UNIVERSITY OF MANITOBA | **Mechanical Engineering**

MECG 7160: Convective Heat Transfer (CRN 11001, Section A01) COURSE OUTLINE - FALL 2014

1. Term and Section

Term: Fall term (September 4th – December 3rd, 2014)
Section: A01
CRN: 11001

2. Relevant Courses

Students who plan to take this course are encouraged to take ME 7410: Theory of Turbulence first or in the same time.

3. Instructor Information

Instructor: Dr. Bing-Chen Wang
Office: E1-488
Email: BingChen.Wang@ad.umanitoba.ca
Tel: (204) 474-9305
Fax: (204) 275-7507

4. Lecture Hours and Classroom

Tuesday & Thursday afternoons: 2:00–4:00PM. 3 credit hours.
Classroom: Room 346, Education building.

5. Office Hours

MWF afternoons: 1:00–2:20PM.
In order to receive individual guidance, a student is encouraged to visit the instructor in his office to discuss the subjects of study on a regular base.

6. Objective

The objective of this course is to provide students with a solid grounding in the classical and modern theories of convective heat and fluid flows, centered on the analytical and numerical solutions of the Navier-Stokes and thermal energy equations. The emphasis is on both the laminar and turbulent boundary-layer heat and fluid flows. It is expected that the students are challenged in terms of their understanding of the physical mechanisms, their related mathematical skills, and most importantly, their passion for studying thermal-fluid science and engineering.

7. Evaluation Method

The performance of a student will be evaluated based on their assignments, a research report and presentation, and mid-term and final examinations. Specifically, the mark distribution follows:

Assignments: 20%
Final exam: 80%

8. Class Discussion

In order to help the student to build a deeper insight into the physical problem and also to create a dynamic teaching–learning environment, some carefully-designed questions to the students will be included in the class. Students are encouraged to participate in class discussions by volunteering answers, even though their answers may be incorrect sometimes.

9. Assignments and Presentation

The course will involve perhaps 6 assignments. The purpose of the assignments is not to obtain the answer but "practise" a solution methodology and theory. Assignment solutions should be complete, concise and elegant.

10. Policy on Late Submission of Assignments and Research Report

A deduction of 10% of the mark per day will be applied.

11. Academic Integrity and Respectful Teaching–Learning Environment

Academic integrity and a respectful teaching–learning environment will be maintained in this class following the general policy stated in the University Graduate Calendar.

12. Reference Books

It is strongly recommended that a student has a convenient access to the following textbook:

[1] Kays, W. M., Crawford, M. E. and Weigand, B. 2005, *Convective heat and mass transfer*, 4th ed., McGraw-Hill, New York.

Other frequently used reference books include:

[2] Schlichting, H. and Gersten, K. 2000, *Boundary Layer Theory*, 8th ed., Springer, Berlin.

[3] Bejan, A. 2004, *Convection Heat Transfer*, 3 ed., Wiley, Hoboken, New Jersey.

[4] Incropera, F. P. and DeWitt, D. P. 2002, *Fundamentals of Heat and Mass Transfer*, 5th ed. (or, 6th ed. 2006), Wiley, New York.

[5] Lewis, P. E. and Ward, J. P. 1989, *Vector analysis for engineers and scientists*, Addison-Wesley, Reading, England.

[6] Simmonds, J. G. 1994, *A Brief on Tensor Analysis* (Undergraduate Texts in Mathematics), 2nd ed., Springer, New York.

13. How to Succeed in this Course

- Attend all lectures and tutorials;
- Take lecture notes;
- Participate in class discussions;
- Bring the textbook to the class;
- Keep up to date with the course material: after each lecture;
- Review and expend the lecture notes;
- Read the related material from the textbook and reference books;
- Solve the assigned problems and submit the assignments on time;
- Consult the instructor regarding difficulties in understanding the course material and procedure;
- Work carefully and diligently on the assigned research project;
- Show professionalism when presenting the research report;
- Be self-motivated and be passionate about the thermal-fluid science and engineering.

14. Course Coverage Outline

[1] Introduction;
[2] Fundamentals of Field Theory and Tensor Notation;
[3] Conservation Laws & Governing Equations;
[4] Integral Equations for the Boundary-Layer;
[5] Laminar Internal Flow: Momentum Transfer;
[6] Laminar Internal Flow: Heat Transfer;
[7] Fundamentals of Reynolds-Averaged Navier-Stokes (RANS) Method;
[8] Turbulent External Boundary-Layer: Momentum Transfer;
[9] Turbulent External Boundary-Layer: Heat Transfer.