CBE 3322: Heat Transfer Operations
Course Outline (Fall 2025)

Description

This course introduces chemical engineering students to the basics of heat transfer (conduction, convection, and radiation). This knowledge will be applied to the design of various types of equipment, including heat exchangers with and without phase change, agitated reactors, evaporators, and condensers.

CEAB graduate attributes assessed (**D** stands for developing)

Problem Analysis		Indiv. & Teamwork	D	Ethics and Equity	
Investigation		Communication		Economics and Project Management	
Design	D	Professionalism		Life-long learning	D
Engineering Tools		Impact on Society			

Prerequisites: CBE 2220A/B, CBE 2221A/B or registration in the Integrated Engineering program

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Corequisite(s): CBE 3395Y or registration in the Integrated Engineering program.
Antirequisite(s): None.

Contact Hours: 3 lecture hours, 1 tutorial hour, 0.5 course.

Instructor: Prof. Kibret Mequanint

- Office: TEB 439, Telephone: 519-661-2111 ext. 88573, email: kmequani@uwo.ca

Teaching Assistants:

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Course Materials - Required Course Textbook:

- Fundamentals of heat and mass transfer. Bergman, Theodore L., Frank P. Incropera, and Adrienne S. Lavine. John Wiley & Sons, 8th Ed. E-book for 150 days rental ($57.00) or hard copy ($157.05) https://bookstore.uwo.ca/textbook-search?campus=UWO&term=W2025A&courses%5B0%5D=001_UW/CBE3322A

Course Notes: The chapters that will be covered in this course are taken from the required textbook (see above); thus, separate complete course notes will not be provided. Additional PPT slides, summary notes, and tables may be provided by the instructor through the OWLbrightspace website when needed. However, solutions to the problems **presented in class will not** be posted on the course website. The students are expected to record the solutions to these problems during the lecture/tutorial.

Primary Learning Outcomes

i. Learn the terminology and physical principles associated with heat transfer operations.
ii. Define applicable heat transfer phenomena for a studied process or system.
iii. Use essential inputs to calculate heat transfer rates and/or material temperatures.
iv. Prepare and evaluate representative models of actual heat transfer processes or systems and draw conclusions regarding their design and/or performance.

Specific Learning Objectives

- Basic principles of heat transfer mechanisms and equations (**conduction – Fourier's law, convection – Newton's law of cooling,** and **radiation – Stefan-Boltzmann equation**) (all of Chapter 1 and Section 2.2 of Chapter 2)
- **Conduction:** Derivation of the heat diffusion equation and boundary conditions, steady state conduction, thermal resistance, heat conduction through composite solid and/or variable area such as cylinder and sphere, conduction in bodies with heat sources, heat transfer from extended surfaces (fins), and transient heat conduction. **(Chapters 2, 3, and 5)**
- **Forced Convection:** Boundary layers, laminar and turbulent flow, forced convection for simple geometries, external (flow over a flat plate, flow across a cylinder, flow past a sphere, flow across tube banks, packed beds) and internal (circular pipes and ducts) flows. **(Chapters 6-8)**
- **Heat Exchangers:** Overall heat transfer coefficients, log mean temperature difference, thermal contact resistance, design procedure for double pipe and shell and tube heat exchangers, effectiveness and NTU method for heat exchanger analysis. **(Chapter 11)**
- **Natural convection heat transfer:** Buoyancy-driven flows; combined natural and forced convection; applications. **(Chapter 9)**
- **Heat transfer with phase change:** Boiling modes (free convection, nucleate, transition, film), condensation (laminar or turbulent, dropwise). **(Chapter 10)**
- Details of Radiation Processes and Properties **(Chapters 12 and 13)** – self-learning reading

Evaluation

The final course mark will be determined as follows:

- Class attendance and participation: **5%**
- Problem analysis assignments (3): **15%**
    - Assignment #1 – covering Chapters 1-3
    - Assignment #2 – covering Chapter 5
    - Assignment #3 – covering Chapters 7-8

- HX Group Design Project (1): **15%**
- Midterm exam (1): **25%** (October 30, 2025@5PM)
- Final exam (1): **40%** (date set by Registrar's Office)

All exams will be **closed-book**; however, an equation sheet may be provided or may be allowed by the instructor during the examinations. Only **non-programmable** calculators will be permitted. The midterm examination will be 2.5 hours and the final examination will be 3 hours.

> **Note:** There will be no make-up midterm exams. If you are unable to write the midterm exam for medical or any other reasons, you must provide the appropriate documentation and the weighting of the final exam will be adjusted accordingly. Failure to provide adequate documentation will result in a mark of 0.

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

Attendance in all lectures and tutorials 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.

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).

Plagiarism

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and Turnitin.com (http://www.turnitin.com).

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 who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

- 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 Accessible Education at 661-2111 x 82147 for any specific question regarding an accommodation.

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.

Notices

Students are responsible for regularly checking their Western e-mail and notices posted on the OWL Brightspace website.

Consultation

Students are encouraged to discuss problems with their teaching assistants and/or instructor in tutorial sessions. Other individual consultations can be arranged by appointment with the instructor.

Additional information on Policy Framework: Missed Classes, Late Work, AI Policy and Academic Integrity Absence/Late Accommodation Policy.

- https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/UG-Policy-Framework-Missed-Classes-Late-Work-and-Academic-Integrity1.pdf

Accreditation (AU) Breakdown

Engineering Science = 70 %
Engineering Design = 30 %