课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	MAE5005 高等计算流体力学 Advanced Computational Fluid Mechanics
2.	**课程性质** **Compulsory/Elective**	核心课程　core course
3.	**课程学分/学时** **Course Credit/Hours**	3/48
4.	**授课语言** **Teaching Language**	英语 English
5.	**授课教师** **Instructor(s)**	王连平教授
6.	**是否面向本科生开放** **Open to undergraduates or not**	是 Yes
7.	**先修要求** **Pre-requisites**	MAE303 流体力学 或者 MAE207 工程流体力学 Fluid Mechanics OR Engineering Fluid Mechanics

8. 教学目标
Course Objectives

Direct numerical simulations of complex flows are now viewed as a third pillar for scientific discovery, due to high-speed computers and advanced algorithms. In many fields including multiphase flows, direct numerical simulation provides a rigorous research tool by solving first-principle governing equations. High-performance fluid-flow simulation is an area of rapid growth and is interdisciplinary covering physics of fluid flows, algorithms, and parallel implementation, etc. This course is designed for students to quickly learn and compare various simulation methods and to obtain some hands-on experience.

9. 教学方法
Teaching Methods

Overview of computational methods for viscous flows including finite difference, finite-volume, finite element, spectral, and mesoscopic Boltzmann-equation based methods. Treatment of fixed and moving solid-fluid and fluid-fluid boundaries. Example codes to study physical and numerical issues such as numerical convergence, accuracy, and stability.

10. 教学内容
Course Contents

Section 1	Direct numerical simulation of viscous flows at finite Reynolds numbers using finite difference based methods.
Section 2	Direct numerical simulation of viscous flows at finite Reynolds numbers using finite-volume based methods.
Section 3	Direct numerical simulation of viscous flows at finite Reynolds numbers using finite element based methods.
Section 4	Direct numerical simulation of viscous flows at finite Reynolds numbers using spectral based methods.
Section 5	Direct numerical simulation of viscous flows at finite Reynolds numbers using mesoscopic Boltzmann-equation based methods.

	Section 6	Immersed boundary methods for fluid interfaces
	Section 7	Structured grid methods for solid particles
	Section 8	Finite element methods for particulate flows
	Section 9	Lattice Boltzmann methods for multiphase flows
	Section 10	Discussion of some example codes provided by the instructor.
11.	课程考核 **Course Assessment**	
	（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 1.no final exam 2.Homework problems 30% Midterm exam 20% Article review 10% Computer project 30% Class participation 10% 3.There is no difference between undergraduate and graduate students.	
12.	教材及其它参考资料 **Textbook and Supplementary Readings**	
	J.H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, 3rd edition, Springer, 2002; R.H. Pletcher, J.C. Tannehill, and D.A. Anderson, Computational Fluid Mechanics and Heat Transfer, 3nd ed., CRC Press, 2013.	