Course Syllabus

VM532

Advanced Convection

Summer 2018

Course Description:

This course includes advanced coverage of convective heat transfer. The aim of the course is to introduce the fundamental convection theory and to provide an understanding of analytical methods and numerical tools used in solving realistic engineering problems in heat transfer. The topics include heat transfer in channel and external flow, laminar and turbulent convection, nature convection, convection in high speed flow (including compressible flow theory), fluids-thermal interactions and conjugate heat transfer analysis, unsteady heat transfer, etc. Engineering examples in electronic cooling and gas turbine applications will be demonstrated and discussed in detail. In-depth physical understanding on these topics will be obtained through a series of course works and projects using Matlab, a classical boundary layer code (TEXSTAN), and commercial CFD solvers.

Instructor:

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Phone:
Office: Room
Office hour:

Textbook (Author, Book Title, Publisher, Publication Year, ISBN):

- Kays, W. M., and Crawford, M. E., Convective heat and mass transfer, McGraw-Hill, New York, April 2004 (4th edition)
- Bejan, A., Convection heat transfer, J. Wiley, New York, 1995.
- Advanced Convection Lecture Notes, Q Zhang, 2018

Course Prerequisites: Thermodynamics, Heat transfer, Fluid mechanics

Course Website:

Grading Policy (Assignments %, Project, Exams, etc.)**:**

- Homework 30%
- Project 30%
- Final exam 40%

Honor Code Policy:

All students in the class are presumed to be decent and honorable, and all students in the class are bound by the Honor Code of the Joint Institute (see the JI's Student Handbook for more details). You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work.
Following are specific policies for different types of course assignments:
Homework and Project Assignments
You may discuss individual assignments with your fellow students at the conceptual level, but must complete all calculations and write-up, from scrap to final form, on your own. Verbatim copying of another student's work is forbidden. You may not consult solutions from a previous term unless they are made available in a publicly accessible form (no unfair advantage can be sought). Separating the calculation work among group members and sharing the results is NOT acceptable. In general, you must have created what goes on to your paper – the words, figures, and especially the ideas – but these can be influenced by other team members' opinions.
Any violation of the above honor policies appropriate to each piece of course work will be reported to the Honor Council, and if guilt is established penalties may be imposed. Typical sanctions for a first violation may include a zero on the assignment, a reduction in grade for the course, Ji Guo, Liu Xiao Cha Kan, suspension from the JI for up to one year, and community service. These or other sanctions are determined by the Faculty Committee on Discipline based on the violation. For especially serious violations of the Honor Code, the sanctions may include expulsion from the UM-SJTU Joint Institute. Second violations of the Honor Code are especially major. For a second violation, students will normally receive Ji Guo or Liu Xiao Cha Kan. In addition, they may be suspended or expelled from the Joint Institute. Students will receive an F in the course if the violation involves academic misconduct. Other sanctions may also be imposed depending on the nature of the violation.
If you are unsure about what is considered acceptable or unacceptable conduct, or have questions about this policy, PLEASE ASK Prof. Zhang for guidance.

Homework Re-submission and Credit Recovery
This is a special policy which will ONLY be implemented if the classroom is small. The students will be given a second chance to correct their homework after receiving their marked homework. **Up to 90 percent** of the full credit can be recovered if the students have made the right corrections and re-submitted their homework.

Teaching Schedule:

Week	NO.	Date	lectures and Exams	Comments
1	1		Course introduction; Governing equations, Control volume analysis, Transport, fluxes and surface forces, Physical meaning of the velocity gradient terms, etc.	
	2		Differential equations – laminar integral equations	
	3		Momentum transfer: laminar flow inside tubes	Homework 1
2	4		Heat Transfer: laminar flow inside tubes (1)	
	5		Heat Transfer: laminar flow inside tubes (2)	
	6		Momentum transfer: laminar external boundary layer	Homework 2
3	7		Heat transfer: laminar external boundary layer(1)	
	8		Transition; Momentum transfer: turbulent external boundary layer (1)	
	9		Momentum transfer: turbulent external boundary layer (2)	Homework 3
4	10		Heat transfer: turbulent external boundary layer	
	11		Momentum transfer: turbulent flow inside tube	
	12		Heat transfer: turbulent flow inside tube	Homework 4 (project topic selection)
5	13		Free convection boundary layers (1)	
	14		Free convection boundary layers (2)	
	15		Influences of temperature-dependent fluid properties	Homework 5
6	16		Compressible flow theory	
	17		Convection at high speed (1)	
	18		Convection at high speed (2)	Homework 6
7	19		Conjugate heat transfer (1)	
	20		Conjugate heat transfer (2)	
	21		Unsteady heat transfer	Project review
8	22		Electronic cooling	
	23		Convective heat transfer in turbomachines	
	24		Review lecture	Final Project Presentation