University of Manitoba | Price Faculty of Engineering
Department of Biosystems Engineering

BIOE 3110 Heat Transfer in Biosystems A01

Fall 2025 (24149), Credit hours: 4

Course Outline

Instruction Team

- Dr. Fuji Jian (he/him), P.Eng., Associate Professor
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- Teaching Assistant
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- Lecture location: E2 164
  Lecture time: MWF 9:30-10:20 am
- Tutorial and lab Location: E2 125
  Tutorial and lab time: T 8:30 -9:45am
- Student Hours
  Individual assistance is always available by appointment – stop by!
- Contact Hours
  3 credit hours per week
  Lectures:
  3 hours x 12 weeks = 36 hours
  Tutorial and lab:
  1.5 hours x 12 weeks = 18 hours
- Prerequisites:
  ENG 1460
  BIOE 2790
  MECH 2150
- Course Website:
- http://umanitoba.ca/umlearn

Prerequisites and how they apply to this course

ENG 1460 Thermal Sciences (or equivalent course such as thermodynamics) provides students with an introduction to the thermodynamics (such as conservation of energy and efficiency of heat engines); the fundamentals of analyzing systems involving heat and energy; and application of mathematics and science to engineering problem solving. BIOE 3110 will build upon these experiences. MECH 2150 provides students with knowledge of calculus. BIOE 2790 provides students with knowledge of fluid mechanics. This knowledge will help students to understand the mathematical models (equations) of heat transfer.

Course Objectives

The intent of this course is to introduce students to:

1. Model and analyze heat and mass transfer problems.
2. Use numerical computation, estimation from graphs, and mathematical models (equations) to obtain information to solve problems.
3. Document technical computations to ensure that assumption, solution technique, and calculations can be validated.
4. Investigate the impact of materials' physical properties on heat and mass transfer (e.g., conductivity, thermal diffusivity, convection coefficient, and emissivity).

Students' Learning Responsibilities

You are expected to learn the materials covered in lectures, tutorials, and assignments. Attendance for lectures and tutorials is strongly expected. Submission of assignments is to be done after tutorial or class time on the date mentioned in the assignments. To benefit the most from this class, you must be willing to review the course materials and participate in discussions about the material preferably during class or tutorial. While it is the instructor's responsibility to inform you changes in due dates, assignment material, et., it is your responsibility to read your university email regularly at least daily. Please also respect your fellow students during class, such as mute your cell phone.

Why this course is useful?

The problem-solving skills developed in this course are key to understanding fundamental principles of heat and mass transfer,

numerical solving skill, model development and analysis, and estimation of complex systems through simpler models.

Who should take this course?

This is a required course in the Biosystems Engineering program and most engineering programs.

- **Early Withdrawal Deadline**
  September 16, 2025
- **National Day for Truth and Reconciliation**
  Mon. Sep. 30, 2025
  No classes or examinations
- **Thanksgiving**
  Mon. October 13, 2025
  No classes or examinations
- **Fall Term Break**
  Nov.10-14, 2025
  No classes or examinations
- **Voluntary Withdrawal Deadline**
  November 18, 2025
- **Last Day of Classes**
  December 08, 2025
- **Midterm exam I**: Oct. 14 (Tuesday)
- **Midterm exam II**: Nov. 18 (Tuesday)
- **Final examination**: Arranged by the Department

Instructional Methods

Learning is most effective when both the teacher and the students are engaged in subject materials. The role of the instructor, therefore, is to create an environment that facilitates student engagement (and therefore learning). In this course, most dissemination of information will occur using the traditional lecture format (PowerPoint slides and writing on white board). A substantial portion of the content will be "presented" experientially through assignments and in-class examples. Therefore, you will be expected to prepare for class by reading the course text, completing the assignments, and questioning the professor whenever possible.

Course Content:

Lecture order	Course content	Instructor
1	Introduction	Dr. Jian
2	Steady-state heat conduction	Dr. Jian
3	Transient heat transfer	Dr. Jian
4	Forced convective heat transfer	Dr. Jian
5	Free convection	Dr. Jian
6	Radiative heat transfer	Derek
7	Solar radiation	Derek
8	Heat exchangers	Derek
9	Psychometrics and mass diffusion	Derek

Texts, Readings, Materials

Textbook(s): Bergman T.L., Lavine A.S., Incropera F.P., and D.P. DeWitt, 2011. Fundamentals of heat and mass transfer, 8th ed., John Wiley & Sons, Inc., Toronto.

Supplementary Reading

Borgnakke, C., Sonntag, R.E., and G.J. Van Wylen 2009. Fundamentals of Thermodynamics, 7th. ed., John Wiley & Sons, New York.

Additional Materials: Supplied by instructor.

Description of Assignments

Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Letter	Mark
A+	90–100
A	85–89
B+	80–84
B	75–79
C+	65–74
C	60–64
F	< 50

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 100%
- Engineering Design: 0%

There will be 9 written assignments throughout the semester. Each assignment will consist of questions. They are to be answered in full using the methodology described in the class and assigned text. A question will be considered correct only if it is answered in the appropriate format, using appropriate significant digits and has an answer(s).

Description of Examinations
Two midterm examinations will be scheduled in the October and November, respectively. A final examination will be scheduled at the end of the semester. The examination will test the student's knowledge of the lecture material covered in this course.

Late Assignments
Will not be accepted and will receive a zero grade.
Missed Assignments
Will receive a zero grade unless student has a valid medical certificate or compassionate reason (see Missed Exams).
Missed Exams
There will be no "make-up" midterms. If a midterm examination is missed and the student has a valid medical certificate or compassionate reason (i.e., death of an immediate family member), the grade will be transferred to the final. Students who miss a midterm examination without a valid reason will receive a grade of zero for the midterm examination.

Learning Outcomes
At the end of the course, the student should be able to:

1. Model and solve heat transfer problems as electrical analogue circuitry,
2. Understand the correspondence between electrical and heat-based systems,
3. Apply steady state assumptions to determine the solutions,
4. Apply geometry simplification to generate and solve models of systems involving heat transfer,
5. Identify assumptions of typical heat transfer modelling,
6. Identify mechanisms of heat and mass transfer under a given situation,
7. Identify and compute thermophysical material properties, and
8. Compute estimations of heat loss from structures.

Grade Evaluation

The grade for this course will be based on assignments, two midterm examinations, and a final examination. The final grade is the combination of the following grades:

35% Final Examination (2 hrs)

25% Midterm I (90 min)

25% Midterm II (90 min),

15% Assignments.

Expected Competency Levels

Com. Level	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1		X										
2												
3	X	X										
4												
5												
6												

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels (Com. Level)

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Graduate Attributes Assessed

KB.3 – Recalls, defines, comprehends, and applies information and concepts in fundamental engineering science.

PA.1 – Identifies and defines complex engineering problems.

PA.3 – Analyzes and solves complex engineering problems.

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Assignments	15	TA	F	1 to 8	I/T
Middle exam I	25	Dr. Jian	F, S	1 to 4	I
Middle exam II	25	Dr. Jian	F, S	4 to 8	I
Final exam	35	Derek	F, S	1 to 8	I

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

** I/T: **I** – Individual effort, **T** – Team effort

Academic Integrity

Plagiarism or any other form of cheating in examinations, term tests or academic work is subject to serious academic penalty. Cheating in examinations or tests may take the form of copying from another student. Exam cheating can also include exam impersonation. A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty. Students should acquaint themselves with the University's policy on plagiarism, cheating, exam impersonation and duplicate submission.

Use of Third-Party Detection and Submission Tools

Electronic detection tools may be used to screen assignments in cases of suspected plagiarism.

Group Work Policies:

All assignments are to be done as individuals and the University's policy plagiarism does apply to assignments (see Academic Integrity above). **Additional Policies:** The tutorials are not optional.

Devised Plan

The Department of Biosystems Engineering has devised a plan so that there is minimal impact on the delivery and content of the course, should the instructor fall sick and is unable to continue lectures in-person. Please be assured that the alternative plan outlining any deviation from the normal mode of instruction will be communicated to you as quickly as possible if/when the need arises.

Requirements/Regulations

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.
- All email communication must conform to the Communicating with Students university policy.

Communicating with Students

- Attending lectures and laboratories is essential for the successful completion of this course.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don't need to share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

Self-Declaration Form for Brief or Temporary Absence

- This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

Self-Declaration Policy for Brief or Temporary Absences

- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance, and withdrawal.

General Academic Regulations

Engineering Academic Regulations

- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Copyright Notice

Copyright Office

Deferred Final Examinations

Students who miss the regularly scheduled writing of a final examination for valid medical or compassionate reasons will only be allowed to write a deferred exam if the Associate Dean (Undergraduate) approves the request. All requests for a deferred examination *must* be made within 48 hours of the missed exam and follow the procedure described on the Faculty website without exception. Course Instructors *do not have the discretion* to grant deferred final examinations. 🔗 *Deferred Exam Policy (student experience website)*