NATIONAL TSING HUA UNIVERSITY
DEPARTMENT OF POWER MECHANICAL ENGINEERING
2011 Fall Semester

Course No.:	PME 510200
Course Title:	**Multiscale Transport (多尺度傳輸)**
	(Fluid, Molecule and Electron Flows)
Hours/Week:	T3 T4 R4
Classroom:	工一館 R 209
Teacher:	Prof. Che-Wun Hong (洪哲文教授)

Objective: This course covers the classical physics and modern physics developed from 19th to 21st centuries. The contents introduce the multiscale transport phenomena of fluid particles (continuum), molecules (non-continuum), electrons and photons (particle-wave duality). Mathematical models of each scale of flow models are derived and their exact solutions as well as numerical solutions will be explained. This is a general course for senior undergraduates, postgraduates from every background, including thermofluids, solid mechanics, optoelctronics, MEMS/NEMS groups.

Contents:

(1) Introduction to Multi-scale Transport

1.1 Development of Multi-scale Transport in Physics
1.2 Classical Physics and Modern Physics
1.3 Macroscopic and Microscopic Models
1.4 Micro Flow Examples
1.5 Macro Flow Development
1.6 Kinetic and Transport Properties of Fluids
1.7 General Boundary Conditions

(2) Macro Flow Models (The Navier-Stokes Equation)

2.1 Fundamental Equations
2.2 Conservation of Mass (Continuity Equations)
2.3 Conservation of Momentum (Navier-Stoke Equations)
2.4 Conservation of Energy (1st Law of Thermodynamics)
2.5 Summary of the Basic Equations
2.6 Examples of Boundary Conditions
2.7 Orthogonal Coordinate System
2.8 Mathematical Characters of the Basic Equations

Lecture Notes: Supplement notes provided by PDF before each lecture

References: (1) "Viscous Fluid Flow"
F.M. White, 3rd Ed., McGraw-Hill, 2006
(2) "Molecular Gas Dynamics and the Direct Simulation of Gas Flows", G.A. Bird, Clarendon Press, 1994.
(3) "Lattice-Gas Cellular Automata and Lattice Boltzmann Models- An Introduction", D. A. Wolf-Gladrow, Springer, 2005
(4) "Modern Physics", 3rd Ed., R.A. Serway, C.J. Moses, C.A. Moyer, Thomson, 2005
(5) "Simulating the Physical World: Hierarchical Modeling from Quantum Mechanics to Fluid Dynamics", 4th Ed., H.J.C. Berendsen, Cambridge Univ. Press, 2007

Grades: Exercises (20%),
Midterm Exam (40%), close book
Final Exam (40%), open book