CBE 3322: Heat Transfer Operations
Course Outline (Fall 2020)

Description
Introduce chemical engineering students to the basics of heat transfer, including conduction, convection, radiation and phase change. This knowledge will be used for the design of various types of equipment such as heat exchangers with and without phase change agitated reactors, evaporators, condensers.

CEAB Attributes Monitored

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<tr>
<th>Attribute</th>
<th>Skills Monitored</th>
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<tbody>
<tr>
<td>Problem Analysis</td>
<td>Team Work</td>
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<tr>
<td>Investigation</td>
<td>Communication</td>
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<td>Design</td>
<td>X Professionalism</td>
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<td>Engineering Tools</td>
<td>Impact on Society</td>
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Prerequisites: CBE 2220A/B, CBE 2221A/B or registration in the Integrated Engineering program

Unless you have the requisites for this course or written special permission from your Dean to enrol, you will 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 if 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: Dominic Pjontek, Ph.D., P.Eng.
- Campus office: TEB 377, Telephone: 519-661-2143, email: dpjontek@uwo.ca

Teaching Assistants:
- TBD

Undergraduate Assistant: Brandy Hunter
- Office: TEB 477, Telephone: 519-661-2111 ext. 82131, email: brandy.hunter@uwo.ca

Course Textbook:

Additional textbook:

Course Notes: The notes will be provided by the instructor through the OWL website. However, solutions to the problems presented in class will not be posted in the course website. It is expected the solutions to these problems will be recorded by the students during the lecture.
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

• **Conduction**: Thermal conductivity, Fournier's law, 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.

• **Convection**: Boundary layers, laminar and turbulent flow, forced convection for simple geometries, external (flow over flat plate, flow across cylinder, flow past a sphere, flow across tube banks, packed beds) and internal (circular pipes and ducts) flows, free convection flows.

• **Heat transfer with phase change**: Boiling modes (free convection, nucleate, transition, film), condensation (laminar or turbulent, dropwise).

• **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.

• **Radiation**: Basic concepts, blackbody radiation, surface emission, greenhouse effect.

Evaluation

The final course mark will be determined as follows (evaluation weighing to be finalized before classes start due to recent changes from the Covid-19 pandemic):

• Participation
• Quizzes
• Design project
• Midterm examination
• Final examination

All exams will be closed book, nonetheless an equation sheet will be provided by the instructor during the examinations. The sheet content will be provided before the examinations. Only non-programmable calculators will be permitted. The midterm examination will be 2 hours and the final examination will be 3 hours.

Notes:

1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned 48% if the aggregate mark is more than 50% of the aggregate mark.

2) There will be no make-up midterm exams or quizzes. If you are unable to write a test or quiz for medical or compassionate 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.

3) Reports will be submitted electronically on the course OWL site. The penalty for late submission of a design assignment or report is 10 percentage points per day.
**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, 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.

**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**
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 661-2111 x 82147 for any specific question regarding an accommodation.
**Notices**
Students are responsible for regularly checking their Western email and notices posted on the OWL website.

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

**Accreditation (AU) Breakdown**
Engineering Science = 70 %
Engineering Design = 30 %