**Western University**
***Department of Mechanical & Materials Engineering***

# MME 3307B – Heat Transfer II

**COURSE OUTLINE – 2024-2025**

***CALENDAR DESCRIPTION:*** Transient heat conduction. Forced and natural convection heat transfer. Radiation heat transfer, including surface properties and shape factor. Heat exchanger design. Applications of heat transfer in engineering systems.

***COURSE INFORMATION:***

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| Instructor: | Dr. J.M. Floryan |
| Email: | floryan@uwo.ca |
| Lectures/tutorials/labs: | See Draft My Schedule |

***CONSULTATION HOURS:*** Wednesdays, 16:30-17:30 in SEB 2051 (or by appointment).

***PREREQUISITES:*** MME 2204A/B, MME 2273A/B.

***ANTIREQUISITES:*** None.

***ACCREDITATION UNITS:*** Science = 25%, Engineering Science = 75%

***TOPICS:***

Conduction
- Transient conduction

Convection
- Introduction to convection
- Forced convection - external flows
- Forced convection - internal flows
- Free convection

Heat exchangers

Radiation
- Radiation processes and properties
- Radiation exchange between surfaces

***LEARNING OUTCOMES:***

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

Upon successful completion of this course, students will be able to:

1. Identify heat transfer processes occurring in a problem of interest (PA1, KB2);
2. Contrast the three modes of heat transfer (PA1, KB2, KB3, KB4);
3. Apply the appropriate terminology used in the field, such as heat flux, thermal conductivity, energy balance, etc. (KB3, KB4);
4. Determine the heat flow through conduction, convection, and radiation (PA2, PA3);
5. Carry out heat balance analysis and predict the thermal performance of simple engineering systems (PA2, PA3);
6. Recommend strategies for increasing/decreasing heat fluxes (PA2, PA3);
7. Analyze and select heat exchangers (PA2, PA3);
8. Conduct investigations using experiments, data analysis, interpretation, and information synthesis to reach valid conclusions (I2, I3).

***CONTACT HOURS:***

3 lecture hours, 2 tutorial hours, 0.5 laboratory hours/week (3 lab activities), half course

***TEXTBOOK:***

T.L. Bergman and A. S. Lavine, Fundamentals of Heat and Mass Transfer, 8th Edition, John Wiley, December 2018. Available from publisher: https://www.wiley.com/

Students are welcome to purchase second-hand or earlier editions of this textbook. Editions 5, 6, 7 are acceptable; all assignments are based on edition 8.

***UNITS:***

SI will be used; however, English units may be introduced through examples as required.

***EVALUATION:***

The final grade is computed as follows:

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|---|---|
| Participation in weekly (lecture) meetings: | 5% |
| Weekly tutorial activities: | 15% |
| Laboratory exercises: | 10% |
| Term Test 1 (open book): | 15% |
| Term Test 2 (open book): | 15% |
| Final Examination (open book): | 40% |

Tests, tutorial assignments, class participation, and laboratories will be carried out according to the following *tentative* schedule:

| Evaluation Format | Weight | Effort Type | Assigned | Due |
|---|---|---|---|---|
| Class participation | 5% | Individual | Weekly | During the lecture |
| Tutorial activities | 15% | Team | Weekly, except Jan.31, March 7, April 4 | During the tutorial |
| Term test 1 | 15% | Individual | January 31 during tutorial time | At the end of the midterm |
| Term test 2 | 15% | Individual | March 7, during tutorial time | At the end of the midterm |

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|---|---|---|---|---|
| Lab 1 | 3.33% | Team | Weeks of January 20 – Feb.3. | At the end of the lab session |
| Lab 2 | 3.33% | Team | Weeks of Feb.10 – March 3 | At the end of the lab session |
| Lab 3 | 3.33% | Team | Weeks of March 10 – March 24 | At the end of the lab session |

Problems will be assigned from the textbook weekly. These problems will not be handed in or graded but will be discussed each week during the tutorial sessions.

***COURSE POLICIES:*** The following course-specific policies will be strictly enforced throughout the course:

**Laboratory sessions**

- Students need to be familiar with the laboratory manual and the objectives of each experiment. This knowledge will be tested at the beginning of each lab session. A student who does not demonstrate proper knowledge of the material will not be allowed to experiment.
- Students need to watch a video for each experiment before coming to the laboratory session.
- All students are to attend the laboratory section to which they signed up.
- The lab schedule will be posted 2-3 weeks before the beginning of labs.
- Failure to pass the laboratory component of the course will attract automatic course failure.
- Passing the laboratory component is equivalent to obtaining more than 50% on the laboratory component of the course.
- A make-up session will be offered to students who have missed a laboratory session **with** academic consideration.
- Missing a laboratory session without academic consideration will translate into a zero mark for that laboratory session.
- When academic consideration has been obtained for a particular laboratory session, it is the student's responsibility to contact the instructor of the course in a *timely* manner to seek alternate arrangements for the missed laboratory session (*i.e.*, within a maximum of three days after consideration has been obtained from the Engineering Undergraduate Services Office).
- Missing more than one lab without academic consideration will result in the course's failure.
- Students must contact the course instructor regarding circumstances not covered by the non-exhaustive list above.

**Term Tests**

- Term tests will be open-book.
- Each of the term tests will be two hours long.
- **No** make-up term test option will be offered regardless of the circumstances for which the term test was missed.
- Missing a term test without academic consideration will translate into a zero mark for that term test.
- Missing the term test **with** academic consideration will automatically shift the weight of the missed term test into the final exam.
- The second term test is the designated assessment for this course; meaning requests for academic consideration without supporting documentation will be denied.
- Students must contact the course instructor regarding circumstances not covered by the non-exhaustive list above.

**Tutorial Activities**

- The overall tutorial grade is worth 15% of the final grade, including 5% based on attendance/participation and 10% based on problem-solving demonstrations.

- *Problem solving demonstration (10%):*
    - Each week, at least 4 teams (randomly chosen by the instructor) will be asked to demonstrate their approach to solving a given problem to the class.
    - Team membership for the semester will be determined by the instructor.
    - Team demonstrations will be evaluated by both the instructor and their classmates, based on their ability to clearly and accurately describe the solution technique.
    - Team members will receive an overall score which is the average of the instructor and classmate scores (50% / 50%). The instructor reserves the right to determine 100% of the overall score if they feel the classmates are providing an unfair assessment.
    - Individual team members may have different scores.
    - Teams may be selected more than once per semester, in which case their problem-solving demonstration grade will be based on their best score.
    - If a student is absent during a tutorial when their team is selected to present **with** academic consideration, their problem-solving demonstration grade will be based on scores from other demonstration opportunities, which may be arranged by the instructor. At the discretion of the instructor, they may be put onto another team which has not presented yet.
    - If a student is absent during a tutorial when their team is selected to present **without** academic consideration, they will receive a score of 0 for that occurrence.
- *Tutorial Attendance/participation (5%):*
    - Full grades are earned by attending and participating in at least 7 of the 9 tutorial sessions. If fewer than 7 tutorials are attended, the grade will be decreased commensurately (e.g. if you only attend 6 tutorials, your tutorial attendance grade will be reduced from 5% to 4.3%). Since there is flexibility in terms of tutorial attendance, any requests for academic consideration for missing tutorials will be denied.
- Students must contact the course instructor for other circumstances not covered by the non-exhaustive list above.

**Term work**

- If a minimum of 50% is not obtained on term work (class participation, term tests, in-tutorial assignments, and laboratory sessions), the student will fail the course irrespective of the mark obtained in the final examination.
- Please note that a warning on this topic will be given whenever possible. Nonetheless, appeals on this topic will not be accepted, such that students are required to self-monitor their academic progress in the course throughout the entire term.

**Final examination**

- If a minimum of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.
- The exam will take place during the April examination period.
- The exam will be open-book.
- The final exam will be three hours in duration.
- Students must contact the course instructor regarding circumstances not covered by the non-exhaustive list above.

**Submissions**

- Lab reports will be due at the end of the laboratory period. No late submissions will be accepted.

Students are required to contact the course instructor for any other circumstances that appear not to be covered by the non-exhaustive list above.