ENGG*6000 Advanced Heat and Mass Transfer
Fall 2016

UNIVERSITY
of GUELPH
School of Engineering

(Revision 1: August 21, 2016)

1 INSTRUCTOR

Instructor: Shohel Mahmud, Ph.D., P.Eng.
Office: RICHARDS 3519, ext. 54058
Email: smahmud@uoguelph.ca
Office hours: TBA on Courselink or by appointment

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*6000 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

None

2.3 Recommended Resources


Note: The digital versions of the recommended textbooks are in the University of Guelph online library.
Journals and Magazines:
1. International Journal of Heat and Mass Transfer
2. International Communications in Heat and Mass Transfer
3. International Journal of Thermal Sciences
4. Journal of Heat Transfer
5. Heat and Mass Transfer
7. Journal of Thermophysics and Heat Transfer

Note: Use search engines (e.g., SCOPUS, Engineering Village, and Google Scholar) to search specific articles.

Following Software will be used in this Course:
1. COMSOL Multiphysics (30 licenses are available in the School)
2. FlexPDE (download the students version from http://www.pdesolutions.com/, request for a one-month free license of the professional version)
3. Solidworks (200 licenses are available in the School)

Note: Check CourseLink (https://courselink.uoguelph.ca/shared/login/login.html) and emails regularly for Tutorials and additional information related to software.

2.4 Additional Resources

Lecture Information: Recommended resources are available in the library. Also instructor has a copy of listed recommended resources. Selected copies of lecture presentation materials, plus supplemental materials, may be posted on Courselink. (Note: posting of all materials shown or discussed in class is not guaranteed.)

Lab Information: There is no lab for this course. However, demonstration material and devices will be made available in the class

Assignments/Project: Assignment and project will be posted in courselink

3 Assessment

3.1 Dates and Distribution (Tentative)

Assignments: 40% (Submission Dates: 19th September, 3rd October, 17th October, 31st October, and 14th November, 2016)

Project: 50% (Project presentation and report submission will be in the last week of class)

Note: Students are encouraged to select a topic from their graduate research which requires some heat and mass transfer modeling. Materials covered in this course should be helpful to advance your project. Details on the project will be available in the courselsink and discussed in the class. Please contact the course instructor if you are not comfortable about project topic selection.

Final Exam (3 hours): 10% (8th December, 2016)
3.2 Course Grading Policies

When You Cannot Meet a Course Requirement: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course in writing, with your name, id#, and e-mail contact. See the graduate calendar for information on regulations and procedures for Academic Consideration:

http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: In order to pass the course, you must pass both the project and exam course portions. Students must obtain an overall grade of 70% or higher to pass the course.

Missed tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

Assignment Reports: Late submissions of lab/assignment reports will not be accepted.

4 AIMS & OBJECTIVES

4.1 Calendar Description


4.2 Course Aims

This course will introduce the general conservation equations (conservation of mass, conservation of momentum, and conservation of energy) for studying the flow and heat transfer processes inside different types of systems and geometries. Modeling different types of heat transfer processes for various systems, exposed to different types of boundary conditions, is an integral part of this course. Many classic techniques to solve the simplified version of the modeled equations will be introduced. Numerical techniques will be applied to solve multi-dimensional complex problems. Applications of heat and mass transfer analyses to different fields of engineering will be introduced. Case studies will be selected from different application areas. Step by step techniques will be shown to model and analyze problems selected from particular application area.
4.3 Learning Objectives

At the successful completion of this course, the student will

- Identify different types of heat transfer processes (e.g., conduction, convection, conjugate, etc.) and their specific application areas
- Understand and interpret the dimensionless parameters (e.g., Biot Number, Nusselt Number, Reynolds Number, Rayleigh Number, Stefan Numbers, etc.) associated with different types of heat transfer processes
- Learn how to model the flow and heat transfer processes inside different systems and develop sets of differential equations.
- Able to simplify the general forms of momentum and energy equations for specific applications and solve to obtain closed form of analytical solutions
- Apply scale analysis to identify relationship between different parameters and interpret the findings physically
- Learn different analytical techniques (e.g., Separation of Variables, Laplace Transformation, Fourier Analysis, Integral Solution, Perturbation Analysis, etc.) to solve heat transfer problems
- Interpret physically the flow and thermal field results and calculate heat transfer
- Learn to solve the multidimensional/multiphysics porous media problems using proper engineering tools (e.g., COMSOL, FlexPDE, and SolidWorks)
- Apply theories learnt in this course to solve real life problems

4.4 Instructor’s Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.5 Students’ Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.
E-mail Communication: As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Recording of Materials: Presentations which are made in relation to course work—including lectures—cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a classmate or guest lecturer.

4.6 Relationships with other Courses

Previous Courses: ‘Heat and Mass Transfer’ and ‘Fluid Mechanics’
Follow-on Courses: None

5 Teaching and Learning Activities

5.1 Timetable

Lectures:
Richard-3527, Wednesday (10:00 am to 1:00pm)

Software Lab:
THRN-2313 TBA

5.2 Course Topics and Schedule

- Introduction and basic concepts
- Conservation of mass, conservation of momentum, and conservation of energy
- Steady state, transient, and periodic conduction
- Analytical solutions of conduction problems (e.g., Separation of Variables, Laplace Transformation, Fourier Analysis, Integral Solution, Greens Function, Perturbation Analysis, etc.)
- Internal and external forced and natural convection heat transfer
- Conduction and convection heat transfer in porous media
- Micro-scale conduction and convection heat transfer
- Conduction and convection heat transfer associated with phase change processes
- Special topics of interest
- Case Studies; Application of COMSOL, FlexPDE, and SolidWorks to solve problems in case studies
5.3 Lab/assignment Schedule
Detailed information will be provided in the Courselink

5.4 Other Important Dates
Drop Date: The last date to drop one-semester courses, without academic penalty, is October 31st. Two-semester courses must be dropped by the last day of the add period in the second semester. Refer to the Graduate Calendar for the schedule of dates:
http://www.uoguelph.ca/registrar/calendars/graduate/current/sched/sched-dates-f10.shtml

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University’s policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Graduate Calendar:
https://www.uoguelph.ca/registrar/calendars/graduate/2014-2015/genreg/sec_d0e1780.shtml
A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.
The School of Engineering has adopted a Code of Ethics that can be found at: http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.