The University of Western Ontario

Faculty of Engineering

DEPARTMENT OF CHEMICAL AND BIOCHEMICAL ENGINEERING

CBE 3318a– Chemical Process Simulation
Course Outline 2023-2024

This course aims to introduce and to develop student skills on modern methods for simulation of chemical process unit. Differential heat balance, mass balance. Energy and material balance methods in process unit. Executive systems for overall balance methods. Physical properties, computer packages.

Students should be able to:

- Identify the principles of modular representation, various types of modules available in the Hysis package, the properties and the limitations of the modules, the strategies for tearing streams and convergence.
- Translate a process flow diagram in a process flowsheet. Develop an understanding of flowsheeting, steady state models, stream variables, degree-of-freedom analysis, simulation of several units in chemical networks, partitioning and precedence order.
- Identify the extent of reaction variables, independent chemical reactions and the degree-of-freedom analysis for chemical reactors.
- Develop an understanding of the element balance approach, the algebra of element balances, the application of element balances in the context of a unit and a chemical process
- Perform mass and energy balances using Hysis package in a unit and in a network of units with consideration of degrees-of freedom, principles of decoupling of mass and energy balances, partitioning and precedence order.
- Identify the common factors in various simulation packages, the physical properties package capabilities, the available modules for quick design of various units.

Prerequisites

CBE 2220A/B, CBE 2221A/B, CBE 2224A/B, or GPE 2218A/B, ES1050.

Note: It is the **student's responsibility** that all the Prerequisite and Corequisite conditions are met or that special permission to waive these requirements have been granted by the Faculty. It is also the **student's responsibility** to ensure that they have not taken course listed as an Antirequisite. They students may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Corequisites

None

Antirequisites
Former CBE 3397

Contact Hours
2 lecture hours; 2 tutorial hours each week.

Course instructor

Dr. H. deLasa (CMLP 3331) Telephone: 519-661-2111 ext: 82144 email: hdelasa@uwo.ca

Undergraduate Assistant
(TEB 477) Telephone: 519-661-2111 ext: 82131 email: cbeundergraduate@uwo.ca

Required Text
None

Course Notes
Will be available (course website)

Reference Text
C.V. Reklaitis, 'Introduction to Material & Energy Balances' John Wiley & Sons, 1983.

Units
SI and other units will be used

Specific Learning Objectives

1. Understand the basic concepts involved in the simulation of a unit in a chemical process
2. Establish the degree-of-freedom of a unit in a chemical process.Solve this unit using the Hysis package. **CEAB-ET2** Indicator.
3. Be introduced to the basic commands of the Hysis package **CEAB-ET2** Indicator.
4. Be introduced to the techniques of drawing flowsheets including icons**. CEAB-ET2** Indicator.
5. Understand the concepts involved in the simulation of a network of units in a chemical process. Establish the degree-of-freedom for the network of a unit. **CEAB-ET2** Indicator.
6. Be trained with several modules available in a computer package. **CEAB-ET2** Indicator.
7. Establish the order of calculation in a process network. Solve a process with several units using the Hysis package **CEAB-ET2** Indicator.
8. Be introduced to the basic commands of the Hysis package. **CEAB-ET2** Indicator.
9. Be introduced to the techniques of flowsheetin. **CEAB-ET2** Indicator.
10. Understand the concept of extent of reaction variables. **CEAB-ET2** Indicator.
11. Perform calculations to establish the number of independent chemical reactions for a set of chemical reactions. **CEAB-ET2** Indicator.
12. Develop flowsheets involving chemical reactions and several chemical reactors. **CEAB-ET2** Indicator.
13. Develop degree-of-Freedom analysis, partitioning and precedence order in processes with chemical reactors. Perform mass balance calculations using Hysis in chemical processes involving chemical reactors. **CEAB-ET2** Indicator.
14. Perform mass balance calculations using Hysis in chemical processes involving chemical reactors. **CEAB-ET2** Indicator.

15. Understand the significance of the element balance approach. The advantages and limitations. Develop calculations to establish number of independent element balances. **CEAB-ET2** Indicator.

16. Develop Degree-of-Freedom analysis. Be able to establish partitioning and precedence order. **CEAB-ET2** Indicator.

17. Perform mass balance calculations using Hysis in chemical processes involving chemical reactors. **CEAB-ET2** Indicator.

18. Understand the complexities and strategies for combined mass and energy balances in a unit and in a network of units, developing their Degree-of-Freedom. **CEAB-ET2** Indicator.

19. Perform combined mass and energy calculations using the Hysis package, using partitioning and precedence order. **CEAB-ET2** Indicator.

20. Propose strategies for mass and energy balances decoupling. **CEAB-ET2** Indicator.

21. Combined mass and energy balances in the context of chemical process with and without chemical reaction. **CEAB-ET2** Indicator.

22. Use Hysis package for modular representation of a process. Use various types of modules available in Hysis and the available icons. **CEAB-ET2** Indicator.

23. Be aware of module properties and their limitations. Be able to translate a process flow diagram in a process flowsheet. **CEAB-ET2** Indicator.

24. Perform calculations considering strategies for tearing streams and convergence. **CEAB-ET2.** Indicator.

25. To develop a ***Special Assignment***. This ***Special Assignment*** *w*ill consider a) an *individual* component where the knowledge acquired on "process simulation" is applied for several units in a selected chemical process, b) a *team* component where the complete degree-of-freedom analysis for the simulated process units will be developed. These learning objectives map with **CEAB-ET2 and CEAB ITW2** Indicators.

Evaluation

Evaluation is on the basis of assignments and final examination. The final mark will be calculated as follows:

- Problems/Computer Assignments: 25%
- Top Hat Participation 10%
- Special Assignment 15%
- Final Examination: 50%

Examinations will be limited open book, as programmable calculators are permitted during the final examination. Be advised that the course instructor will be clearing all information stored. Otherwise, only non-programmable calculators will be permitted.

Note: **1) Students must pass the final examination to pass the course**. Students who fail the final examination will be assigned 48% if the aggregate mark is higher than 50%, or the aggregate mark. **2) Assignments are to be handed in the CBE 3318 locker on the specified due date provided by the Instructor**.

Graduate Attribute Assessment for Accreditation by the Canadian Engineering Accreditation Board

Graduate Attribute	Indicator	Assessment tool	Assessment Level
Engineering Tools	ET2: Demonstrate ability to apply	a) Establish the degree-of-freedom for the network of a	D: Developed

	appropriate engineering tool(s) and resources	process unit, b) Perform combined mass and energy calculations using the Hysis-Aspen package, using partitioning and precedence order	
Individual and Team Work	ITW2: Demonstrate ability to contribute to team goals	Develop individually "process simulation" for several units in a selected chemical process. Develop a complete degree-of-freedom analysis as a student team.	D: Developed

Repeating All Components of the Course

In accordance with Senate and Faculty Policy, students who have failed an Engineering course (i.e. <50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Use of English

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance

a) **Attendance in lectures, tutorials and laboratories is mandatory.** Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

b) **Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled**

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Assessments worth less than 10% of the overall course grade: A student seeking academic accommodation for any work worth less than 10% must contact the instructor directly. The instructor will use good judgment and ensure fair treatment for all students. Where medical documentation is required, such documentation must be submitted by the student directly to the appropriate Faculty Dean's office, and it will be the Dean's office that will make the determination whether accommodation is warranted. Given the University's Official Student Record Information Privacy Policy, instructors may not collect medical documentation.

Assessments worth 10% or more of the overall course grade: For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible.

For further information, please consult the University's medical illness policy at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf. The Student Medical Certificate is available at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Absences from Final Examinations

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

Note: missed work can *only* be excused through one of the mechanisms above. Being asked not to attend an in-person course requirement due to potential COVID-19 symptoms is **not** sufficient on its own.

Cheating

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).

Plagarism

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

Conduct

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems

Students should immediately consult with the instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at (519) 661-2111 x82147 for any specific question regarding an accommodation.

Notices

Students are responsible for regularly checking their Western email and posted OWL site notices.

Consultation

Students are encouraged to discuss problems with their teaching assistant and/or instructors in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultations can be arranged by appointment with the appropriate instructor.

Contingency plan for an in-person class pivoting to 100% online learning

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at: https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

Important Term Dates

Classes begin: September 8, 2022

Classes end: December 8, 2022

Exam period: December 10 – 22, 2022

Accreditation Breakdown

Engineering Science	=	50%
Engineering Design	=	50%
Total AU's (38.2)	=	100%

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. *GENERAL REGULATIONS & PROCEDURES*

1. All first-year students will report to the Undergraduate Services Office by submitting the Academic Consideration Request Form, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request Form. Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.

3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. *TERM/MIDTERM TESTS*

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the Academic Consideration Request Form. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.

3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. *FINAL EXAMINATIONS*

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the Academic Consideration Request Form and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must submit an "Application for a Special Exam" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: **It is the student's responsibility to check the date, time and location of the Special Examination.**

D. *LATE ASSIGNMENTS*

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).

2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see reverse side for information on documentation).

3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.

4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.

   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. ***SHORT ABSENCES***

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. ***EXTENDED ABSENCES***

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. ***DOCUMENTATION***

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and**

duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.

In Case of Serious Illness of a Family Member*:* Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: **Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).**

H. ***ACADEMIC CONCERNS***

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

2. You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=

Scheduling of Term Assignments:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:
https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf

Engineering Academic Regulations:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:	First term half course (i.e. "A" or "F")	September 15, 2023
	Full courses and full-year half course (i.e. "E", "Y" or no suffix)	September 15, 2023
	Second term half course (i.e. "B" or "G")	January 16, 2024

***Drop Deadlines*:** First term half course without penalty (i.e. "A" or "F") November 13, 2023

Full courses and full-year half courses without penalty (i.e. "E","Y" or no suffix) November 30, 2023

Second term half or second term full course without penalty (i.e. "B" or "G") March 7, 2024

Contact Information:

Undergraduate Services Office: SEB 2097 Phone: 519-661-2130 E-mail: engugrad@uwo.ca

Chemical & Green Process Engineering: TEB 477 Phone: 519-661-2131 E-mail: cbeugrad@uwo.ca

Civil Engineering: SEB 3005 Phone: 519-661-2139 E-mail: civil@uwo.ca

Computer, Electrical, Mechatronic Systems & Software Engineering TEB 279 Phone: 519-661-3758 E-mail: eceugrad@uwo.ca

Integrated Engineering ACEB 2410 Phone: 519-661-6725 E-mail: engceli@uwo.ca

Mechanical Engineering: SEB 3002 Phone: 519-661-4122 E-mail: mmeundergraduate@uwo.ca