*, *exploratory data analysis*, *probability*, *estimation*, *hypothesis testing*, *predictive models*, *regression models*, *analysis of variance*, *simulation*, and *classification*. At the end of the course each student is expected to have:

- A good understanding of several commonly used statistical techniques in business;
- The ability to model and solve business problems using statistical methods;
- The ability to give a non-technical presentation containing solutions, obtained by statistical analysis of a data set from a business problem, to an audience of managers/decision makers;
- A good understanding of how to use statistics software.

D. Grading Policy

- Homework assignments 20 %
- Quizzes 25 %
- Team and class participation 10 %
- Final examination 45 %

METHODS OF INSTRUCTION

The course is taught as a mix of lectures, case/data set presentations, class discussions, interactive problem-solving, and computer exercises/demonstrations. Case/data set analyses illustrate applications in diverse areas of management and provide opportunities for the creative application of statistics to unstructured management problems. Homework exercises emphasize the understanding of concepts and aim to develop proficiency in translating business problems into statistical questions. Computer exercises familiarize the students with statistical software for data analysis.

YOUR ROLE IN THE COURSE

Preparation

Each student is expected to be prepared for each class, to contribute to class discussions, and to complete all assigned readings and exercises. The class will be divided into several teams. All assignments will be handed in as a team. Class and teamwork is subject to the following rules:

- if a team member does not contribute, then his/her name should not appear on the assignments handed in, and he/she must do the entire assignment and hand it in separately;

- *active participation in class discussions and teams is encouraged and is viewed as essential for clarifying difficult concepts.* Thus, each team member will evaluate his or her team members at the end of the course. Class and team participation accounts for a total of 15% of the course grade.

Proficiency in working with data and statistical modeling can be attained only through extensive practice with textbook problems and cases. We recommend that students attempt the numerous exercises in the textbook on their own. Homework and case assignments must be turned in on the specified due dates, except under extenuating circumstances. Homework and case assignments must be turned in on using Brightspace before their due time. The name of the submitted file should be HW XXX Team YYY

COURSE HONOR POLICY

We expect and encourage students to discuss readings, case materials, and the concepts covered by the course with one another. However, do not falsely represent someone else's work as if it were your own. It is further expected that students will prepare case, homework, or other assignments without the assistance or reference to students who have taken the class before, prior semester's class notes and the like.

While working individually and with your team members,

make sure that you understand, in doing homework and case assignments, the reason for choosing a particular technique, the mechanics of the solution procedure, and the implication(s) of your final solution(s) and recommendations.

DEALING WITH 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. Brightspace and my email address are ways to get information about changes in this course.

COURSE SCHEDULE

Session	Date
1	August 25: Introduction and descriptive statistics
2	August 26: Sampling and sampling distributions
3	August 28-September 3: Discrete and continuous distributions (Online)
4	September 9: Hypothesis testing
5	September 11-September 17: Estimation (Online)
6	September 23: Regression
7	September 25-October 1: SPC (Online)
8	October 7: Comparisons of two and multiple populations
9	October 8-10: Online final exam

TENTATIVE COURSE OUTLINE

Session 1 **Course Introduction**

8/25

- Data types and sources
- Descriptive versus inferential statistics
- Issues associated with data
- Minitab and Excel Solver

Descriptive Statistics

- Single Variable
  - Central tendency
  - Dispersion
  - Frequency distributions
  - Box plot and histogram
  - Bar-chart, pie-chart, etc.
- Multiple Variables
  - Association of two variables
  - Scatter Plot
  - Covariance
  - Correlation coefficient
  - Scatter plot for two continuous variables and a categorical variable

Reading

- SBE Section: 1.2-1.3, 3.1-3.5
- Handout: M670W Introduction and Review Note.pdf

Session 4 **Sampling and Sampling Distributions**

8/26

- Sampling methods
  - Convenience and judgement sampling
  - Simple random, stratified, cluster, and systematic sampling
- Sampling distributions
- Central limit theorem
- Sampling distribution for population mean
- Sampling distribution for population proportion

Reading

- SBE Section: 7.1-7.6, 7.8

Assignment

- Quiz 1 (Due 11:59 PM, September 3, Sunday)

Session 3 **Discrete and Continuous Probability Distributions**

8/28-9/3

- Discrete Probability Distribution
  - Random variable
  - Probability mass function
  - Expected value (mean)
  - Variance

  - Standard deviation
- Normal distribution
  - Mean, variance, and standard deviation
  - Probability density function (PDF)
  - Cumulative distribution function (CDF)
  - Normal inverse cumulative distribution function
  - Standard normal distribution
  - Excel functions
- *t*-distribution

Reading

- SBE Section: 5.1-5.3, 6.2, 6.3
- Handouts with Videos:
  - Video 1 Discrete Probability Distribution Note.pdf
  - Video 2 Continuous Probability Distribution Note.pdf

Assignments

- Team Assignment 1 (11:59 PM, November 6, Sunday)
- Quiz 2 (11:59 PM, September 10, Sunday)

Session 4 **Hypothesis Testing**

9/9

- Review of Normal and Sampling Distributions
- Basic concepts and procedure
- Single population/process hypothesis testing
- *p*-value

Reading

- SBE Section: 9.1, 9.2, 9.4-9.6
- Handout: Review of Normal and Sampling Distributions
- Handout: M670W Hypothesis Testing Note.pdf

Assignments

- Quiz 3 (11:59 PM, September 17, Sunday)

Session 5 **Estimation**

9/11-9/17

- Point and interval estimation
- Sample size selection
- Relationship with hypothesis testing

Reading

- SBE Section: 8.2, 8.3, 8.4
- Handouts with Videos
  - Video 5 Estimation for Population Mean Note.pdf
  - Video 6 Estimation for Population Proportion Note.pdf

Assignment

- Team Assignment 2 (Due 11:59 PM, November 20, Sunday)
- Quiz 4 (Due 11:59 PM, September 24, Sunday)

Session 6 **Regression Analysis**

9/23

- Basic concept and assumptions
- Least-squares estimation
- Partition of sum of squares
- R^2
- ANOVA
- Hypothesis testing
  - Overall test
  - Individual tests
  - Multicollinearity
- Residual analysis
- Build a regression model (variable selection)
- Indicator (dummy) variable
- Prediction and Extrapolation
- Beta calculation

Reading

- SBE Section: 14.1-14.8; 15.1-15.6
- Handout: M670W Regression I Note.pdf
- Handout: M670W Regression II Note.pdf

Assignment

- Team Assignment 3 (11:59 PM, November 27, Sunday)
- Quiz 5 (11:59 PM, October 1, Sunday)

Session 7 **Statistical Process Control**

9/25-10/1

- History of quality management
- Total quality management
- Six Sigma
- Process capability
- Seven basic tools for quality
- Process control charts for variables
- Process control charts for attributes
- Sensitizing rules

Reading

- SBE Section: 21.1, 21.2
- Handouts with Video
  - Video 7 Statistical Methods for Quality Control I Note.pdf
  - Video 8 Statistical Methods for Quality Control II Note.pdf

Assignment

- Quiz 6 (11:59 PM, October 8, Sunday)

Session 8 **Comparison of Two and Multiple Populations**

10/7

- Paired (matched) samples
- Independent samples
  - Equal variance
  - Unequal variance

- Comparison of two variances
- Comparison of two proportions
- Analysis of variance (ANOVA)
  - Partitions of sum of squares
- Overall test
- Multiple comparisons

Reading

- SBE Section: 10.2-10.4; 13.1-13.2
- Handout: M670W Comparisons of Two Populations Note.pdf
- Handout: M670W ANOVA Note.pdf