PURDUE UNIVERSITY

DAVIDSON SCHOOL
OF CHEMICAL ENGINEERING

Spring 2026

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 may not align with the Spring semester.

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

Specific Notes for Spring 2026 Courses:

1) CHE 54000 will now be taught by Prof. G. Medvedev. Prof. Won has previously taught the course and his syllabus is included in this packet.

2) The detailed syllabi for each of the 1 credit hour courses for Biotrain are available in Course Insights. These courses are CHE 59700FL, CHE 59700PDM, and CHE 59700PI.

3) CHE 59700 Energy Transition Sustainable Future – the syllabus is from the Spr 2024 offering and the faculty instructor plans to use the same or similar topics in Spr 2026.

4) Course syllabi for CHE 30600 and 34800 are at the end of the syllabi packet.

5) The syllabus for CHE 69700 Adv Modeling for Catalysis was not available at the time this packet was created. There is a syllabus from Sp 2023 in Course Insights, however for Spring 2026 there is a new instructor. Once I have an updated syllabus, I can share it with any of you that specifically want information about that course.

CHE 59700: Chemical Engineering Applications in Medical Devices

A. Instructors: William Clark, M.D. and Michelle Chutka

B. Course Description. This course provides a unique perspective to the medical device field, with emphasis on the ways in which chemical engineering processes provide the foundation for many device-related therapies. The course involves the application of several fundamental chemical engineering principles, including those related to mass transfer, separations, and fluid flow, to devices used for extracorporeal therapies and other treatments. The first part of the course addresses the relevant physiology and pathophysiology serving as a foundation for subsequent clinical material. With the focus on extracorporeal devices, the interactions between blood and biomaterials in a general sense are also explored. The second part of the course assesses the extracorporeal treatment of kidney failure by dialysis, which is highlighted as the only long-term, device-based replacement therapy for terminal organ failure (end-stage renal disease). This analysis will not only consider the evolution of dialysis therapy from a technology perspective (with emphasis on fundamental chemical engineering principles) but also the forces that have shaped its development into a market generating annual revenue of nearly $100 billion on a global basis. The third segment of the course addresses industry-focused concepts pertaining to medical device development, including the role of the chemical engineer in design verification and validation activities, process validations including IQ/OQ/PQ, risk analysis, lean manufacturing concepts, and project management in an increasingly complex regulatory environment. Providing a real-world perspective based on over 15 years of experience in the medical device field, Ms. Michelle Chutka (Director of Product Engineering, Cook Biotech, Inc; Continuing Lecturer, Davidson School of Chemical Engineering, Purdue University) will lead this third part of the course.

C. 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. During this time, he applied engineering principles to gain expertise in two broad areas, namely extracorporeal membrane structure/function and solute kinetics during dialysis. Dr. Clark continues to serve as a consultant in the dialysis industry.

Ms. Chutka is a chemical engineer by training with both B.S and M.S degrees from the University of Michigan. For the past 17 years, she has held roles of increasing responsibility at Cook Biotech, a medical device company based in West Lafayette, IN. In her current position as Director of Product Engineering, Ms. Chutka oversees the product engineering team, responsible for both upstream and discovery work, all aspects of product development through regulatory approval and commercialization, along with sustaining engineering for all aspects of the medical device's product lifecycle. Outside of medical device experience, Ms. Chutka has also worked in the pharmaceutical industry and abroad within the automotive industry.

D. Prerequisites. CHE 37700 (or equivalent) and BIOL 23000 (or BCHM 30700). These are not strict requirements - interested students should contact Dr. Clark with inquiries.

E. Recommended (NOT REQUIRED) Texts.

- *Guyton and Hall Textbook of Medical Physiology*, Edited by John E. Hall, Elsevier, 2016, ISBN: 978-1-4557-7005-2
- *Medical Device Development*, Edited by Jonathan S. Kahan, Barnett International, 2009, ISBN: 1-882615-92-1
- *Biomaterials Science: An Introduction to Materials in Medicine*, Edited by Buddy Ratner, Allan Hoffman, Frederick Schoen, Jack Lemons, Elsevier, 2012, ISBN: 978-0-12-374626-99

F. Course Learning Outcomes

- Assess the mechanisms of blood-surface interactions defining the biocompatibility of an extracorporeal device

- Evaluate the influence of extracorporeal membrane structure and material on transport properties (diffusion, convection, and ultrafiltration) and the overall effect on device performance

- Based on a mass balance approach, analyze device-related and patient-related (physiologic) parameters required for kinetic modeling of different dialysis therapies

- Apply fundamental chemical engineering principles to provide a quantitative basis for treatments of specific clinical disorders, including end-stage renal disease (ESRD), acute kidney injury (AKI), sepsis, cardiac failure, and respiratory failure

- Characterize the major components of a medical device company and the manner in which these different functions interact during the pre-market and post-market phases of product development

- From the perspective of a chemical engineer working in the medical device field, understand how the principles of project management, verification/validation, process validation, risk analysis, and lean manufacturing pertain to product development and the regulatory approval process.

G. Course Meeting Schedule

Lectures: Tues/Thurs 3:00-4:15 PM
Homework 1: due February 5
Homework 2: due February 26
Homework 3: due April 1
Homework 4: due April 22
Presentation 1: Feb 29 (8-10 PM)
Presentation 2: April 15 (8-10 PM)
Final Report due: April 28

Early in the semester, students will assemble into groups of 3 and choose a medical device-based clinical therapy 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
Professor Michelle Chutka - Email: mchutka@purdue.edu

Office Hours: by appointment

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

Homework (4): 5% each = 20% total
Presentations (2): 20% each = 40% total
Final report: 40%

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 an B–). Marks of an A– will not be given.

Group projects

Student groups may assess a medical device-based therapy from a suggested list prepared by Professor Clark or choose one on their own. 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 disease state(s) for which the technology is used, its historical development and evolution, the engineering principles underlying its use, the clinical challenges associated with the device, and potentially improved designs for the future. Requirements for the presentations during the semester and the final written summary will be provided early in the semester.

J. Class Schedule.

- January 9: Introduction
- January 11: Physiology overview (I)
- January 16: Physiology overview (I)
- January 18: Physiology overview (III)
- January 23: Interactions of blood with biomaterials (I)
- January 25: Interactions of blood with biomaterials (II)
- January 30: Kidney structure/function
- February 1: Normal kidney function
- February 6: Chronic kidney disease (CKD) and end-stage renal disease (ESRD)
- February 8: Uremic toxins: Chemical structure and clinical relevance
- February 13: Hemodialysis membrane properties
- February 15: Hemodialysis mass transfer
- February 20: Hemodialysis dose: Mass balance principles
- February 22: Extracorporeal therapy for AKI
- February 27: New device approaches for ESRD and AKI
- February 29: Extracorporeal therapies beyond renal failure
- **February 29 (8-10 PM): Presentation #1**
- March 5: No class
- March 7: No class
- March 12: Spring Break
- March 14: Spring Break
- March 19: Drug/device combinations*
- March 21: Wearable devices*
- March 26: Vascular access for dialysis
- March 28: Medical device regulation and clinical trials (I)
- April 2: Medical device regulation and clinical trials (II)
- April 4: Medical device market dynamics
- April 9: Medical device product development: Design verification/validation (I)
- April 11: Medical device product development: Design verification/validation (II)
- **April 15 (8-10 PM): Presentation #2**
- April 16: Medical device product development: Process Validation (I)
- April 18: Medical device product development: Process Validation (II)
- April 23: Applying risk analysis to device design (I)
- April 25: Lean manufacturing in the medical device industry, project management & regulatory strategy

*: guest lecture

K. Consulting with the Instructor. I encourage you to discuss academic or personal questions with me during my office hours or via email. These discussions need not be limited to CHE 59700 content.

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

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

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

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

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

Q. Bereavement Policy. Purdue recognizes that a time of bereavement is very difficult for a student. The University therefore provides rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS): http://www.purdue.edu/odos/services/griefabsencepolicyforstudents.php. Students who find

themselves in need of assistance in a time of bereavement should contact Professor Clark privately to discuss specific needs.

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

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

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

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

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

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

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

CHE 540 Spring 2025

INTRODUCTORY TRANSPORT PHENOMENA

Instructor: Professor You-Yeon Won, Room 2031, Forney Hall (FRNY)
Telephone: 765-494-4077, Email: yywon@purdue.edu
Office Hour: M, 17:00 – 18:00, F, 10:30 – 11:30

Classes: M, W, F, 14:30 – 15:20, HAMP 1252

Teaching Assistant: Gautam Khare, Room 1008, FRNY
Email: gkhare@purdue.edu
TA Hours: M, T, 16:00 – 17:00, FRNY 3062A

Textbook: R. B. Bird, W. E. Stewart, E. N. Lightfoot, and D. J. Klingenberg
Introductory Transport Phenomena,
1st Edition, Wiley, 2014.

Course Objectives:

1. Develop a unified understanding of momentum, heat and mass transport phenomena, and apply this understanding to solve problems of practical importance in chemical engineering and allied fields.
2. Gain insight into current topics in the field of transport phenomena (refer to the guidelines for the term project, which include a contemporary literature review and presentation, for details).

Course Organization: There will be 36 lectures, two evening exams, and a final exam. Part of the lecture may be devoted to help session and problem solving.

Course Prerequisites: Passing grades in CHE 377 (Momentum Transfer) and CHE 378 (Heat & Mass Transfer) or equivalents.

Attendance: Attendance is required. Unexcused absences may be detrimental to your performance and grade. Missing more than eight (8) lectures without advance permission or a valid excuse will yield a failing grade (F) in the course. Absences must be excused in advance, for documented family, medical, or professional reasons.

Homework: There will be 6 homework sets, typically due (one to) two weeks after assigned. Homework problems will mostly be due every other Wednesdays before class. On each homework assignment, students are required to do all problems, and the assigned problems will be graded and returned. Answers will be posted on Brightspace. Homework must be submitted on time. Please mark your name, date, homework set number, page numbers, and total number of pages submitted. Please write neatly in black and on one side of the page only. The grade will be determined

by correctness, precision, and styles. In problem solutions, be sure to identify by numbers any figures or equations taken from the text. Be sure to put all the assumptions in one place so that they can be reviewed. Use schematics for describing the physical systems being considered, and label important variables. Indicate the control volumes in the schematics if appropriate, and be sure to identify relevant processes associated with control volumes.

Professional ethics mandates that you work your answers independently, unless directed otherwise. Names of all coauthors must be disclosed. Requests for re-grading must be made in writing and within a week after the homeworks are handed back.

Examinations: There will be no make-up exams. Every exam will be comprehensive, with some possible emphasis on the more recent material. Exams will be in two parts: (A) closed-book-and–notes, and (B) open-book-and-closed-notes. Exams will cover comprehension questions (definitions, derivations, concepts, etc.) and problems requiring derivations and numerical answers.

Quizzes: There might be unannounced quizzes. No make-up quizzes will be given.

Grades: Grades will be determined from homework, 10%; quizzes/class participation/oral presentation 15%; Exam #1, 20%; Exam #2, 20%; and Final Exam, 35%. The final grades will be assigned based primarily on absolute performance criteria. For every unexcused absence, grade will be reduced by 2% of the total grade. This course will use a +/- grading system.

Unethical Conduct: Any activity in which a student seeks credit for work performed in the unjust manner (or helps another student to do so) constitutes cheating. This includes falsifying class attendance records, using aides during exams and quizzes, and working together (or doing work in the name of another student) on exams, quizzes and homework submissions. Students caught cheating will be prosecuted to the maximum extent possible under Purdue University guidelines. Punitive actions will include at minimum reduction of course grade but may include expulsion from the University.

Campus Emergency: In the event of a major campus emergency (e.g., an influenza epidemic), 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 e-mail.

Suggestions for Succeeding in This Course: Come to class, and come to class prepared. Read the assigned chapter of the textbook before class. Review your lecture notes within 24 hours after the class; this is the most important step toward enhancing your course performance. Without review, you will forget most of what you heard by the next day. Identify points that you have difficulty with. Discuss these points with your classmates, and ask the professor or TA for an explanation. If you have done all these

things, you should already find it easier (and more fun) to do homework. As far as exams are concerned, understanding the material is essential but not sufficient for success. Practicing with problems is the key; do as many problems as possible.

Oral Presentation:

All students are required to give an oral presentation in front of the class on a recent paper published in the literature since 2015. The presentations will be given in teams of three students. Each talk will be composed of a 10-minute presentation and 2 – 3 minutes of question and answer afterwards; questions will be asked by the audience. A PowerPoint presentation is the suggested 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 names, journal information (name, volume/issue/page numbers, year of publication) and abstract of the paper. The choice of paper should be approved by the instructor no later than Friday 4/4/2025. The main subject of the paper should be relevant to the topics of this course. The following are some of the examples of recommended journals from which you choose an article: Science, Nature, Nature Physics, Langmuir, Soft Matter, Physical Review Letters, AIChE Journal, Journal of Fluid Mechanics, Journal of Rheology, Proceedings of the National Academy of Sciences, etc. You are required to submit an electronic copy (in the PowerPoint format) of your presentation in its FINAL form by 11:59 PM on the night before the scheduled date of your presentation. When you submit your presentation file, please use the following format for the filename: "CHE 540 Presentation [Your Team Number, e.g., Team 1].pptx". The presentations will be scheduled in the weeks of 4/21 and 4/28. The grades will be given based on the choice of paper (i.e., relevance, quality, and potential impact), clarity of presentation, depth of understanding, and ability to answer questions.

Tentative Outline: (Subject to changes)

Lecture #	**Date**	**Topics**	**Reading assignments from the textbook (homework dues)**
1	01/13/25	Introduction	Ch. 0 (hw1 assigned)
2	01/15/25	Viscosity, momentum flux vector	Ch. 1
3	01/17/25	Viscosity, momentum flux vector	Ch. 1
	01/20/25	No class (MLK Day)	
4	01/22/25	Shell momentum balances, velocity distributions	Ch. 2
5	01/24/25	Shell momentum balances, velocity distributions	Ch. 2
6	01/27/25	Equations of change (isothermal)	Ch. 3
7	01/29/25	Equations of change (isothermal)	Ch. 3 (hw1 due; hw2 assigned)
8	01/31/25	Equations of change (isothermal)	Ch. 3
9	02/03/25	Turbulent momentum transport	Ch. 4

10	02/05/25	Turbulent momentum transport	Ch. 4
11	02/07/25	Dimensional analysis of momentum transport	Ch. 5
12	02/10/25	Dimensional analysis of momentum transport	Ch. 5
13	02/12/25	Review	(hw2 due)
	02/14/25	**Exam #1** (in-class)	
14	02/17/25	Friction factors, use of empirical correlations	Ch. 6 (hw3 assigned)
15	02/19/25	Friction factors, use of empirical correlations	Ch. 6
16	02/21/25	Macroscopic isothermal energy balances	Ch. 7
17	02/24/25	Thermal conductivity, heat flux vector	Ch. 9
18	02/26/25	Shell energy balances, temperature distributions	Ch. 10 (hw3 due; hw4 assigned)
19	02/28/25	Shell energy balances, temperature distributions	Ch. 10
20	03/03/25	Shell energy balances, temperature distributions	Ch. 10
21	03/05/25	Equations of change (non-isothermal)	Ch. 11
22	03/07/25	Equations of change (non-isothermal)	Ch. 11
23	03/10/25	Turbulent energy transport	Ch. 12
24	03/12/25	Review	(hw4 due)
	03/14/25	**Exam #2** (in-class)	
	03/17/25	No class (Spring Break)	
	03/19/25	No class (Spring Break)	
	03/21/25	No class (Spring Break)	
25	03/24/25	Turbulent energy transport	Ch. 12 (hw5 assigned)
26	03/26/25	Dimensional analysis of energy transport	Ch. 13
27	03/28/25	Dimensional analysis of energy transport	Ch. 13
28	03/31/25	Heat transfer coefficients, use of empirical correlations	Ch. 14
29	04/02/25	Heat transfer coefficients, use of empirical correlations	Ch. 14
30	04/04/25	Macroscopic non-isothermal energy balances	Ch. 15 (paper selection due)
31	04/07/25	Diffusivity, mass flux vector (lecture by TA)	Ch. 17
32	04/09/25	Diffusivity, mass flux vector (lecture by TA)	Ch. 17 (hw5 due; hw6 assigned)
33	04/11/25	Shell mass balances, concentration distributions	Ch. 18
34	04/14/25	Shell mass balances, concentration distributions	Ch. 18
35	04/16/25	Equations of change (binary mixtures)	Ch. 19

36	04/18/25	Equations of change (binary mixtures)	Ch. 19
	04/21/25	Student presentations	
	04/23/25	Student presentations	
	04/25/25	Student presentations	(hw6 due)
	04/28/25	Student presentations	
	04/30/25	Student presentations	
	05/02/25	Student presentations	
		Final exam (comprehensive, schedule TBA)	

01/12/2025

CHE 597: Computational Optimization, Spring 2025

Instructor: Can Li
Email: canli@purdue.edu
Classroom: Hampton Hall of Civil Engineering, Room 2102
Time: Tuesday and Thursday, 4:30 pm - 5:45 pm
Office: Forney Hall of Chemical Engineering, Room G027A
Office Hours: Wednesday, 5 pm - 6 pm
Make-up lecture classroom Max W and Maileen Brown Family Hall (BHEE) 236
Make-up lecture time Monday, Wednesday, 4:30 pm - 5:45 pm

Course Description:

This is a graduate-level introductory course to mathematical optimization. We will cover the theory and algorithms of linear programming, mixed-integer linear/nonlinear programming, conic programming, global optimization of nonconvex problems, and decomposition algorithms for mixed-integer programs. We will motivate the algorithms using modern applications in chemical engineering, transportation, energy systems, machine learning, and control.

The course lectures will be 30% proofs, 50% algorithms and computation, and 20% modeling and applications in engineering. The homework will keep a similar portion. However, we will not have proofs in the exams since this is a class targeted at engineering students.

Previous Offerings:

Previous offerings of the courses can be found below.

- Spring 2024 (/courses_2024Spring.html)

Syllabus

Date	Topic	Slides	Homework
Tue Jan 14	Introduction to Course	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%201/Lecture_1_Intro_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%201/Lecture_1_Intro_ipad.pdf)	HW1 (https:/ Computatio
Tue Jan 21	Linear Algebra and Calculus Review	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Linear%20Algebra%20and%20Calculus/Recitation__Linear_Algebra_and_Calculus_Review_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Linear%20Algebra%20and%20Calculus/Recitation__Linear_Algebra_and_Calculus_Review_ipad.pdf)	
Wed Jan 22	Convex sets, functions	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%202/Lecture_2_convex_sets_and_functions_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%202/Lecture_2_convex_sets_and_functions_ipad.pdf)	
Mon Jan 27	Unconstrained optimization	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%203/Lecture_3_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%203/Lecture_3_ipad.pdf)	HW2 (https:/ Computatio
Tue Jan 29	Linear Programming Applications	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%204/Lecture_4_Linear_Programming_Applications_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%204/Lecture_4_Linear_Programming_Applications_ipad.pdf)	
Thu Jan 30	Polyhedron Theory	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%205/Lecture_5_Polyhedron_Theory_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%205/Lecture_5_Polyhedron_Theory_ipad.pdf)	HW3 (https:/ Computatio
Tue Feb 4	Simplex Algorithm	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%206/Lecture_6_Simplex_Algorithm_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%206/Lecture_6_Simplex_Algorithm_ipad.pdf)	
Thu Feb 6	Linear Programming Duality	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%207/Lecture_7_Linear_Programming_Duality_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%207/Lecture_7_Linear_Programming_Duality_ipad.pdf)	HW4 (https:/ Computatio
Tue Feb 11	Conic Programming	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%208/Lecture_8_Conic_Programming_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%208/Lecture_8_Conic_Programming_ipad.pdf)	
Thu Feb 13	Langrangian Dual and Optimality Conditions	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%209/Lecture_9_Langrangian_Dual_and_Optimality_Conditions_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%209/Lecture_9_Langrangian_Dual_and_Optimality_Conditions_ipad.pdf)	HW5 (https:/ Computatio

Date	Topic	Slides	Homework
Tue Feb 18	Nonlinear Programming Algorithms	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2010/Lecture_10_Nonlinear_Programming_Algorithms_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2010/Lecture_10_Nonlinear_Programming_Algorithms_ipad.pdf)	
Thu Feb 20	Modeling of Discrete and Continuous Decisions	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2011/Lecture_11_Modeling_of_Discrete_and_Continuous_Decisions_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2011/Lecture_11_Modeling_of_Discrete_and_Continuous_Decisions_ipad.pdf)	HW6 (https:/ Computatio
Tue Feb 25	Formulating Mixed-Integer Linear Programming Models	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2012/Lecture_12_Formulating_Mixed_Integer_Linear_Programming_Models_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2012/Lecture_12_Formulating_Mixed_Integer_Linear_Programming_Models_ipad.pdf)	
Thu Feb 27	Mixed-Integer Linear Programming Applications	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2013/Lecture_13_Mixed_Integer_Linear_Programming_Applications_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2013/Lecture_13_Mixed_Integer_Linear_Programming_Applications_ipad.pdf)	HW7 (https:/ Computatio
Tue March 4	Branch and Bound	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2014/Lecture_14_Branch_and_Bound_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2014/Lecture_14_Branch_and_Bound_ipad.pdf)	
Thu March 6	Cutting Planes	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2015/Lecture_15_Cutting_Planes_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2015/Lecture_15_Cutting_Planes_ipad.pdf)	
Tue March 25	MIP Solvers	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2016/Lecture_16_MIP_Solvers_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2016/Lecture_16_MIP_Solvers_ipad.pdf)	
Tue April 1	Nonconvex Optimization Applications	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2017/Lecture_17_Nonconvex_Optimization_Applications_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2017/Lecture_17_Nonconvex_Optimization_Applications_ipad.pdf)	HW8 (https:/ Computatio
Thu April 3	Convex Relaxations	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2018/Lecture_18_Convex_Relaxations_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2017/Lecture_18_Convex_Relaxations_ipad.pdf)	
Tue April 8	Branch and Reduce	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2019/Lecture_19_Branch_and_Reduce_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2019/Lecture_19_Branch_and_Reduce_ipad.pdf)	HW9 (https:/ Computatio Optimizatio
Thu April 10	Decomposition Algorithms for MINLP	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2020/Lecture_20_Decomposition_Algorithms_for_MINLP_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2020/Lecture_20_Decomposition_Algorithms_for_MINLP_ipad.pdf)	
Tue April 15	Stochastic Programming and Benders Decomposition	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2021/Lecture_21_Stochastic_Programming_and_Benders_Decomposition_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2021/Lecture_21_Stochastic_Programming_and_Benders_Decomposition_ipad.pdf)	HW10 (https Computatio
Thu Apr 17	Column Generation and Dantzig Wolfe Decomposition	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2022/Lecture_22_Column_Generation_and_Dantzig_Wolfe_Decomposition_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2022/Lecture_22_Column_Generation_and_Dantzig_Wolfe_Decomposition_ipad.pdf)	
Tue Apr 22	Lagrangian Relaxation and Decomposition	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2023/Lecture_23_Lagrangian_Relaxation_and_Decomposition_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2023/Lecture_23_Lagrangian_Relaxation_and_Decomposition_ipad.pdf)	HW 11 (https Computatio
Thu Apr 24	Augmented Lagrangian and ADMM	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2024/Lecture_24_Augmented_Lagrangian_and_ADMM_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2024/Lecture_24_Augmented_Lagrangian_and_ADMM_ipad.pdf)	HW 12 (https Computatio
Tue Apr 29	Bilevel Optimization	slides (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2025/Lecture_25_Bilevel_Optimization_slides.pdf) ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Lecture%2025/Lecture_25_Bilevel_Optimization_ipad.pdf)	

Date	Topic	Slides	Homework
Thu May 1	Final Review	ipad (https://github.com/li-group/ChE-597-Computational-Optimization/blob/main/Practice%20Exam%202/Practice_Exam_2_ChE_597_2024_Spring_soln.pdf)	

Recommended Textbooks:

This class will not exactly follow any textbook. But we may cover some of the content in the following textbooks.

1. Grossmann, I. E. (2021). Advanced optimization for process systems engineering. Cambridge University Press.
2. Wolsey, L. A. (2020). Integer programming. John Wiley & Sons.
3. Bertsimas, D., & Tsitsiklis, J. N. (1997). Introduction to linear optimization. Belmont, MA: Athena scientific.
4. Ben-Tal, A., & Nemirovski, A. (2001). Lectures on modern convex optimization: analysis, algorithms, and engineering applications. Society for industrial and applied mathematics.
5. Conforti, M., Cornuéjols, G., Zambelli, G (2014). Integer programming. Graduate Texts in Mathematics
6. Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization. Cambridge university press.
7. Tawarmalani, M., & Sahinidis, N. V. (2013). Convexification and global optimization in continuous and mixed-integer nonlinear programming: theory, algorithms, software, and applications (Vol. 65). Springer Science & Business Media.
8. Horst, R., & Tuy, H. (2013). Global optimization: Deterministic approaches. Springer Science & Business Media.

Software

We will use the following software

- Pyomo (https://www.pyomo.org/) is a collection of Python software packages for formulating optimization models. Tutorial: ND Pyomo Cookbook (https://jckantor.github.io/ND-Pyomo-Cookbook/README.html)
- Gurobi (https://www.gurobi.com/documentation/) and Cplex (https://www.ibm.com/products/ilog-cplex-optimization-studio) are both high-performance mathematical programming solver for linear programming, mixed integer programming, and quadratic programming.
- Mosek (https://www.mosek.com/) is a software package for the solution of linear, mixed-integer linear, quadratic, mixed-integer quadratic, quadratically constraint, conic and convex nonlinear mathematical optimization problems.

Prerequisite

Some familiarity with linear algebra, calculus, and programming in python is required.

- YouTube videos review of linear algebra and calculus by 3Blue1Brown (https://www.youtube.com/@3blue1brown/courses)
- Linear algebra review (https://www.cs.cmu.edu/~zkolter/course/linalg/index.html) videos by Zico Kolter
- General mathematical review: Appendix A of Boyd and Vandenberghe (2004) (https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf)

Related courses

- Convex optimization (https://www.stat.cmu.edu/~ryantibs/convexopt/) by Ryan Tibshirani
- Convex analysis (https://ocw.mit.edu/courses/6-253-convex-analysis-and-optimization-spring-2012/pages/syllabus/) by Dimitri Bertsekas
- Linear programming (https://www2.isye.gatech.edu/~sdey30/CourseLinearProgramming.html) by Santanu Dey
- Integer programming (https://coral.ise.lehigh.edu/~ted/teaching/ie418/) by Ted Ralphs
- Linear and convex optimization classes (https://www2.isye.gatech.edu/~nemirovs/) by Arkadi Nemirovski

Site made with Jekyll (https://jekyllrb.com), following a template made available by Allan Lab (https://www.allanlab.org/aboutwebsite.html)

We are part of the Davidson School of Chemical Engineering (https://engineering.purdue.edu/ChE) at Purdue University (https://www.purdue.edu/).

Contact:
Purdue University
610 Purdue Mall
West Lafayette
IN, 47907, USA
(Maps (https://goo.gl/maps/37FPbUkUgS59Xnec9))

Follow us:
(https://twitter.com/Can__Li) (https://scholar.google.com/citations?user=EkwNNlAAAAAJ&hl=en) (https://www.linkedin.com/in/can-li-b36647a4/) (https://github.com/li-group) (https://www.youtube.com/channel/UCxuFcGhbr50bVaDPo4CECbA)

Crystallization Systems Engineering

Aim

To provide an introduction to advanced concepts of crystallization process engineering, including crystallization mechanisms, multicomponent crystallization and crystallization in impure media, as well as population balance modeling, model-based dynamic optimization and control, process analytical technology (PAT) and chemometrics and quality-by-design techniques. Introduce students in approaches and tools for the mathematical modeling and control of crystallization systems and to provide hands on experience with simulation software packages as well as a variety of PAT technologies.

Learning Outcomes

On completion of the training, the students are expected to be able to:

- Understand the fundamentals of crystallization thermodynamics and kinetics.
- Understand key concepts of crystallization technologies and control approaches
- Understand key differences between batch and continuous crystallization technologies
- Understand the key features and develop practical experience in the use of process analytical technologies such as ATR-UV/Vis, FBRM, Raman and Image analysis for monitoring crystallization processes
- Understand the main numerical solution techniques for population balance models
- Use commercial simulation tools (CrySiV) as well as implement in Matlab/Python/PharmaPy to simulate crystallization processes and apply direct numerical optimization techniques for optimal control, model predictive control and parameter estimation
- Formulate mathematical models, develop dynamic simulations and optimization as well as parameter estimation based on experimental data for batch and continuous crystallization processes using dedicated simulation software packages.
- Industrial case studies of crystallization process development delivered by a series of industrial guest lecturers.

Content

Particulate crystal characteristics; crystal size distribution, shape, purity, polymorphism. Crystallization mechanisms, nucleation, growth, breakage, agglomeration, effect of additives on growth and nucleation. Description of phase diagram and supersaturation. Analysis and conceptual design of crystallization processes in the phase diagram. Multicomponent crystallization and phase diagrams. Crystallization technologies (cooling, antisolvent, reactive, evaporative, membrane, microfluidic, melt, etc.). Overview of batch and continuous crystallization technologies and unit operations. Fluid dynamics in solid-liquid systems, scale-up. Crystallization in high share.

Process analytical technologies, quality-by-design and design space. Presentation of key process analytical tools used for monitoring and control of crystallizations processes (FBRM, ATR-UV/Vis/FTIR, Raman, ultrasound, image analysis based approaches, acoustic monitoring), and calibration procedures. Signal processing, sensor integration and crystallization process informatics system.

Model-free design and control approaches. Supersaturation control, direct design and direct nucleation control and applications.

Model-based optimization and control approaches. Population balance modeling (one- and multidimensional), with solution approaches (method of moments, quadrature method of moment, method of classes, finite difference, method of characteristics). PBM for modeling CSD, shape distribution and polymorphic transformation. Dynamic modeling of batch and continuous (batch and plug flow) crystallization systems. Dynamic optimization and optimal control using direct numerical optimization (control vector parameterization, simultaneous strategies and multiple shooting). Parameter estimation, and robust optimization. State and parameter estimation and nonlinear model predictive control for crystallization processes. Applications to batch, continuous mixed suspension mixed product removal (MSMPR), cascade of MSMPR and plug flow crystallization processes.

Industrial case studies for crystallization development delivered by a series of industrial guest lecturers.

Simulation studies using Matlab/Python (PharmaPy), and CrySiV. Industrial case studies.

Delivery-mode:

Lecture (L), Computing Laboratory (CL), Practical Study Observation (PSO) and laboratory demonstration session.

Assessment:

- Assignment 1 (group) 25%: Short paper based on laboratory experiment.
- Assignment 2 (individual) 25%: Short paper based on simulation exercise.
- Assignment 3 (individual) 25%: Digital design project.
- Assignment 4 (individual) 25%: Set of HW assignments

Recommended readings:

1. R. Davey, J Garside, From Molecules to Crystallizers. An Introduction to Crystallization, Oxford Science Publications, 2000.
2. J.M. Mullin, Crystallization, 4th Ed., Elsevier, 2001.
3. A. Randolf, M. Larson, Theory of Particulate Processes, Analysis and Techniques of Continuous Crystallization, Academic Press, 1971

Spring 2024 CISTAR course: Energy Transition to a Sustainable Future

The CISTAR course – Energy Transition to a Sustainable Future – will be offered virtually with four CISTAR Universities in the Spring of 2022. It will be offered as a 3 credit (semester basis) hr course (or equivalent). The course is targeted at entering graduate students, but advanced undergraduates may also enroll in the class.

Instructors:

Joan Brennecke	University of Texas at Austin	jfb@che.utexas.edu
Abhaya Datye	University of New Mexico	datye@unm.edu
Jeff Miller	Purdue University	mill1194@purdue.edu
Ruilan Guo	University of Notre Dame	rguo@nd.edu

Time:

MW 4:30-5:45p Eastern (PU and ND)

MW 3:30-4:45p Central (UTA)

MW 2:30-3:45p Mountain (UNM)

Short description:

A survey course on all aspects of the transition from fossil fuels to more sustainable energy resources. This will include an understanding of 1) current energy production and use, 2) the importance of light hydrocarbons as a bridge to a net-zero carbon economy, 3) the environmental implications of energy production and storage, 4) carbon capture, sequestration and conversion, 5) the role that electrification plays in the transition, and 6) sources of low-CO_2 footprint energy necessary to achieve a sustainable energy future.

Learning Objectives:

1. Understand the historical, current and potential future roles that hydrocarbons play in the economy for energy, fuels, and materials.
2. Understand the environmental impact (environmental, health, legal, social) of various aspects of energy production and use.
3. Understand the methods for carbon capture, storage and conversion to meet future environmental CO_2 reductions.
4. Understand the options for decarbonization of energy production.

Class Schedule: We are currently confirming the guest lectures who we leading experts on these topics. At the end of the semesters, student teams (4 students each) will submit a written report and give a 20 min lecture on a topic of their choosing.

*** Home Work:**

HW 1 Students select projects of most interest

HW 2 Team formation and information exchange

HW 3 Literature Citations due (minimum 15)

HW 4 Outline of report content due

HW 5 Draft Report due (10 pages)

1 week after draft report: Draft report feedback

Grading

- **Exam (40%):**

  Multiple choice

- **Homework/Class Participation (10%)**

  Report outline, draft report

- **Written Final Project Report (25%):** 10 pages
- **Oral Final Project Report (25%):** 25 min + 12 min Q&A

Purdue University
Davidson School of Chemical Engineering

ChE 597: Data Science in Chemical Engineering – Spring 2025

Instructor **Professor David E. Bernal Neira**
Office: FRNY G027C
Email: dbernaln@purdue.edu
Office Hours: Will be organized online or in person by appointment

Please start all email communication subject line with "CHE597" (Capital letter, No space).
If you do not start the subject line with this, your email may get missed and not get answered.

Schedule:

- **Lectures:** Regular in-person class
  10:30 am - 11:45 am, Tuesdays and Thursdays | Helen B. Schleman Hall, Room 302 | Jan 14th- May 1st, 2025
- Lectures will generally be in-person, with a few online or recorded lectures during the semester. For the schedule of topics, see the table at the end of the syllabus.

Supplemental Texts (optional):

"Machine Learning: A Probabilistic Perspective" (The latest version is partially online)
K. P. Murphy; MIT Press, 2012
A comprehensive textbook with many advanced topics. All applicable algorithms are derived or discussed in the general context of probability theory.

"Dive Into Deep Learning" (https://d2l.ai)
A Zhang et al., Online
Excellent online textbook for deep learning. In browser executable code snippets and examples of common architectures

"The Elements of Statistical Learning" (Online)
T. Hastie, R. Tibshirani, J. Friedman; Springer, 2017
A comprehensive text with derivation and statistical treatment and many standard algorithms. Covers similar ground to Murphy, but many topics have complementary treatment.

"Python Machine Learning"
S. Raschka, V. Mirjalili; Packt Publishing, 2017
A beginner text with lots of python examples.

"Introductory Lectures on Convex Optimization"
Y. Nesterov; Springer, 2004
A classic text by a central figure in numerical optimization.

http://neuralnetworksanddeeplearning.com/

Additional Course Materials
A set of PowerPoint slides and Jupyter notebooks covering the lecture materials will be made available online. These will be useful for preparation for the exams.

Objectives
This course intends to present data analysis and machine learning from a practical perspective focused on applications, use cases, and the limitations of various approaches to problems in chemical engineering. The focus is on learning by doing, with theoretical material supplemented by concrete coding examples and programming-based homework.
Keeping in mind that most students in this class have limited programming experience, there will be a rapid 1-week review of the python programming language at the start of the course. This introduction will be critical for students with limited programming experience to get familiar with the language and to be successful in the remainder of the course. Python will be used throughout the course so that these skills will be reinforced throughout the semester through in-class examples and homework.
Course material is divided approximately equally between (i) general topics in data science and machine learning and (ii) specific machine learning methods, their applications, and limitations. The material covered in the first half will thus be revisited and reinforced in the context of specific modeling problems in the second half of the semester. When discussing specific machine-learning models, lectures will typically be broken into a theoretical component followed by a practical implementation component to give students both a general understanding and an opportunity to see concrete applications and coded examples. Given the short time available to cover this large topic, we can only cover a subset of the most popular and/or illustrative machine learning methods in depth. To supplement this limited scope, the course will conclude with a survey of contemporary topics in machine learning that will be provided through student presentations on topics selected in consultation with the instructor.

Grading
Final grades will be based on a group presentation (further described below) and homework. Homework will be assigned approximately weekly in the form of Jupyter Python notebooks and datasets uploaded to BrightSpace. Students will need to use a Jupyter client, like Anaconda, Google Colab, or Purdue Scholar, to complete these assignments (these options are reviewed on the first day of class). Completed assignments will be uploaded to BrightSpace and graded by the instructor. Homework constitutes an important part of the course and should be done conscientiously.

NO LATE HOMEWORK WILL BE ACCEPTED.

The final course grade will be weighted as follows:

Presentations/Projects	25 points
Weekly Homework	75 points
TOTAL	100 points

In the event that the University closes for a period of time during the semester (e.g., due to an outbreak or other unforeseen disaster), we will attempt to continue ChE 597 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 expect that each student will stay connected via your Purdue email account.

Academic Honesty
Group discussions concerning homework are encouraged since the sharing of ideas is an excellent way to learn. However, *you need to write your own Jupyter notebooks to submit to BrightSpace.*

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 that is submitted, the greater the opportunity for the university to investigate the concern.
The highest standards of Academic Honesty are expected in CHE 597. Any participation in an academically dishonest practice, such as copying on work, etc., will result in an F in CHE 597, and your case will be forwarded to the Dean of Students for appropriate disciplinary action.

Artificial Intelligence policy
The prevalence of large language models (LLMs) is a reality that affects us all. For this reason, learning to use AI is an emerging skill that we all need to acquire. Please be aware of the limits of these tools and consider the following:

- If you provide minimum-effort prompts, you will get low-quality results. You will need to refine your prompts in order to get good outcomes. This will take work.
- Don't trust anything it says. If it gives you a number or fact, assume it is wrong unless you either know the answer or can check with another source. You will be responsible for any errors or omissions provided by the tool. It works best for topics you understand.
- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment where you use AI explaining what you used the AI for and what prompts you used to get the results (save the prompts as they might be required for revision). Failure to do so is in violation of academic honesty policies.

Be thoughtful about when this tool is useful. Don't use it if it isn't appropriate for the case or circumstance."

Mental Health and Wellness
We strive to make this course and your time at Purdue University an enjoyable and nourishing learning experience. Therefore, we encourage you to take care of your physical and mental health. **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 free and can be done on BoilerConnect.
If you're struggling and need mental health services, Purdue University is committed to advancing its students' mental health and well-being. If you or someone you know is feeling overwhelmed, depressed, and/or needing 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.
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. No appointment is needed, and Student Support Services is available to serve students 8 am-5 pm Monday through Friday.

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 on the course website or obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email frequently.
A link to Purdue's Information on Emergency Preparation and Planning is located on our Brightspace under "University Policies and Statements." This website covers Severe Weather Guidance, Emergency Plans, and a place to sign up for the Emergency Warning Notification System. We encourage you to download and review the *Emergency Preparedness for Classrooms document (**PDF**) or (**Word**).*
On the first day of class, we will review the **Emergency Preparedness plan for our specific classroom**, following Purdue's required Emergency Preparedness Briefing. Please make a note of items like:

- The location to where we will proceed after evacuating the building if we hear a fire alarm.
- The location of our Shelter in Place in the event of a tornado warning.
- The location of our Shelter in Place in the event of an active threat such as shooting.

Purdue University is committed to maintaining a community that recognizes and values every person's inherent worth and dignity, fosters tolerance, sensitivity, understanding, and mutual respect among its members, and encourages each individual to strive to reach their 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.

Group Presentations
This is a highly accelerated course on data science and machine learning, which necessarily leaves a lot of topics out. To provide a supplemental overview of contemporary developments, 30-minute group presentations will be prepared and delivered by students in the last three lectures of class. Groups will be assigned mid-semester, and the topic for each presentation will be discussed in consultation with the instructor. The following list of provisional topics for this semester are:

- Reinforcement Learning
- Generative Models
- Symbolic Regression
- Ensemble Methods
- Transfer Learning

The presentations should provide (*i*) a general overview of the topic, including its basic definitions, the classes of problems it is concerned with, and how it relates to material covered in the course, and (*ii*) a detailed review of one paper published within the last two years on the chosen topic. These presentations will constitute one fourth of the final grade.

Individual Projects
Some of you taking the class are motivated by some concrete problems where you think machine learning tools could be useful. If you would like to do an individual research project rather than a group presentation, **discuss this with Professor Bernal Neira sometime before March 1st (3/1)** to confirm the suitability of your project idea and grading expectations.

Tentative Lecture Schedule – Spring 2025

	Date	Topic
Part 1: ML Overview and Python Introduction		
1	Jan. 14	Course overview;
2	Jan. 16	Jupyter notebooks; Python syntax, datatypes, operators, functions.
3	Jan. 21	Data structures, control statements, comprehensions, and classes.
Part 2: Data Analysis Using Scipy and Pandas		
4	Jan. 23	Numpy array, matrix, and tensor operations.
5	Jan. 28	Data visualization with Matplotlib; linear regression worked example
6	Jan. 30	Introduction to Pandas series and dataframe objects.
7	Feb. 4	Pandas Filtering; Pandas/Numpy Conversion; Spectral data worked example
Part 3: Elements of Data Analysis		
8	Feb. 6	Introduction to Dow plant dataset, Missing Values, and Correlation.
9	Feb. 11	Outlier Detection, Data Imputation, and Linear Dimension Reduction.
10	Feb. 13	Dow plant dataset: Principle component analysis (PCA) and K-means.
Part 4: Optimization Algorithms		
11	Feb. 18	Optimization: Theory of gradient-based methods
12	Feb. 20	Optimization: Implementation of gradient-based methods
13	Feb. 25	Optimization: Theory and Implementation of Global and Heuristic Methods
Part 5: Supervised Learning		
14	Feb. 27	Model Training – Data Splits, Cross-Validation, Data Scaling (Normalization and Standardization), Loss Functions
15	Mar. 4	Model Training – Linear Regression, Error Metrics, Parameter Estimation
16	Mar. 6	Model Training – Regularization; Bias-Variance Tradeoff; Worked Examples
17	Mar. 11	Theory of Random Forests, Ensemble Methods, Boosting Concepts
18	Mar. 13	Implementation of Random Forests and Ensemble Methods
	Mar. 18	No Class – Spring Break
	Mar. 20	No Class – Spring Break
19	Mar. 25	Theory of Neural Networks
20	Mar. 27	Implementation of Common Neural Network Architectures I
21	Apr. 1	Implementation of Common Neural Network Architectures II
22	Apr. 3	Classification: Distinct Error Metrics, Loss functions
23	Apr. 8	Classification: Worked examples of classification models
24	Apr. 10	Active Learning – Theory of Gaussian Processes Regression
25	Apr. 15	Active Learning – Implementation of active learning during training
Part 6: Unsupervised Learning		
26	Apr. 17	Overview of Algorithms
27	Apr. 22	Implementation of Algorithms
Part 7: Survey Topics		
28	Apr. 24	Student Presentations
29	Apr. 29	Student Presentations
30	May 1	Student Presentations

SPRING 2026 BIOTRAIN OFFERINGS

Principles of Injectable Drug Product Manufacturing

ChE 59700-078/IMPH 59000-003
(CRN 40904/40903)
1 credit hour

Are you fascinated by how life-saving biologics and injectable drugs go from concept to clinic? This course invites you to explore the science, engineering and regulations behind modern injectable products.

This course offers an overview of:

- Regulatory Framework for Pharma
- Parenteral Drug Formulation
- Aseptic Manufacturing Techniques
- Lyophilization (Freeze Drying)
- Quality Control
- Good Manufacturing Practices (cGMP) and Good Documentation Practices (GDP)

Whether you're an engineering major curious about process design, a pharmacy student interested in formulation, or a scientist considering a career in the pharma industry, this class will broaden your perspective and equip you with knowledge used across the biopharma landscape.

MW 12:30-1:20 HAMP 2108
March 9 – May 2

Practical Applications of Injectable Drug Product Manufacturing

ChE 59700-079/IMPH 59000-004
(CRN 40906/40905)
1 credit hour

Ready to apply what you learned in the classroom to career-enhancing practical skills? Join us at the state-of-the-art Indiana Manufacturing Institute to learn skills that will be immediately translatable for your career aspirations.

This course allows you to practice:

- Cleanroom Gowning
- Aseptic Techniques
- Sterile Filtration and Filling
- Quality Control
- Batch Processing Records

Transportation to this location is available via CityBus (route 43 Northwestern Ave).

Fridays at IMI (1105 Endeavour Dr)
March 9 – May 2

The development of this course is supported by the BioTrain at Purdue program, part of the Heartland BioWorks Regional Tech Hub. For more information, email BioTrain@purdue.edu

SPRING 2026 BIOTRAIN OFFERINGS

Fundamentals of Lyophilization

ChE 59700-080/IMPH 59000-005
(CRN 40907/40908)
1 credit hour

Discover the Science Behind Freeze-Drying Pharmaceuticals

Interested in how vaccines, biologics, and injectable drugs are stabilized through freeze-drying, or interested in freeze-drying technology itself? CHE 59700/IMPH 59000 offers a focused introduction to the principles and practices of pharmaceutical lyophilization.

This course combines the theory behind lyophilization practices with interactive content which allows the user to explore freezing, sublimation rates, primary and secondary drying, and recent advances in lyophilization process assessment tools.

Through a mix of online learning modules and in-person discussions, students will gain both conceptual understanding and practical insights into modern freeze-drying operations. The course will also cover equipment fundamentals, design-space visualization, and real-world case studies from current pharmaceutical applications.

By the end of the course, students will be able to interpret process data, understand key quality attributes of lyophilized products, and connect theory to current industry practices and research trends.

Whether you are interested in pharmaceutical engineering, formulation science, or process development, this class offers a hands-on entry point into a vital biomanufacturing technology. Register today for CHE 59700/IMPH 59000.

TTh 9:30-10:20 RHPH 162
March 9 – May 2

The development of this course is supported by the BioTrain at Purdue program, part of the Heartland BioWorks Regional Tech Hub. For more information, email BioTrain@purdue.edu

Purdue University
CHE 597 Industrial Chemical Technology
Spring 2026, 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 13 Jan	Course introduction; scope of the chemical and allied process industries
Thu 15 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 20 Jan	Natural Products 1 - Animal and vegetable fiber, leather, oils, fats, waxes, gelatin, dairy products, food processing
Thu 22 Jan	Natural Products 2 - Pulp and paper, naval stores, resins, turpentine, rosin, rubber (Report 1 Due)
Tue 27 Jan	Inorganics 1 - Chemistry of dehydration/hydration: ceramic pottery, tile, and brick, glass, plaster, cement, mortar, and concrete
Thu 29 Jan	Inorganics 2 - Chemistry of reduction: ore smelting, iron and steel, silicon, copper, brass, bronze, aluminum

Tue 3 Feb	Inorganics 3 - Bases and acids: soda ash, caustic soda, lime, mineral acids (nitric, sulfuric, phosphoric, hydrochloric)
Thu 5 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 10 Feb	Fuels 1 - Wood, coal, petroleum (gasoline, diesel, jet fuel, fuel oil), LPG, natural gas
Thu 12 Feb	Fuels 2 - Natural gas processing, petroleum refining processes and products
Tue 17 Feb	Fuels 3 - Synthetic fuels: town gas, F-T, SNG, MTG, biofuels
Thu 19 Feb	Organics 1 - Wood and coal chemicals and materials (Report 3 Due)
Tue 24 Feb	Organics 2 - Basic building blocks: acetylene, olefins (ethylene, propylene, butadiene) aromatics (BTX, Styrene), carbon monoxide
Thu 26 Feb	Organics 3 - Commodity intermediates and solvents: alcohols glycols and phenols, aldehydes and ketones, acids, esters, ethers
Tue 3 Mar	Organics 4 - Commodity monomers and polymers (PE, PP, PS, PET, PC, SBR)
Thu 5 Mar	Organics 4 continued (Report 4 Due)
Tue 10 Mar	Organics 5 - Adhesives, coatings, films, fibers, plastics
Thu 12 Mar	Organics 6 - Fine chemicals: dyes pigments and cosmetics, flavors and fragrances, soap and detergents, explosives, agrichemicals, pharmaceuticals
16-20 Mar	Spring Break
Tue 24 Mar	Organics 6 continued
Thu 26 Mar	Organics 7 - Fermentation and biochemical processes; biotechnology (Report 5 Due)
Tue 31 Mar	Technical Impact Factor 1 - Homogeneous and heterogeneous catalysis
Thu 2 Apr	Technical Impact Factor 2 - Engineering and operational digital computation
Tue 7 Apr	Current Issues 1 - Environmental protection: air, wastewater, land; personnel protection: health and safety
Thu 9 Apr	Current Issues 2 - Loss prevention and process safety (Report 6 Due)
Tue 14 Apr	Current Issues 3 - Sustainability: triple bottom line, life cycle analysis, industrial ecology, green chemistry and engineering
Thu 16 Apr	Current Issues 4 - Sustainability: population and economic growth, raw materials; energy and water resources
Tue 21 Apr	No Class
Thu 23 Apr	Current Issues 5 - Climate change
Tue 28 Apr	Current Issues 6 - Carbon dioxide management, capture, and sequestration
Thu 30 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 22 January)
Report 2 - Reaction Path Synthesis: Solvay Process (Due 5 February)
Report 3 - Block Flow Diagram: Petroleum Refining (Due 19 February)
Report 4 - Process Supply Chain: Polyethylene Terephthalate (Due 5 March)
Report 5 - General Purpose Batch Processing: Fine Chemical Manufacture (Due 26 March)

Report 6 - Safety and Environmental Protection: Methyl Isocyanate (Due 9 April)
Report 7 - Sustainability: Carbon Management (Due 30 April)
Bonus Report: Process Narrative: Major Chemical Intermediate (Due 30 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)

CHE 59700 **Spring 2025**

Introduction to the Upstream Oil and Gas Industry

A. Instructors. Leon Robert, PhD and Nate Schultheiss, PhD

B. Course Description. This course provides a practical overview of current engineering technologies and practices to identify, drill and complete hydrocarbon bearing reservoirs. The oil and gas (O&G) industry seeks to achieve long-term energy security with a balanced, diversified, and sustained investment in both traditional energy sources and lower-emission solutions throughout the energy transition in this century. Access to reliable and affordable energy is essential to our daily lives and is a major underpinning of social and economic progress in the U.S. This course incorporates practical examples and applications to progressively give the student an introduction to advanced knowledge of upstream O&G exploration and production.

This course is relevant to a broad base of students in engineering, geology, and chemistry, especially those planning a career in energy or more specifically in the oil and gas industry. The course content is designed especially for those students interested in upstream oil and gas topics including but not limited to exploration, drilling, production, hydraulic fracturing, and recent advances in each.

C. Course Requirements. ChE 20500 – Chemical Engineering Calculations or equivalent course is recommended by not mandatory.

D. Instructor Biographical Information.

- Leon Robert holds dual academic appointments at Purdue University as Professor of Engineering Practice in the Davidson School of Chemical Engineering and Professor of Clinical Practice in the Department of Entomology. He is a retired military officer and Professor Emeritus, United States Military Academy. He received his PhD in Entomology at Texas A&M University. In addition, he received B.A. and M.Ed. degrees from the State University of New York at Potsdam; an M.S. degree in Biology at Old Dominion University, and a M.S.S. degree from the U. S. Army War College. Recently he worked as a consultant for Chevron for 5 ½ years in drilling and completions operations in the Permian Basin of West Texas and Southern New Mexico.

- Nate Schultheiss is the Director of Unconventional Energy at Purdue University where he shares his time between the Davidson School of Chemical Engineering and Pioneer Oil Company (Vincennes, IN). Pioneer Oil is one of the largest O&G operators in the Illinois Basin. Part of his responsibilities are to direct Purdue's Enhanced Oil Recovery laboratory where fundamental and applied research is conducted to maximize hydrocarbon production for O&G operators. Before joining Purdue University, Nate was a technology leader at Halliburton guiding the research and development of chemical solutions used in completions operations. As a chemical subject matter expert, he supported Halliburton's

field operations in the piloting of new products and services. He received his PhD in Chemistry at Kansas State University. In addition, he received B.S. and M.S. degrees from Missouri State University also in Chemistry.

E. Required and Recommended Textbooks.

- **No** required textbooks for this course, but topical articles will be provided throughout the course for reading/understanding.

F. Course Learning Objectives.

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

G. Course Meeting Schedule.

Lectures:	Monday/Wednesday/Friday time/location TBD
Quizzes:	January 31, February 17, March 3, April 2, and April 23
Individual Project Selected:	by March 7
Individual Project due:	May 7

At the approximate mid-point in the semester students will choose an individual topic related to oil and gas production engineering or technology. Topic will be described in 1-3 sentences and emailed to instructor for approval. Upon approval, a completed written report, not to exceed five double-spaced pages will be due at the end of the semester in lieu of a final exam.

On March 7th, additional information will be provided about the Individual Project requirements.

H. Instructor Contact Information.

- Professor Leon Robert – Email: Robert9@purdue.edu; Telephone: (765) 494-0551 (office), (806)342-5020 (cell)
  Office: FRNY 2043B
  Office Hours: TBD

- Dr. Nate Schultheiss – Email: Nschulth@purdue.edu; Telephone: (765) 586-4382 (cell)
  Office: FLEX 2041C
  Office Hours: TBD

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

- Five (5) Quizzes – 50% of total

  Quiz #1: January 31
  Quiz #2: February 17
  Quiz #3: March 3
  Quiz #3: April 2
  Quiz #4: April 23

- Individual Project – 50% of total

  Due: May 7

- **Grading Scale**

  A: 100% - 90% of the weighted points
  B: 89.9% - 80% of the weighted points
  C: 79.9% - 70% of the weighted points
  D: 69.9% - 60% of the weighted points
  F: Less than 60% of the weighted points

J. Course Schedule.

Lecture	Date	Topic
BLOCK 1 – Introduction to Hydrocarbons and the Oil and Gas Industry		
Lecture 1	Jan 13	A Brief History of the Oil and Gas Industry in the U.S.
Lecture 2	Jan 15	Origin and Occurrence of Hydrocarbons
Lecture 3	Jan 17	Reservoir Engineering – Rock and Fluid Properties
No Class	Jan 20	**MLK Day – University Closed**
Lecture 4	Jan22	Petroleum Geology
Lecture 5	Jan 24	Petroleum Exploration

Lecture 6	Jan 27	Procuring the Right to Drill: Mineral Rights and Leasing
Lecture 7	Jan 29	Regulatory Permits
BLOCK 2 – Drilling Rig Systems and the Drilling Process		
Lecture 8	Jan 31	**Quiz #1 (Block 1)** & Introduction to the Drilling Rig and Rig Site
Lecture 9	Feb 3	Well Design
Lecture 10	Feb 5	Drilling Fluids and Chemicals
Lecture 11	Feb 7	Basic Drilling Operations
Lecture 12	Feb 10	Well Flowback Fluids and Tailings
Lecture 13	Feb 12	Well Bore Architecture
Lecture 14	Feb 14	Introduction to Gas and Liquid Flow Through Well Tubing
Lecture 15	Feb 17	**Quiz #2 (Block 2)** Open Hole Evaluation using Well Logs, Cores, and Fluid Tests
Lecture 16	Feb 19	Well Casing (Liner Completion)
Lecture 17	Feb 21	The Cementing Process
Lecture 18	Feb 24	Well Control
Lecture 19	Feb 26	Well Control Calculations
Lecture 20	Feb 28	Drilling Safety
BLOCK 3 – Gas production and Completions Operations		
Lecture 21	Mar 3	**Quiz #3 (Block 2)** & Shale Gas
Lecture 22	Mar 5	Introduction to Completions Operations
Lecture 23	Mar 7	**Project Topic Selection** & Perforations
Lecture 24	Mar 10	Hydraulic Fracturing Operations
Lecture 25	Mar 12	Chemistry of Fracturing Fluids
Lecture 26	Mar 14	Oil and Gas Field Processing Basics
No Classes	**Mar 17-21**	**Spring Break**
Lecture 27	Mar 24	Pollution Prevention
Lecture 28	Mar 26	Emergency Planning and Environmental Law
Lecture 29	Mar 28	Gas Dehydrators and Separators
Lecture 30	Mar 31	Gas Compressors and Water Disposal
Block 4 – Well Intervention and Technology Advancements		
Lecture 31	Apr 2	**Quiz #4 (Block 3)** & Storage Tanks and Work Over Techniques
Lecture 32	Apr 4	Supervision and Management of an Oil and Gas Site
Lecture 33	Apr 7	Technology Advancements Part 1 (Exploration)
Lecture 34	Apr 9	Technology Advancements Part 2 (Drilling)
Lecture 35	Apr 11	Technology Advancements Part 3 (Completions and Production)
Lecture 36	Apr 14	Enhanced Recovery Techniques (Secondary Production)
Lecture 37	Apr 16	Enhanced Recovery Techniques (Tertiary Production)
Lecture 38	Apr 18	Geothermal
Lecture 39	Apr 21	Improved Oil Recovery Methods: Water, CO2, and Chemical Flooding
BLOCK 5 – The Big Picture and Final Project		
Lecture 40	Apr 23	**Quiz #5 (Block 4)** & Oil and Gas Transportation – Trucks, Railway, Pipelines, and Ships
Lecture 41	Apr 25	Closing a Project – Plug and Abandonment and Site Restoration
Lecture 42	Apr 28	Global Best Practices

Lecture 43	Apr 30	Corporate Social Responsibility
-	May 2	Work on Individual Project
-	**May 7**	**Individual Project Due**
No Class	**May 5-10**	**Final Exams**

K. Consulting with the Instructor. I encourage you to discuss academic or personal questions with me during my office hours or via email. These discussions need not be limited to CHE 49700/50200 content.

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

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

N. Conduct. University policy states that it is the responsibility of all students to attend all classes. (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, and the faculty members. Each student is expected to exhibit a positive attitude. Your conduct will be a factor in awarding grades to students between two letter

grades. Purdue University's student conduct policy specifically addresses academic dishonesty.

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

P. Nondiscrimination. Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community based on 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. Diversity and Inclusion Statement. In our discussions, structured and unstructured, we will explore a variety of challenging issues, which can help us enhance our understanding of different experiences and perspectives. This can be challenging, but in overcoming these challenges we find the greatest rewards. While we will design guidelines as a group, everyone should remember the following points:

- We are all in the process of learning about others and their experiences. Please speak with the instructors, anonymously if needed, if something has made you uncomfortable.
- Intention and impact are not always aligned, and we should respect the impact something may have on someone even if it was not the speaker's intention.
- We all come to the class with a variety of experiences and a range of expertise, we should respect these in others while critically examining them in ourselves.

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

S. **Individual Learning and Testing Needs.** Any student who feels he/she may need accommodation with any aspect of the course based on personal circumstances should contact Professor Clark privately to discuss his/her specific needs. If you are a student with any form of individual learning needs, please speak with the faculty instructors whether 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.

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

1. For any emergency call 911.

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

3. If there is a fire alarm, we will immediately evacuate the building and proceed to in front of Hampton Hall (FRNY). Do not use the elevator.

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

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

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

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

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, 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. **Responsible Use of AI in Completing Coursework.** Advancements in Artificial intelligence (AI) provide students with unparalleled access to information and problem-solving capabilities. However, with these advantages come the responsibilities of ethical use and academic integrity. This statement outlines the expectations and guidelines for the responsible use of AI in our course.

By adhering to these guidelines, students aim to:
- Uphold academic honesty and personal integrity.
- Ensure equitable access and opportunities for all students.
- Develop skills for critical thinking and independent reasoning.
- Understand the strengths and limitations of AI tools.

Guidelines for Responsible Use:

• Original Work: Students should ensure that assignments submitted are original and based on their understanding. While AI can assist in research or provide general guidance, it should not produce work on behalf of the student.

• Citation: Any content, ideas, or assistance obtained through AI tools must be appropriately cited, like any other reference or source. You will need to locate the relevant citations from the primary literature (i.e., journal articles).

• Collaboration: If a student collaborates with AI tools, (you are encouraged to do so in this course) they must specify the nature and extent of this collaboration in their submission. This includes providing details of the prompts used to generate the AI responses.

Prohibited Uses: AI should not be used to complete quizzes, reflections, presentations, projects, or any other assessments unless explicitly permitted by the instructor.

• Accessibility: All students must have equal access to AI tools. If a particular tool is used in a course, it should be free of cost for all users.

• Data Privacy: Students must be cautious when sharing personal or sensitive information with AI platforms and should be familiar with the terms of service of any third-party AI tools.

• Sharing of copyrighted material with third-party AI tools: This is prohibited. While faculty and instructors do not own copyright to facts or ideas in their discipline, they do own copyright to their expression, explanation, and presentation of those facts and ideas in course notes, PowerPoint slides, etc. including assessments constructed for the course. As such, those instructor-generated materials should never be uploaded to any third-party site (whether AI oriented or not).

FERPA and Privacy Issues: Both student and instructor commit to never sharing personally identifiable information about students with any third-party AI tool.

Consequences for Misuse:
Misuse of AI tools in coursework, which includes but is not limited to producing unoriginal work, uncited use of AI- generated content, or unauthorized assistance on assessments, will be considered a breach of academic integrity. Consequences will follow Purdue policy on academic dishonesty as detailed in this syllabus, which may include grade penalties, course failure, or more severe disciplinary actions.

The promise of AI in enhancing learning and research is vast, but it must be used judiciously. Responsible use not only ensures academic honesty but also maximizes genuine learning and skill development. Students are urged to approach AI as a supplementary tool, not a replacement for their unique intellectual capacities and insights.

W. **Netiquette.** Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you are not to attack an individual. Our differences, some of which are outlined in the University's nondiscrimination statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience.

Please read the Netiquette rules for this course:

- Do not dominate any discussion. Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Keep an "open mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

X. **Course Evaluation.** During the last two weeks of the course, you will be provided with an opportunity to evaluate this course and your instructors. 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.

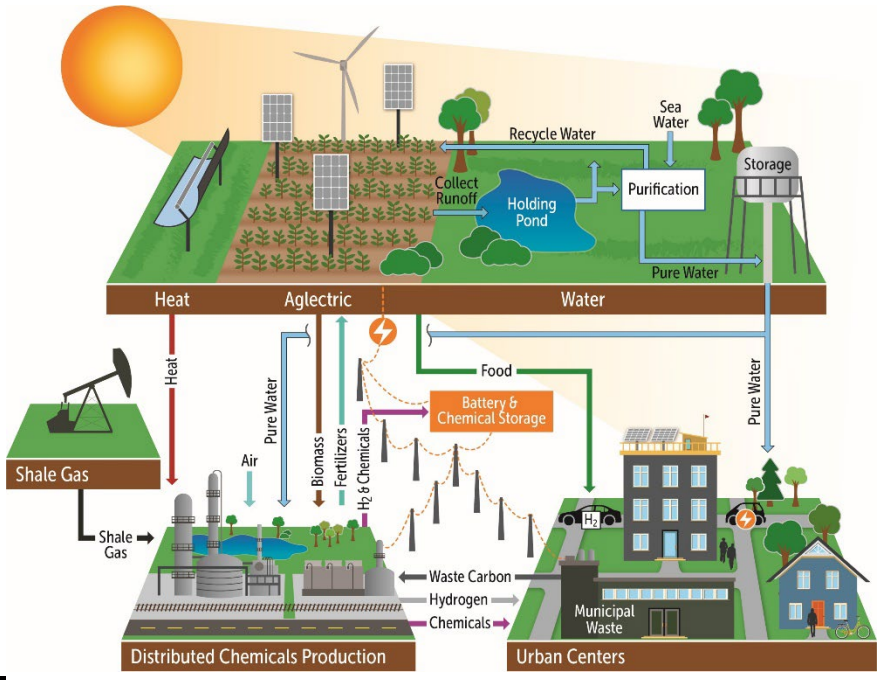
The instructors strongly urge you to participate in the evaluation system and to provide them honest and constructive feedback about how they may improve the course in future offerings.

Disclaimer: This syllabus is subject to change. Students will be notified through Brightspace in the event of changes to the syllabus.

CHE 59700 Systems Analysis for Efficient and Environmentally Friendly Energy Production, Transformation and Use

Prof. Rakesh Agrawal
Office: FRNY 3053D
Email: agrawalr@purdue.edu

While chemical engineering evolved against the backdrop of an abundant supply of fossil resources for chemical production and energy and a 20th-century design for large tonnage-scale manufacturing facilities, the changing landscape of energy supply and environmental pressure requires a careful analysis of chemical plants in the context of energy supply and use. In addition to the rise of shale gas, the energy supply and economic use of renewable energy resources such as solar and wind are now rising rapidly. This course will first discuss fundamental concepts underlying the efficient use of energy in chemical and power plants. These concepts will then be integrated with various chemical transformations and separations at chemical and petrochemical plants. We will first analyze fossil resources such as coal, oil, and shale gas. Then we will address opportunities and challenges available to us due to the potential electrification of chemical plants because of the direct availability of renewable electricity. Currently chemicals and petroleum refining use nearly half of the manufacturing sector's primary energy, emit half of its greenhouse gases (GHG), and are among the largest CO_2 emitters in the US manufacturing sector. We will address how renewable energy can be prudently used to radically reduce GHG emissions from chemical plants. Indeed, as shown in the figure below, the entire picture of energy harvesting, transformation, and use based on the fundamental analysis provides us with an unprecedented opportunity for shaping future chemical production and its interaction with how humans will perform their daily activities.



Recommended Books:

1. Sustainable Energy, J.W. Tester, E.M. Drake, M.J. Driscoll, M.W. Golay and W.A. Peters, MIT Press. ISBN: 0-262-20153-4

2. The Dynamics of Energy – Supply, Conversion and Utilization, H. Perez-Blanco, CRC Press, ISBN: 978-1-4200-7688-2

3. Synthetic Fuels, R.F. Probstein, R. Edwin Hicks

Books are available in the Reserve Section of the Potter Engineering Library. It is not essential that you own one of the books.

Homework, Exam and Term Papers:
In this course we will have two exams and one oral term paper.

Homework – 30%
Exam 1 – 25%
Exam 2 – 25%
Oral Term Paper – 20%

Homework Policy:
For the first homework that is less than one day late, 30% mark will be deducted. For the second homework that is less than one day late, 50% mark will be deducted. For any further late homework, no credit will be given.

Important Dates:
Exam 1 - Thursday, October 10th
Exam 2 – Thursday Nov. 21st
Both the exams will be during the lecture period.

Term Paper:
Term paper teams will be formed by **Tuesday, Sept. 10th.** Team members may be randomly selected.
Term paper topics will be due by **Tuesday, October 15th**.
Term paper presentations to the class will be on **Nov. 26th, December 3rd, December 5th**

Final grading for the course will be done using letter grades A, B, C, D and F.

Makeup Lectures:
I will need two to three make-up lectures. The dates and times will be announced in advance.

Guidelines for Academic Integrity:

While Students are encouraged to discuss homework problems with each other, the submitted work must be work of the individual and no copying is allowed.

We will enforce the penalty if a student is caught cheating as proposed by Purdue:

"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."

Expected Conduct in the Class:
Avoid being late to the lectures.
Be attentive during lectures.
It is OK to ask clarifying questions during lecture.
Have your cell phone on silent and no texting during lectures. If you must use your cell phone during lecture, please walk outside, make your call and then return to the lecture.

Covered Topics: The following major topics will be covered in the lectures:

1. The Energy Landscape
    a. The current world demand for energy
    b. The demand projections and associated challenges
    c. Environmental impact

2. Historical evolution of Fossil Energy and its Use

3. Thermodynamic Laws
    a. The first law
    b. The second law
    c. Concept of exergy and process of efficiencies

4. Resources and their current utilization methods including heat, work and electricity.
    a. Coal
    b. Natural Gas
    c. Oil
    d. Nuclear
    e. Solar
    f. Biomass
    g. Wind
    h. Others

5. Transport Sector – A systems approach
    a. Synthetic fuel from coal
    b. Synthetic fuel from biomass

c. An overall transportation picture

6. Electrification of chemical Production
   a. Electricity Demand
   b. Reactor design opportunities
   c. Reimaging separation processes
   d. Integration with Renewable energy such as Solar and Wind -challenges and opportunities

7. A discussion on a possible H_2 economy

8. Chain Efficiencies – from Capture to Utilization

Note:
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 get information about changes in this course.

- *Blackboard Learn website: http://www.itap.purdue.edu/learning/tools/blackboard/*
- *Instructor's email: agrawalr@purdue.edu*

EMERGENCY PREPAREDNESS SYLLABUS ATTACHMENT

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.

- **Indoor Fire Alarms** mean to stop class or research and immediately **evacuate** the building.
  - Proceed to your Emergency Assembly Area away from building doors. **Remain outside** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.
- **All Hazards Outdoor Emergency Warning Sirens** mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.
  - "Shelter in place" means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

**In both cases, you should seek additional clarifying information by all means possible…Purdue Emergency Status page, text message, email alert, TV, radio, etc…review the Purdue Emergency Warning Notification System multi-communication layers at*
http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html

EMERGENCY RESPONSE PROCEDURES:

- Review the **Emergency Procedures Guidelines** https://www.purdue.edu/emergency_preparedness/flipchart/index.html
- Review the **Building Emergency Plan** (available on the Emergency Preparedness website or from the building deputy) for:
  - evacuation routes, exit points, and emergency assembly area
  - when and how to evacuate the building.
  - shelter in place procedures and locations
  - additional building specific procedures and requirements.

EMERGENCY PREPAREDNESS AWARENESS VIDEOS

- "Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm (Link is also located on the EP website)
- All Hazards Online Awareness training video (on Webcert & Blackboard.) A 30 minute computer based training video that provides safety and emergency preparedness information. See the EP website for sign up instructions.

MORE INFORMATION

Reference the Emergency Preparedness web site for additional information:
https://www.purdue.edu/ehps/emergency_preparedness/

CHE 59700-030 (3 credit-hours)
Financial Analysis and Project Management
Spring 2025

Class Location/ Format	FRNY B124 – In person
When	Monday, Wednesday, Friday 11:30p – 1:00p
Duration	January 13, 2025 – March 9, 2025
Exam Format	Interim and Final Presentations; Final Paper

Primary Instructor

Michelle Chutka
Email: mchutka@purdue.edu Office Hours: M/W 1:30-2:30 FRNY 3062A

Michelle Chutka, M.S., is a graduate of the University of Michigan Chemical Engineering program (B.S. 2002, M.S, 2003). She has 19 years of experience in Medical Device industry, and founded Symbiosis Consulting LLC concluding her work as the Director of Product Engineering at Cook Biotech in West Lafayette, IN. She joined Purdue as a Continuing Lecturer in Fall 2019 and works closely with students pursuing the Professional Master's Program.

Featured Guest Lecturer

Charlie Smith
Email: <charlie4129@yahoo.com> Office Hours: M/W 1:30-2:30 FRNY 3062A

Charlie Smith is a featured lecturer and former CEO of Countrymark. He has also served on the Board of the Indiana Chamber of Commerce, including the committees for Congressional Affairs and Energy, the Indiana University Kelly School of Business (Indianapolis) Board of Visitors, the Board of the Michigan Oil and Gas Association, and the Industry Advisory Council for Purdue University's School of Chemical Engineering. In 2015, the Purdue University Davidson School of Chemical Engineering honored Charlie as an Outstanding Chemical Engineer.

Course Description

In both industry and academic settings, outcomes and goals are attained through project management. The goal of this course is to teach foundations of project management through a variety of case studies and course work, including financial analysis methods used to make investment decisions and discern opportunities for cash flow analysis. Businesses and other undertakings thrive through creating customer value. This course will challenge students to examine methods of creating customer value through assuming different roles within an organization.

At the beginning of the course, students will work both in teams and as individuals to analyze the financial reporting of a publicly traded entity. Students will be expected to provide one mid-point report as well as one final report regarding their recommendations for investments and management of that entity's portfolio.

Course Objectives

Following the successful completion of this course, the student will achieve the following course objectives:

1. Understand the role of the engineer in creating value for an organization.
2. Understand and apply basic accounting principles to analyzing cash flows and balance sheets. Distinguish between managerial accounting and GAAP accounting principles.
3. Apply future and present valuation methods towards project selection.
4. Gain skills in proactive and reactive project selection using new analytical skills.
5. Grow engineering project management skills with focus on application tools.
6. Apply newfound analytical perspective towards an organization's financial health.

Course Format

The format of this class will be a mix of in-person and synchronous lectures. Many guest lecturers will provide content that is available only through online meetings, and these lectures will be performed exclusively over an online platform with an asynchronous option if the guest lecturer consents to information sharing. We will have opportunities to meet and discuss content in-person as well.

The guest lecturers will discuss a wide range of issues, including investments and the stock market, corporate taxes, the start-up process, entrepreneurship, mergers and acquisitions, private equity, hedge funds, venture capital, strategic risk, and assessment of funding for R&D investments. Several companies will be specifically highlighted during these guest lectures, including representatives from Consumer Goods, Pharma/Med Device, Energy and Petroleum industries.

Prerequisites

Ability to use EXCEL or hand-calculate simple problems. Some background in general accounting principles may be helpful but is not required.

Learning Outcomes

Students will learn to:

- Interpret and understand financial earnings statements

- Think of projects in an expansive way where projects can be new business lines, improvements in existing businesses, start-ups, partnerships and capital expenditures of any size
- Do project analysis including economic evaluations
- Balance quantitative analysis with business judgment
- Distinguish between project management practices that have a good chance of success from those that are less likely to succeed
- Learn how to assess and manage risks

Optional Textbook

- Stermole et al, Economic Evaluation & Investment Decisions Methods Edition 16
- **This particular edition will be referenced in class, but Edition 16 is not required. Much of the content is available in previous editions if easier to obtain.

Optional Texts

- "Finance for Executives," Hawawini and Viallet 5th edition – Selected Chapters

- "Sources of Value, A Practical Guide to the Science and Art of Valuation," Woolley, Cambridge, 2009 – selected chapters from this book may be used, and will be uploaded to Brightspace

- "Project Management for the Unofficial Project Manager," 2015, Franklin Covey Co. Selected excerpts may be discussed in class.

Policies

General Course Policies

We expect the highest standards of professionalism and ethics in this course. Each student is expected to come to class on time and participate in lectures and content. 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 members. Each student is expected to exhibit a positive attitude. Expectations for each student include (but are not limited to):

- Attending all class sessions.
- Coming to on time and prepared by reading assigned material beforehand.
- Participating in classes and online lectures through posing questions and engaging in course material.
- Maintaining the highest standards of academic honesty and integrity.
- Being knowledgeable about the policies and information described in the syllabus.

Grading

Course participation is a critical portion of this course, even classes held online or asynchronously!

Course participation grades will be assessed through confirmation that you've engaged the recorded/asynchronous or synchronous lectures. Lectures given in an asynchronous format for those unable to attend in-person are to be reviewed with the expectation that the student engages the content and returns with questions for the lecturer.

The lecturers may use discussion forums on Brightspace to provide tools and opportunities for enrichment. Discussion on these forums outside of coursework is encouraged and will count favorably towards class participation grades.

Grading rubric is illustrated below:

Class Activity	Approximate Total Grade Weight (points/total)
Class participation (200 pts) Including: - Attendance and participation in lectures - Completing assigned reading - Completing non-graded/enrichment assignments	100/600
Homework (200 pts)	200/600
Mid-Point Presentation 1 (100 pts)	100/600
Final Presentation 2 (100 pts)	100/600
Final Paper (100 pts)	100/600

Letter Grade Ranges	**Grade Range**
A	100% - 93.0%
A-	92.9% - 90.0%
B+	89.9% - 87.0%
B	86.9% - 80.0%
C	79.9% - 70.0%
D	69.9% - 60.0%
F	<59.9%

***Unless otherwise specified, a letter grade may be assigned with a + or – contingent upon class participation and engagement, among other factors.**

If an assignment or homework was too difficult (as judged by the faculty instructors) the final 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.

For the presentations, students will collaboratively analyze a chosen publicly traded entity. While each student is free to decide what aspects of a company will be assessed, basic expectations include a review of recent financial statements and a critical analysis of the company's strategy over time. Each student's work will be summarized in a series

of presentations. More details about the expectations for the presentations will be provided during the first week of class.

The final paper will be written and submitted individually by each team member and include a summary of the team's findings and progress throughout the semester. This paper will be due prior to the end of the grading period for the Spring 2025 semester.

Instructor's Commitment
As your instructor, I hold myself to the highest standards and expectations to provide a model for student behavior. These commitments include, but are not limited to:

- exhibiting punctuality and preparedness for lectures, both in content and knowledge.
- providing a safe and open forum for learning. No student should feel ashamed or embarrassed to ask a question, for any reason.
- providing timely responses to email or in-person inquiries. If class time is not the best forum to answer these questions, a suitable time outside of class will be chosen.
- grading with objectivity and consistency based on pre-determined guidelines.

Instructor Questions & Office Hours.
The best way to reach Michelle is by email mchutka@purdue.edu. I will arrange a Teams discussion if an email discussion is not convenient or effective. Expect a response within 24 to 48 hours on business days. Guest lecturers will also be available for subsequent consult.

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;
(iii) enabling other students to create work that is not their original work.

The consequence of the first offense of plagiarism is a grade of zero for the entire work, even if the work is a final presentation, final paper, or homework.

The consequence of the a second offense is an F mark for the class.

All students involved in the plagiarism will receive the above noted consequences, unless there is incontrovertible evidence that the original work that was plagiarized was done so without knowledge or permission from the original work's author.

Refer to Purdue's student guide for academic integrity:
https://www.purdue.edu/odos/academic-integrity/

NOTES: Instances in previous years have included students turning in overtly and obviously similar work. Where work is noted as required to be individual, students may collaborate on the problem-solving approach, but the write-up must be unique to each student. All involved students suspected of plagiarism or non-individual work will be given 0 points on the assignment regardless of who authored the "original" work.

Use of Copyrighted Materials
Students are expected, within the context of the Regulations Governing Student Conduct and other applicable University policies, to act responsibly and ethically by applying the appropriate exception under the Copyright Act to the use of copyrighted works in their activities and studies. The University does not assume legal responsibility for violations of copyright law by students who are not employees of the University.

A Copyrightable Work created by any person subject to this policy primarily to express and preserve scholarship as evidence of academic advancement or academic accomplishment. Such works may include, but are not limited to, scholarly publications, journal articles, research bulletins, monographs, books, plays, poems, musical compositions and other works of artistic imagination, and works of students created in the course of their education, such as exams, projects, theses or dissertations, papers and articles.

You may want to refer students to the University Regulations on policies:
http://www.purdue.edu/policies/academic-research-affairs/ia3.html

Attendance
Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities, an interview or religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email. 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, the student or the student's representative should contact the Office of the Dean of Students.

The link to the complete policy and implications can be found at:
http://www.purdue.edu/studentregulations/regulations_procedures/classes.html

Missed or Late Work
All assignments must be completed and submitted on time. As a rule, late submissions will not receive credit. Assignments will be submitted through Brightspace by the time and date indicated on the assignment. If an extreme circumstance arises, contact the Professor.

Grief Absence Policy for Students
Purdue University recognizes that a time of bereavement is very difficult for a student. The University 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.

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

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.

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

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. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

See the University's website for additional information:
https://www.purdue.edu/ehps/emergency_preparedness/

Students with Disabilities
Any academic accommodation must be arranged for by the student through Purdue's Disability Resource Center. Instructors cannot make academic accommodations without a DRC accommodation letter. Below is Purdue's policy statement for supporting students with disabilities.

Purdue University is committed to maintaining an inclusive 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,

Purdue University seeks to develop and nurture its 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 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 University does not condone and will not tolerate Discrimination against any individual on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, disability, status as a veteran, marital status, parental status, sexual orientation, gender identity or gender expression. Purdue University promulgates policies and programs to ensure that all persons have equal access to its employment opportunities and educational programs, services and activities. The principal objective of this policy is to provide fair and consistent treatment for all students and employees of the University. Purdue is committed to increasing the recruitment, selection and promotion of faculty and staff at the University who are racial or ethnic minorities, women, persons with disabilities and veterans. The University also is committed to policies and programs that increase the diversity of the student body.

Here are some links that may be relevant:
http://www.purdue.edu/policies/ethics/iiic2.html
http://www.purdue.edu/studentregulations/equal_opportunity/studentgrievance.html
https://www.purdue.edu/studentsuccess/specialized/drc/faculty/index.html

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.

You may want to refer students to Purdue's nondiscrimination statement:
http://www.purdue.edu/purdue/ea_eou_statement.html

EMERGENCY PREPAREDNESS SYLLABUS ATTACHMENT

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.

- **Indoor Fire Alarms** mean to stop class or research and immediately **evacuate** the building.
  - Proceed to your Emergency Assembly Area away from building doors. **Remain outside** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.
- **All Hazards Outdoor Emergency Warning Sirens** mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.
  - "Shelter in place" means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

**In both cases, you should seek additional clarifying information by all means possible…Purdue Emergency Status page, text message, Twitter, Desktop Alert, Albertus Beacon, digital signs, email alert, TV, radio, etc.…review the Purdue Emergency Warning Notification System multi-communication layers at http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html*

EMERGENCY RESPONSE PROCEDURES:

- Review the **Emergency Procedures Guidelines** https://www.purdue.edu/emergency_preparedness/flipchart/index.html
- Review the **Building Emergency Plan** (available on the Emergency Preparedness website or from the building deputy) for:
  - evacuation routes, exit points, and emergency assembly area
  - when and how to evacuate the building.
  - shelter in place procedures and locations
  - additional building specific procedures and requirements.

EMERGENCY PREPAREDNESS AWARENESS VIDEOS

- "Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm (Link is also located on the EP website)

MORE INFORMATION

Reference the Emergency Preparedness web site for additional information: https://www.purdue.edu/ehps/emergency_preparedness/

CHE 668 Spring 2024

Colloidal and Interfacial Phenomena

Instructor: Professor You-Yeon Won; Room 2031 FRNY
Tel: 4-4077; email: yywon@purdue.edu
Office hours: T 14:00 – 15:00 PM, FRNY 2031

Classes: M, W, F 12:30 PM – 13:20 PM, HAMP 1266

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

Prerequisites: Undergraduate physical chemistry

Text:

D. F. Evans, and H. Wennerström, "The Colloidal Domain: Where Physics, Chemistry, Biology, and Technology Meet", 2nd ed., Wiley-VCH, 1999 (on reserve in Engineering Library).

Supplemental Text:

R. J. Stokes, and D. F. Evans, "Fundamentals of Interfacial Engineering", Wiley-VCH, 1996 (on reserve in Engineering Library).

P. C. Hiemenz, and R. Rajagopalan, "Principles of Colloid and Surface Chemistry", 3rd ed., CRC Press, 1997 (on reserve in Engineering Library).

Additional References:

J. Israelachvili, "Intermolecular & Surface Forces", 3rd ed., Academic Press, 2011.

K. A. Dill, and S. Bromberg, "Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology", 2nd ed., Garland Science, 2010.

V. A. Parsegian, "Van Der Waals Forces: A Handbook for Biologists, Chemists, Engineers, and Physicists", Cambridge University Press, 2006.

M. Rubinstein, and R. H. Colby, "Polymer Physics", Oxford University Press, 2003.

T. A. Witten, "Structured Fluids: Polymers, Colloids, Surfactants", Oxford University Press, 2004.

P.-G. de Gennes, F. Brochard-Wyart, and D. Quere, "Capillary and Wetting Phenomena: Drops, Bubbles, Pearls, Waves", Springer, 2004.

B. W. Ninham, and P. Lo Nostro, "Molecular Forces and Self-Assembly: In Colloids, Nano Sciences and Biology", Cambridge University Press, 2010.

H. Bechhold, "Colloids in Biology and Medicine", D. Van Nostrand Company, 1919 (translation from the 2nd German edition).

W. Norde, "Colloids and Interfaces in Life Sciences", Marcel Dekker, 2003.

H. C. Berg, "Random Walks in Biology", Princeton University Press, 1993.

W. M. Saltzman, "Drug Delivery: Engineering Principles for Drug Delivery", Oxford University Press, 2001.

B. J. Berne, and R. Pecora, "Dynamic Light Scattering: With Applications to Chemistry, Biology, and Physics", Dover Publications, 2000.
P. C. Hiemenz, and T. P. Lodge, "Polymer Chemistry", 2nd ed., CRC Press, 2007.

Course Objectives:

1. Gain a comprehensive understanding of fundamental principles, concepts, and experimental techniques, pertaining to colloidal and interfacial phenomena (refer to the course outline for specific topics covered).
2. Explore contemporary developments in colloid and interface science through assigned readings from current research literature distributed throughout the semester.

Tentative Course Outline: (subject to changes)

Weeks of	Topics
1/8	0. Introduction (definition, examples, history) 1. Forces between molecules & between particles
1/8, 1/15, 1/21, 1/29 **(No class on 1/15: Martin Luther King Jr. Day)**	1.1 van der Waals (vdW) forces 1.1.1 vdW forces between molecules in vacuum (Keesom (orientation)/Debye (induction)/London (dispersion) interactions) 1.1.2 vdW forces between particles in vacuum 1.1.3 vdW forces between particles in solvent
1/29, 2/5	1.2 Forces between charged particles in electrolyte solutions 1.2.1 Electrostatic force 1.2.2 Osmotic force 1.2.3 DLVO theory 1.2.4 Surface chemistry & chemical specificity
2/12, 2/19	1.3 Steric polymeric force
2/19, 2/26	1.4 Hydration force 1.4.1 Hydrophobic hydration of small non-polar molecules 1.4.2 Hydrophobic hydration of larger particles
2/26, 3/4 **(Midterm exam on 2/29)**	1.5 Other forces 1.5.1 Solvent packing force 1.5.2 Undulation force 1.5.3 Depletion force 2. Phenomena involving collections of molecules & particles
3/4, 3/18 **(No classes on 3/4, 3/6 (APS Meeting), 3/11, 3/13, 3/15 (Spring Vacation))**	2.1 Coagulation & ordering of particles 2.1.1 Kinetics of coagulation of particles 2.1.2 Structures of aggregates 2.1.3 Concentration-dependent phase behaviors of colloids
3/25, 4/1	2.2 Capillarity, wetting, & insoluble monolayers 2.2.1 Surface tension 2.2.2 Cohesion, adhesion, spreading

	2.2.3 Capillarity 2.2.4 Insoluble monolayers 2.2.5 Amphiphilic assemblies
	3. Dynamics of particles & molecules in colloidal systems
4/8	3.1 Microscopic theory 3.1.1 Mean square displacement 3.1.2 Gaussian distribution
4/8	3.2 Macroscopic theory 3.2.1 Fick's law equations 3.2.2 Diffusion to a spherical absorber
4/8	3.3 Diffusion coefficient from first principles: Stokes-Einstein equation 3.3.1 Diffusion as thermal drift 3.3.2 Viscous drag coefficient
4/15	3.4 Sedimentation 3.4.1 Sedimentation velocity 3.4.2 Sedimentation equilibrium
	4. Measurements of structures & dynamics of colloids
4/15	4.1 Light scattering 4.1.1 Static light scattering (if time allows) 4.1.2 Dynamic light scattering
4/15	4.2 Rheology of suspensions and gels/networks (if time allows)
4/22 **(Final exam on 4/26)**	Student presentations

Grading:

Your course grade will be determined as follows: Homework (15%), Midterm Exam (30%), Final Exam (40%), Oral Presentation/Class Participation (15%). Regular attendance is mandatory. Unexcused absences will result in a one-point deduction from your final grade (out of 100). This course will employ a +/- grading system.

Homework:

There will be 3 – 4 homework sets, with deadlines set 2 – 3 weeks after assignment. *Students are required to complete all problems, but only specific problems will be graded*. Solutions for selected problems will be provided in advance, and some exam questions may be based on these homework problems. While general discussion among students is encouraged, individual work is expected unless otherwise specified. Copying will result in significant penalties for all parties involved.

Exams:

The midterm exam is scheduled for the evening of **Thursday 2/29** (specific time & location TBD). The final exam will be held during the class on **Friday 4/26**. Both exams are closed book and closed notes; however, students may use a single letter-size paper (8.5" × 11") with information on both sides.

Oral Presentation:
Each student is expected to deliver an oral presentation in front of the class, focusing on a research paper published in the scientific literature. Each presentation should last for approximately 12 minutes, followed by a Q&A session with the audience. It is recommended to use PowerPoint as the presentation format. To assist you in selecting suitable research papers, the instructor will provide a list of recommended papers by **Friday 3/15**. Students must email their paper selection for approval *no later than **Friday 3/29***. In the event that multiple students opt for the same paper, priority will be given to the student who submitted their selection first. Presentation dates are scheduled for **Monday 4/22** and **Wednesday 4/24**. It is mandatory to submit an electronic copy of your final presentation in PowerPoint format by 11:59 PM on the night before your scheduled presentation date. When submitting your presentation file, please adhere to the following filename format: "CHE 668 Presentation [Your Last Name].pptx". Grades will be determined based on several criteria, including the clarity of presentation, depth of understanding, and the ability to effectively respond to questions from the audience.

Unethical Conduct:
Engaging in any form of dishonesty, including seeking credit for work done unjustly or aiding others in doing so, is considered cheating. This includes activities such as falsifying class attendance records and using unauthorized aides during exams. Students found cheating will face substantial penalties.

Communication Protocols:
To seek additional assistance or address course-related questions, it is highly recommended to utilize the professor's office hours. If you have personal issues that require immediate attention, you may contact via email or phone.

Campus Emergency:
In the event of a significant campus emergency, such as a pandemic, please be aware that course requirements, deadlines, and grading percentages may be subject to modifications necessitated by revised semester calendars or other unforeseen circumstances. During such disruptions, any changes to this course will be communicated through email.

ChE 30600 Design of Staged Separation Processes Fall 2025

A. Instructor:

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

B. Teaching assistants:

Samantha Jernigan
Gautam Kare
Rajeev Kumar

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

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

Classes will meet on Mondays and Wednesdays and some Fridays.

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

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

F. Course Outcomes.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Recitations:

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

Laboratory:

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

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

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

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

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

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

A few reminders:

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

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

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

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

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

Course Grading:

The final course grade will be determined by the following:

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

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

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

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

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

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

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

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

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

Exams:

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

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

Homework:

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

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

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

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

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

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

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

Official Purdue University Student Policies

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ChE 348 – Fall 2025 - Tentative Course Schedule

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

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

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

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

Exam 3/ Final	TBD	Ch 1-15

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

G. Anticipated Course Content

1. Introductory Material..... 1 week

2. Flash Distillation ..... 1 week

3. Binary Distillation ..... 2 weeks

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

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

6. Batch Distillation ……1 week

7. Staged and Packed Column Design …… 1 week

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

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

8. Extraction ..... 1 week

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

10. Adsorption Separations …… 1week

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

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

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

J. Grading Policy:

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

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

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

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

K. Homework:

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

L. Exams

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

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

M. On-line Course Evaluation

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

N. Design Project:

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

O. Student Expectations.

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

P. Instructors' Commitment.

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

Q. Consulting with the Faculty Member.

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

R. Academic Dishonesty.

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

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

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

T. Violent Behavior Policy.

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

U. Nondiscrimination.

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

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

1. For any emergency call 911.

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

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

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

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

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

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

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

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

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

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

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

CC. Individual Learning and Testing Needs.

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