

TUSKEGEE UNIVERSITY
College of Engineering
Department of Chemical Engineering
CENG 210 – Material and Energy Balances
Fall 2023

<u>Instructor:</u>	Kyung C. Kwon
<u>Office:</u>	Rooms 103/514, Luther H. Foster Hall
<u>Office Hours:</u>	MW: 12:00 pm (noon) – 5:00 pm
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<u>Class Room</u>	LHFH 528
<u>Class Schedule:</u>	MWF: 9:00 am -10:00 am Th: 12:00 pm (noon) – 1:00 pm
<u>Catalog Description:</u>	Materials and Energy balances for engineering systems subjected to chemical and physical transformations; Calculations on industrial processes.
<u>Pre-requisite:</u>	CENG 110 (Introduction to Chemical Engineering), MATH 207 (Calculus I), CHEM 231 (General Chemistry)
<u>Co-requisite:</u>	None
<u>Required Textbook:</u>	Richard M. Felder and Ronald W. Rousseau, <u>Elementary Principles of Chemical Processes</u> , 4th edition with Integrated Media and Study Tools, Wiley and Son, New York, 2016.
<u>References:</u>	David M. Himmelblau, <u>Basic Principles and Calculations in Chemical Engineering</u> , 7th edition, Prentice-Hall, Englewood Cliffs, NJ, 2004.

Chemical Engineering Program Educational Objectives:

Within a few years after graduation, our graduates will:

1. Be successful practitioners in chemical and related industries, private practice, government or academia.
2. Be engaged in graduate studies or continuing education endeavors in chemical engineering or related fields.
3. Be engaged in professional development commensurate with a career by participating in structured professional activities.

The following course objectives of this course are chosen to advance our above-mentioned chemical engineering program objectives.

Course Objective:

1. Learn fundamental chemical and physical principles of material and energy balances.
2. Apply fundamental principles of material and energy balances to solutions of realistic problems in chemical processes
3. Apply mathematical principles to solutions of balance problems
4. Learn to use computer software for solutions of material and energy balance problems

Course Outcomes

ABET Student Outcomes	1	2	3	4	5	6	7
Objective 1	X						
Objective 2	X						
Objective 3	X						
Objective 4	X						

ABET Student Outcomes

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.

CLASS POLICIES & GRADING:

All students are REQUIRED to use Canvas. All communications will be through Canvas and TU email. Your Tuskegee email must be secured and use it. Syllabus, announcements, and others will be posted in Canvas. You are entirely responsible for failure to receive and read TU emails in a timely manner.

Cell phone and portable computers:

Cell phones (working or not) and portable computers **MUST** be turned off and **PUT AWAY** during quizzes, tests, and final exam; otherwise, it will be considered a form of cheating. Cell phones and portable computers **MUST** also be turned off and **PUT AWAY** during class time.

Class Participation:

Class participation includes attendance, participation in class discussions and activities, and working problems on the board. Students are required to attend all scheduled classes. The instructor will take attendance before starting each class. You are expected to stay in the classroom during one-hour and two-hour sessions.

Home work/Tests/Final exam:

Homework will be assigned in the class or Canvas and completed homework assignments will be submitted to the instructor at the beginning of the class on the due date. Students are responsible to check the Canvas regularly for any assigned homework and announcements.

All Tests/final exam will be taken with available references such as the textbook, class notes, homework assignments, and any other references.

Covid:

All students in the class room must wear masks that covers both their nose and their mouth.

Excuses related to **Covid infection** as well as exposure have to be received from the Dean of Students office. Students should request excuses for absence from the Dean of Students office as soon as they become aware of Covid infections or exposures. Students may request a class-missed memo by completing this form (<https://forms.gle/4ozusHX2tTCUW4yK6>) and then contact 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 in the Tompkins Hall.

Grading:

Homework	=	20 %
Tests	=	50 %
Final Exam	=	30 %
Total	=	100 %

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

Policies:

1. Lectures will be delivered in the class on MWF. Problems will be discussed during the lab (study session) period on Thursday.
2. The course outline, homework assignments, and announcements are posted in the Canvas

3. You should show your all works (solution procedures) in tests, final examination, homework problems to get partial credits on your works, even if your answers are wrong.
4. Our CENG 210 class starts on 9:00 am.
5. 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.
6. Students are not allowed to talk with each other during lecture, tests, and final exam. If there is an emergency, students need to go outside of the class to talk for maintaining a better learning environment in the classroom.
7. All **electronic devices** (i.e. cell phones, iPad, laptop etc.) must be turned off and put away during class time to avoid disruptions.
8. **Head gear and dark sun shades** are not allowed in class, unless they are of religious significance.
9. The student is expected to attend regularly all classes in 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. However, students who do not return will receive an absence. The instructor has the right to establish rules and regulations for the classroom. The classroom is the place for the beginning of professional training.
10. No make-up assignments (tests, homework assignments, final examinations) 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. The student will receive a full credit for class participation for an excused absence.
11. No food, drink, candy, and chewing gum in the class
12. Answers to homework problems and tests should be hand-written on 11-inch x 8.5-inch papers. Answers to homework problems should be well organized, paginated, and have a typed cover page indicating your name, course name, and assigned homework problems. Each student should prepare his/her own reports.
13. Other policies may be announced later if necessary

Important points to remember

1. Read ahead – make sure you have already read the chapter/section before it is being discussed.
2. Discussion – be prepared to answer questions during the lecture and ask questions on the topic that you do not understand
3. Check Canvas frequently to get information about the class.

Course Timetable/Test/Exam Schedule

Sessions	Topics	Reading Assignments, Chapters
1	<u>Chemical Engineers</u>	1
2-4	<u>Introduction to Chemical Engineering</u> Units & Dimensions, Unit Conversions Force & Weight, Dimensional Homogeneity, Dimensionless Quantities, Arithmetic Calculations, Scientific Notations Significant Figures, Precision	2
5	Test 1	
6-8	<u>Processes and Process Variables</u> Mass and Volume, Flow Rate, Chemical Composition, Pressure, Temperature	3
9	Test 2	
10-16	<u>Fundamentals of Material Balances</u> Balances on Multiple-Unit Processes, Recycle and By-pass, Chemical Reaction Stoichiometry, Balances on Reactive Systems, Combustion Reactions.	4
17	Test 3	
18-21	<u>Single-Phase Systems</u> Liquid and Solid Densities, Ideal Gases, Equations of State for Nonideal Gases	5
22	Test 4	
23-26	<u>Multiphase Systems</u> Single Component Phase Equilibrium, The Gibbs Phase Rule, Gas-Liquid Systems with One Condensable Component, Multi-component Gas-Liquid Systems, Solutions of Solids in Liquids, Solubility	6
27	Test 5	

Sessions	Topics	Reading Assignments, Chapters
28-32	<u>Energy and Energy Balances</u> Forms of Energy with The First Law of Thermodynamics, Kinetic and Potential Energy, Energy Balances on Closed Systems and Open Steady-State Systems, Tables of Thermodynamics Data, Energy Balance Procedures, Mechanical Energy Balances	7
33	Test 6	
34-35	<u>Balances on Nonreactive Processes</u> State Properties, Process Paths, Changes in Pressure and Temperature, Phase Change Operations, Mixing and Solutions	8
36	Test 7	
37-40	<u>Balances on Reactive Processes</u> Heat of Reaction, Heat of Formation, Heat of Combustion, Energy Balances on Reactive Processes, Fuels and Combustion	9
41	Test 8	
42	<u>Balances on Transient Processes</u> The General Balance Equation, Material Balances, Energy Balances on Single-Phase Nonreactive Processes	10
43	Test 9	
	Final Examination	