

**Tuskegee University
College of Engineering
Department of Chemical Engineering**

Spring 2024



Course: CENG 0470, Chemical Engineering Plant Design

Lecture Hours: Tuesday and Thursday 09:30 AM - 12:30 PM

Location: Luther H. Foster Hall, Room 528

Instructor: Shahryar Jafarinejad, PhD

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Office Hours: Tuesday 01:00 PM - 02:00 PM; Wednesday 11:00 AM - 01:00 PM; others by appointment

Credit Hours: 4.0

Prerequisites: CENG 0310, CENG 0360, and CENG 0380

Corequisite: CENG 0430

Textbook: M.S. Peters, K.D. Timmerhaus, R.E. West, Plant Design and Economics for Chemical Engineers, Fifth Edition, McGraw-Hill.

Course Objectives:

Students will

Objective1. Design a complete chemical process.

Objective2. Perform economic analysis of a process.

Objective3. Understand professional and ethical responsibilities of chemical engineers.

Objective4. Develop oral and written communication skills.

Course level student learning outcomes:

Outcomes	1	2	3	4	5	6	7
Objective1	X	X					X
Objective2		X					
Objective3				X			
Objective4			X				

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

General Policies:

- Attendance is important for successful completion of this course. You will need to sign the class roster each day to be counted as attending the class. Students are expected to attend all scheduled classes. A student who arrives in class after beginning of class will be considered absent but may still attend the remainder of the class.
- All assignments are due at the beginning of class on the due date. Due dates may be extended at the professor's discretion.
- **No late homework is accepted. ALL HOMEWORK must be turned in complete in order for the student to be eligible to sit for the final exam.**
- **No late project is accepted.**
- A "day" for the purpose of defining early, timely and late assignments is referenced to 09:40 AM.
- You should use CANVAS to submit assignments. Some assignments may be given through email. You will be held entirely responsible for failure to receive and read email in a timely manner.
- You should show all your work in homework, tests, exams, or quizzes, not just to receive partial credit in cases where your answer is not correct but also to support your answer and receive full credit when correct. Correct answers that are not fully supported by work will generally not receive full credit.
- Cheating will not be tolerated. **Any student caught cheating will get a zero for that exam.**
- A second offense will result in an F for the course.
- Be prepared to work out example/homework problems on the board.
- Students are not allowed to talk with each other during lecture, quizzes, exams, and final exam. If there is an emergency, the students need to go outside of the class to talk for maintaining a better learning environment in the classroom.
- The student is expected to attend regularly all classes in an attire that meets the College's Dress Code Policy of Business Casual. Students who are not attired appropriately will be asked to leave class and may return with appropriate dress. Students may return with the tardy noted; however, students who do not return will receive an absence. The instructor has the right to establish the rules and regulations for the classroom for it to be a conducive place for teaching and learning. The classroom is the place for the beginning of professional training.
- Final exam will be done in the exam white book given by the instructor in pen.
- Cell phones must be turned off and put away during quizzes, exams, and final exam; otherwise, it will be considered a form of cheating. The use of Cell phones during class is discouraged at all times as it is distracting to the user, the instructor, and other students.
- You will have 3 tests throughout the semester and ALL test scores will count towards the calculation of your final grade. Quizzes will be announced or unannounced, and may be given at any time for 10 or 15 minutes. You will not

get extra time if you arrive late. Students who miss a quiz without an official excuse will receive a zero for that work.

- No sharing of any materials (e.g., calculator) during exams.
- No make-up assignments (tests, quizzes, and design problems) will be given. Exceptions:
 - University allowed excuses with WRITTEN PROOF.
 - Medical reasons with WRITTEN PROOF.
 - In the event of a medical emergency, proof must be provided within 24 hours of the student's return to campus or release from doctor's care.
 - In the event of an excused absence, make up assignments must be done by the next class meeting following the date of the excused absence (unless scheduled with the instructor). The student is responsible for his/her own missed assignments.
 - A student, who has a medical excuse (i.e. note from a physician or qualified health care facility) for missing an exam, waives that excuse when he/she shows up at the exam and begins to take the exam. A make-up exam will not be given.
 - It is likely that any makeup work will need to be scheduled during the interim period. Thus, a student with a valid excuse will receive a grade of I in the course until the work is made up. The exception is if the score on the missed work does not impact the final letter grade. In this case, no make-up assignment will be given. Regarding exams, the first excused absence for an exam will result in the substitution of the final exam score for that exam grade. General makeup policies apply for subsequent excused absences from exams.
 - Effective Spring 2012, the tuskegee.edu email system at Tuskegee University is required for all instructional administrators, faculty, staff and students.
 - Effective Spring 2012, all instructional administrators, faculty, staff and students are required to use CANVAS and Navigate (EAB).
 - Academic dishonesty policies outlined in the undergraduate handbook will be strictly enforced.

Grading Criteria:

Category	Percentage (%)
Exams	20
Design Project	50
Final Exam	20
Homework/Quizzes	10

Final Grading Scale:

Percentage (%)	Letter Grade
90-100	A
80-89	B
70-79	C
60-69	D
0-59	F

Design Project:

Tuesday and Thursday (11:00 AM - 12:30 PM): Each student should present a progress report on his/her project.

Design projects are due 20 days before the final examination. These should be written and typed independently; however, group discussion is encouraged.

Design Project (50%):

Category	Percentage (%)
Weekly progress reports	15
Oral presentation	10
Final report	25

Final Report (25%):

Category	Percentage (%)
Content	5
Summary	5
Introduction and theory	10
Hazard control and analysis	10
Results	10
Discussion	10
Conclusion	5
References	5
Design calculations	40

Course Content and Reading Assignment Schedule:

Topics	Session
Chapter 1: Introduction	1a
Chapter 11: Written and oral design reports	1b
Chapter 2: General design considerations	2a-4a
Chapter 12: Materials-handling equipment-design and costs	2b-4b
Chapter 3: Process design development	5a-6a
Chapter 13: Reactor equipment-design and costs	5b-6b
Test No. 1	7
Chapter 4: Flowsheet synthesis and development	8a-9a
Chapter 14: Heat transfer equipment-design and costs	8b-9b
Chapter 5: Software use in process design	10a-12a
Chapter 15: Separation equipment-design and costs	10b-12b
Chapter 6: Analysis of cost estimation	13a-14a
Design of process control systems	13b-14b
Chapter 7: Interest, time value of money, taxes, and fixed charges	15-16
Chapter 8: Profitability, alternative investments, and replacements	17-18
Test No. 2	19
Chapter 9: Optimum design and design strategy	20-22
Chapter 10: Materials and fabrication selection	23
Engineering ethics and professionalism	24
Review	25

References

- 1) Seider, Seader and Lewin, Process Design Principles, John Wiley & Sons, Inc., New York, NY 1999.
- 2) R. Turton, R. Bailie, W. Whiting, and A. Shaeiwitz, analysis, Synthesis, and Design of Chemical Processes, Prentice Hall, upper Sadlle River, NJ., 1998.
- 3) Perry and Chilton, Chemical Engineer's Handbook, Sixth Edition, McGraw-Hill Book Company, New York.
- 4) McCabe and Smith, Unit Operations of Chemical Engineering, Third Edition, McGraw-Hill Book Company, New York.
- 5) Gael D. Ulrich, A Guide to Chemical Engineering Process Design and Economics, John Wiley & Sons, N. Y.
- 6) Joseph E. Shigley, Mechanical Engineering Design, Second Edition, McGraw-Hill Book Company, New York.
- 7) H. Carl Bauman, Fundamentals of Cost Engineering in the Chemical Industry, Reinhold Publishing Corporation, N. Y.
- 8) Thomas K. Sherwood, A Course in Process Design, The M.I.T. Process, Cambridge, Mass., 1963.
- 9) Aerstin and Street, Applied Chemical Process Design. Plenum Press, New York.
- 10) Kenneth M. Guthrie, Process Plan Estimating Evaluation and Control, Craftsman Book Company of America, Solona Beach, California.
- 11) Flow of Fluids Through Valves, Fittings and Pipes, Crane Corp, New York.
- 12) M. W. Martin, and R. Schinzinger, Ethics in Engineering, 2nd Edition, McGraw Hill, New York, 1989.
- 13) Donald E. Garrett, Chemical Engineering Economics, Van Nostrand Reinhold, New York, 1989.
- 14) William D. Baasel, Prepliminary Chemical Engineering Plant Design, Van Nostrand Reinhold, New York, Second Edition, 1990.
- 15) S. Jafarnejad, Petroleum Waste Treatment and Pollution Control, 1st Edition, Butterworth-Heinemann, Elsevier, 2016.
- 16) N. Nevers, Air Pollution Control Engineering, The McGraw-Hill Companies, Inc., 2000.
- 17) K.B. Schnelle, C.A. Brown, Air Pollution Control Technology Handbook, CRC Press LLC, 2002.
- 18) L.K. Wang, N.C. Pereira, Y.T. Hung, Advanced Air and Noise Pollution Control, Humana Press Inc., 2005.

List of design books in the reference section of engineering library

Book Name	Author	Copyright	Publisher	City Published
Handbook of Chemical Processing Equipment	Nicholas P. Cheremisinoff	2000	Butterworth-Heinemann	Boston
Chemical Engineer's Condensed Encyclopedia of Process Equipment	Nicholas P. Cheremisinoff	1999	Gulf Publishing Company	Houston
Chemical Reaction Hazards, Second Edition	John Barton and Richard Rogers	1997	Gulf Publishing Company	Houston
Handbook of Chemical Compound Data for Process Safety	Carl L. Yaws	1997	Gulf Publishing Company	Houston
Applied Process Design for Chemical and Petrochemical Plants, Volume 1 Third Edition	Ernest E. Ludwig	1999	Butterworth-Heinemann	Boston
Applied Process Design for Chemical and Petrochemical Plants, Volume 2 Third Edition	Ernest E. Ludwig	1997	Gulf Publishing Company	Houston
Applied Process Design for Chemical and Petrochemical Plants, Volume 3 Third Edition	Ernest E. Ludwig	2001	Gulf Professional Publishing, an imprint of Butterworth-Heinemann	Boston

STATEMENTS OF COE EXPECTATIONS REGARDING STUDENTS' ACADEMIC PROFICIENCY

Academic excellence is a tradition of the Tuskegee University College of Engineering, (COE). Students and faculty must collectively and proactively guard this tradition. The college hereby renews its commitment to the tradition by stating as follows:

1. Students are expected to develop self-confidence through acquisition of in-depth knowledge in all subjects through, as a minimum:
 - a. Studying to understand rather than studying to get by.
 - b. Challenging oneself to solve problems independent of textbooks or formulae sheets
 - c. Attempting diverse and multiple problems, multiple times, for depth and breadth of knowledge

2. Students are expected to be self-motivated through setting their own goals & schedules, spending time to study, and sharing their knowledge with peers.
 - a. Students should invest a minimum of two hours of study-time per week for every credit hour taken.
 - b. Students should seek or establish environments that encourage positive social interaction and engages in active learning.

3. COE is committed to providing support systems to students for higher achievement through the following avenues:
 - a. Direct access to instructors
 - b. Archives of faculty recorded course lectures
 - c. Dedicated peer tutors by fellow students at all academic levels
 - d. Periodic visits by alumni and industry subject matter experts
 - e. Opportunities for local and national academic related competitions

4. All COE students are expected to take advantage of all support systems. Students are particularly expected to adopt the notions of “self-confidence through knowledge acquisition” and “self-motivation to bring out best in self” as the COE fundamental culture for success.

Covid-Statement

Excuses related to covid infection as well as exposure have to be received from the Dean of Students office. Students should request the excuse for absence from the Dean of Students office as soon as they become aware of covid infection or exposure. Students may request a classes missed memo by contacting the Office of the Dean of Students and Student Conduct (334) 727-8421, via e-mail tharper@tuskegee.edu or by going into the office located in suite 203 Tompkins Hall.