Western Engineering

DEPARTMENT OF CHEMICAL AND BIOCHEMICAL ENGINEERING

CBE 3318 – Chemical Process Simulation

Course Outline Fall 2026

Hugo de Lasa, hdelasa@uwo.ca

ANTIREQUISITE(s):	Former CBE 3397
PREREQUISITE(s):	CBE 2220A/B, CBE 2221A/B, CBE 2224A/B, or GPE 2218A/B, ES1050
CEAB Academic Units:	Engineering Science=50%, Engineering Design=50%; Total AU's (38.2)=100%
TEXT / Course Resources / References	Hugo de Lasa's Course Notes C.V. Reklaitis, 'Introduction to Material & Energy Balances' John Wiley & Sons, 1983.

DESCRIPTION (50 words max)

This course aims to introduce and to develop student skills on modern methods for computer based chemical process simulation. Calculation strategies of both energy and material balances are established using the degree-of-freedom analysis. Physical and chemical properties of chemical species and process units are accounted in the calculations using HYSIS-Aspen advanced computer software.

Learning Outcomes	**(CAEB) Graduate Attribute**
• 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 flow sheeting, 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.	ET2 ITW2

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 HYSISs 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 flow sheeting. **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.

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 appropriate engineering tool(s) and resources	a) Establish the degree-of-freedom for the network of a process unit, b) Perform combined mass and energy calculations using the HYSIS-Aspen package, using partitioning and precedence order	D: Developed
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

Evaluation

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

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

Examinations will be limited to an 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.

EXTRA COURSE INFORMATION

For Western University Undergraduate Policies Please refer
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html