

Material and Energy Balances

ECH 3023 Sections 12351 & 12352

***Class Periods:* MTRF; Period 8 (3:00-3:50 PM) or Period 9 (4:05-4:55 PM)**

***Location:* N/A (online)**

***Academic Term:* Fall 2020**

A quick word of advice

Material and Energy Balances (MEB) is the first class in the curriculum of Chemical Engineering. This course will introduce you to ideas, concepts, equations, and processes that you will **repeatedly** revisit in finer detail in later ChE courses. Therefore, it is essential that you work hard to master the material, because subsequent courses will build on the foundation established here.

Most concepts in MEB might not seem difficult to understand at face value. However, the difficulty in this class lies in the *application* of these concepts in order to solve problems. While your core science and math courses relied heavily on rote memorization to teach you the mechanics of problem-solving, this course will test your ability to apply old information in new situations.

The people that you meet in this class will become your colleagues for the remainder of your ChE education and beyond. I suggest that you meet and interact with as many of your classmates as possible, even if you are introverted. You are encouraged to work and study in groups and help each other as much as possible (in compliance with principles of academic honesty; see below).

Instructor: VJ Tocco

I prefer that you call me "VJ", but you may also call me "Dr. Tocco" if you are more comfortable addressing your instructors formally.

E-Mail: vjtocco@ufl.edu

E-mail is my preferred method of communication outside of class time. To ensure that I reply, you must use proper e-mail etiquette and include "ECH3023" in the subject line.

Office: 322 Black Hall, (352) 294-1290

Because the semester is online, I do not plan to be in my office very often (if at all).

Supervised Teaching Student: Sitong Liu

E-mail: liusitong@ufl.edu

Online Course Format

All required course materials and resources (except the textbook) for ECH 3023 are contained on, or linked to, the course Canvas page. It also serves as the primary means of communication with your classmates and instructors (outside of zoom interactions). You should get into the habit of checking this Canvas page regularly for announcements and action items. You should also enable Canvas to send you e-mail notifications, such that you are alerted to any updates or correspondence (the default state is "on", so no action is required unless you've disabled this feature).

Lectures

All course content will be delivered via asynchronous, screen-casted videos. For a usual class day, expect 2-3 short (10-15 minute) videos. These videos will be posted on MediaSite no later than the beginning of the class period, and links posted on the "Modules" page of Canvas.

Office Hours/Review: Mondays, 3:00 – 3:50 PM & Thursdays 4:05-4:55 PM on Zoom

These sessions are meant to foster interaction between students and the instructor. Attendance is completely optional. The content of these sessions will be different on Mondays and Thursdays, and open for students in either section to attend.

VJ will begin the session by giving a cursory review of lecture material covered since the last review session and field student questions relating to this material. At the end, the floor will open for other student questions.

Portions of the office hour/review sessions will be recorded and posted in a similar manner to the lecture videos for those who are unable to attend.

Online Course Recording

Our class sessions may be audio-visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Problem-Solving Sessions (required): Tuesdays 3-3:50 PM & 4:05-4:55 PM on Zoom

Each Tuesday, VJ or Sitong will lead a guided problem-solving session, where you may work with a group of peers to complete a practice problem. The content of the two sessions will be the same, and you are required participate in the session of the section for which you are registered. Attendance will not officially monitored (no credit or course points awarded). As such, these sessions will not be recorded or posted to MediaSite/Canvas.

Exam dates:

Tuesday, September 29 (8:00 PM - 10 PM)

Tuesday, October 20 (8:00 PM – 10 PM)

Tuesday, November 10 (8:00 PM – 10 PM)

Tuesday, December 8 (8:00 PM – 10 PM)

These exam dates are subject to change, with at least 2 weeks of notice. If you have a conflict (another exam) during any of these times, please notify your instructor ASAP.

Course Description

(4 credits) Formulation and solution of material and energy balances utilizing physical/chemical properties of matter as applied to analyzing unit operations systems.

Course Pre-Requisites / Co-Requisites

Prerequisites: CHM 2046 (General Chemistry), MAC 2312 (Calculus 2) and PHY 2048 (Physics 1)

Co-requisites: PHY 2049 (Physics 2), MAC 2313 (Calculus 3), and MAP 2302 (Differential Eq.)

Course Objectives

Broadly, at the end of this course, a student should be able to do the following:

- 1) Perform basic chemical engineering calculations, including (but not limited to) unit conversions, mass/mole conversions, balance chemical reactions, interpolate tabulated data...
- 2) Draw and label a process flow diagram from a written description of a process.
- 3) Perform a degree-of-freedom analysis.
- 4) Derive and solve the equations needed to solve for unknown process variables.
- 5) Use Microsoft Excel to automate repeatable and tedious calculations.

In addition to these learning objectives, the assignments are designed to develop the following skills, which are characteristic of real-world problems, and therefore essential for any practicing chemical engineer:

- 1) Read, interpret, and follow directions, prompts, and problem statements.
- 2) Detect and disregard superfluous given information.
- 3) Use resources to find extra information which is needed, but not given.
- 4) Brainstorm reasons for unexpected behavior (troubleshooting).

Materials and Supply Fees

None

Professional Component (ABET):

Specific outcomes of instruction

- The student will be able to identify the unit operations involved in a process, draw process flowcharts for single- and multiple-unit operations, identify process variables, label process streams, and develop relationships between process variables for individual process units and complex processes common to chemical engineering practice.
- The student will be able to develop mass and energy balance equations necessary to solve reactive and non-reactive steady-state and transient systems by hand.
- The student will be able to perform simple degree-of-freedom analysis to identify the number of unknowns relating total mass and energy, mass and energy flow rates, and mass composition.
- The student will be able to use fundamental thermodynamic relationships (equations of state, phase equilibria, vapor pressure) as well as empirical thermodynamics relationships (Raoult's law, Henry's law, Antoine equation), and apply these to the solution of mass and energy balance problems.
- The student will be able to report engineering calculations and problem solutions in a professional manner.

Relation to Program Outcomes (ABET):

Outcome	Coverage
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
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	High

Required Textbook

Elementary Principles of Chemical Processes (4th Ed.) by Felder, Rousseau, and Bullard; Wiley, ISBN 13:978-0-470-61629-1

Note: This textbook is widely regarded by practicing Chemical Engineers as one of the most helpful and well-written Chemical Engineering textbooks. Although readings will not be assigned for credit, you may find that reading the textbook is essential in order to perform well in this course. The textbook also contains many useful tables of physical data. You may use another edition of the textbook, but keep in mind that it is your responsibility (and your responsibility alone!) to determine the differences between your edition and the 4th edition.

Required Software

Microsoft Excel will be needed for some homework assignments. Therefore, you will need access to this software on your personal laptop.

Recommended Materials

Any model of scientific calculator may be useful for solving homework and exam problems.

Course Schedule

Refer to the "Modules" page on Canvas for more detail

Week	Begins	Topic(s)
1	8/31	Course Introduction, Chemical Processes, Data Fitting, Pressure
2	9/7	Process Variables, Process Classification, Process Flow Diagrams
3	9/14	Material balance calculations, Single-Unit Processes, Multiple-Unit Processes
4	9/21	Recycle/Bypass, Stoichiometry, Reactive Systems
5	9/28	Combustion Reactions, Exam 1
6	10/5	Ideal Gas Law, Single-Phase Systems, Introduction to Phase Equilibrium
7	10/12	Multiphase Systems, Txy & Pxy Diagrams
8	10/19	Exam 2 , Introduction to Energy Balances
9	10/26	Thermodynamic Data Tables, Mechanical Energy Balances
10	11/2	Non-reactive Systems Involving an Energy Balance
11	11/9	Nonreactive Energy Balances, Exam 3
12	11/16	Reactive Energy Balances
13	11/23	Chemical Engineering Ethics and Safety
14	11/30	Unsteady-State Processes
15	12/7	Course Debrief and Outlook, Exam 4

Attendance Policy and Expectations

Virtual attendance will not be officially monitored or graded, but you are expected to attend and participate in Tuesday problem-solving sessions (see above). You are required to watch all course content videos at your own pace, but watching recordings of office hour sessions is optional.

When interacting with fellow students and instructors online, you are expected to maintain professionalism and behave respectfully. The community of ECH 3023 will be supportive and inclusive. Offensive imagery and/or language will not be tolerated in any capacity.

Evaluation of Grades/Course Assignments

Exams: 4 exams, 100 Points Each

All exams are open-resource (books, notes, internet), and will therefore not be proctored with HonorLock or ProctorU. However, you are not permitted to consult with any other person (or work done by other people) in any capacity while completing exams. This includes, but is not limited to: communication with classmates or previous ECH 3023 students and searching for/referencing solutions online or from previous semesters.

Each exam will last two hours with a 30-minute grace period for scanning and uploading solutions to Canvas. The exams are not necessarily cumulative, however, material from each section builds upon skills and concepts learned in previous chapters. The primary focus will be on material covered since the last exam.

The format of the questions will vary, but expect a range of “easy” (roughly 30%), “medium” (roughly 40%) and “challenging” (roughly 30%) parts, with the point values for each question/part clearly labeled.

Quizzes: 10 quizzes, 10 points each (due Mondays)

Each week (approximately), a multiple choice/short answer quiz will be administered in Canvas that will cover material from the previous week of class. These quizzes will be published on Sunday evening/Monday morning, and due at 11:59 PM on Monday evening. They should ensure that you stay current with course material.

There will be a time limit associated with these quizzes (20 minutes), but may be completed at any time in the day (before 11:59 PM). Each student will only get only one attempt.

Homework: 8 assignments, 50 points each (due Tuesdays)

Homework will be assigned weekly, except exam weeks and the class project due date.

Expect the homework problems to challenge you. VJ and Sitong will answer direct, well-articulated questions relating to the homework, but will not guide you through the solution, troubleshoot your mistakes, or check your answers before submission. You are permitted to discuss the problems and problem-solving strategies with your classmates, but you may not breach the Academic Honesty Course Policy (see below).

Solution Submission: Homework is to be submitted electronically on Canvas. Your homework solution must include the problem statements, with all requested answers reported in the answer box(es) provided.

A good problem solution primarily consists of a description of problem-solving logic in complete sentences, with equations to supplement the logic. Your work should be organized neatly and be easy to read and follow. You may type your solutions, but equations must be typeset with the “Equation Editor” in Word (or equivalent in another program). Because this can become quite time-consuming, I recommend hand-writing your solutions.

There are several free smartphone apps that can scan your work and convert it to a PDF (such as “CamScanner”). Photographs (learn the difference between a PDF and a photograph) are not acceptable. Please let VJ know if access to this technology is unavailable, and accommodations will be made.

Grading: Homework assignment rubrics will be set and released after assignment submission, and are not limited to only “correctness” of your solution; they may include criteria relating to simply following directions or professionalism in the presentation of your solution.

Scores/feedback will be available approximately one week after submission. We will attempt to give individualized comments electronically for less than full marks, but recognize that this may not be practical for such a large class size. In addition to posting the homework solutions, we will review the most common errors during a class period after assignment grading.

Due Date: Homework is due at 11:59 PM on Tuesdays and graded *as submitted*.

To incentivize you to start (and finish) homework assignments early, homework submitted by **noon** on the day before the due date will earn five automatic bonus points.

Late homework will be penalized 10 points per day, up to **three days** after the due date. In other words, assignments submitted from 12:00 AM – 11:59 PM on Wednesday can earn a maximum of 40 points, from 12:00 AM – 11:59 PM on Thursday: 30 points, and 12:00 AM – 11:59 PM on Friday: 20 points. Homework solutions will be posted on Saturday morning, after which no homework will be accepted.

Low Score Drop: Each student's lowest homework score **and** quiz score (**one** assignment of each type) will be replaced with the average of the other assignments of that type at the end of the semester. This policy covers emergencies and technological issues alike, and no documentation or action is required of the student.

No further accommodations or deadline extensions for homework or quizzes will be granted due to technological issues or emergencies. You should anticipate that these issues will arise at the worst possible time (for example, wifi always seems to crash 10 minutes before the homework is due), and plan contingencies.

Significant progress must be demonstrated on a minimum of 70% of the homework problems in order to pass the course.

Team-Based Project: 100 Points

In the class project, you will work in assigned groups of 3-4 to compose and solve an original problem. More details will be given when the project is assigned in late October.

Extra Credit: 20 Points Possible (due Monday, 12/7)

Option 1: Write an original exam/homework problem. You must submit the **problem statement, an answer key, and an explanation of the concept** that the question is testing. In addition, by submitting these questions, you authorize me to use them in subsequent semesters (or, if the question is good enough, this semester!). You may submit as many questions as you like.

Option 2: Submit a creative expression of your experiences in ECH3023. Submissions may include a song, video, poem, craft, artwork, or any other creation. The only constraints are that your submission must be completely original, and your submission must be **shared** with the rest of the class on the last day of class.

Each extra-credit submission is worth 10 points, and the maximum per student is 20 total extra-credit points. You may submit as many "Option 1" problems as you wish, but you are limited to only one "Option 2" creative extra credit project.

Grading Policy

You may earn 1000 possible points in this course by completing assignments (see above). Your final letter grades will be based on your final point total only (no curve). The official thresholds to earn a given letter grade are listed below:

Point Value	Letter Grade
960-1000	A
920-950	A-
880-910	B+
840-870	B
800-830	B-
760-790	C+
720-750	C
680-720	C-
640-680	D+
600-640	D
0-600	F

At the end of the term, the instructor may add points to all students' scores uniformly to improve grades, but may NOT subtract points to diminish grades.

Students in the "gray areas" (gaps) between grading bins may earn either the next letter grade up, or the next letter grade down based on their professionalism, participation, effort, distance to the next bin, and performance trajectory. Final decisions are based solely on the instructor's discretion. Note that there are no gray areas below C letter grades.

More information on UF grading policy may be found at:
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Regrades:

To submit a regrade, fill out the regrade request form (a blank copy may be found on Canvas). This form will require you to directly state the number of points you think you deserve and a full explanation of the discrepancy (unless it is a simple addition error). **The deadline for regrades is one week from the date the assignment was graded.**

Make-Up Policy

In the case of an emergency, technological issue, or excused absence during an exam, one **comprehensive** make-up exam will be offered at the end of the semester, provided that **adequate proof/documentation is presented in writing.**

Make-up work for extended excused absences will be considered on a case-by-case basis in a manner that is fair for you and your classmates. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.
<https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.