Syllabus – Fall Semester, 115 Academic Year

Department of Mechanical Engineering, National Chung Cheng University

<table>
<tr><td colspan="4">Course Name: Intermediate Fluid Mechanics</td><td colspan="2">Dept.
Course Code</td><td>4205601(ME),
4465016(AIM-HI)</td></tr>
<tr><td>Instructors</td><td>Chien-Shing Lee</td><td>Credits</td><td>3</td><td>Compulsory /Elective</td><td>Grade</td><td>Elective, Master/PhD</td></tr>
<tr><td>EMI</td><td colspan="6">■Yes ☐ No</td></tr>
<tr><td colspan="7">Prerequisites:
Undergraduate level on engineering mathematics (vector calculus and linear algebra)
Class Description：
This course is designed to provide an introduction to fluid mechanics principles, focusing on flow kinematics, ideal-fluid flows and viscous flows.
Class Objective：
The main course objective is threefold: 1) to build the theoretical framework that allows students to apply vector calculus to the derivation of integral and differential conservation equations, 2) to provide the fundamental understanding needed for further study of 2-D and 3-D potential flows, and 3) to address practical problems involving high-Re and low-Re viscous flows.</td></tr>
<tr><td>Textbooks</td><td colspan="6">Fundamental Mechanics of Fluids, 4th Edition, by I. G. Currie, CRC Press, 2013
[Where to purchase: Liwen Campus Store (CCU Student Center 3F)]</td></tr>
<tr><td colspan="7">An overview of the main points of teaching</td></tr>
<tr><td>Teaching Materials</td><td colspan="6">☐ PPT ■ Course handouts
☐ Self-edited textbooks ☐ Teaching Procedures
☐ Self-made instructional videos ☐ Other</td></tr>
<tr><td>Teaching Methods</td><td colspan="6">■ Lectures ☐ Group discussion
☐ Oral presentation ☐ Problem-oriented learning
☐ Case studies ☐ Other</td></tr>
<tr><td>Evaluation Tools</td><td colspan="6">■ Mid-term Exam ■ Final Exam
☐ In-class Quiz ☐ In-class homework
■ Homework ☐ Mid-term Report
☐ Final Report ☐ Special Report
☐ Other ☐ Scales</td></tr>
<tr><td>Teaching Resources</td><td colspan="6">■ Course website
☐ Electronic files of textbooks are available for download
☐ Internship website</td></tr>
<tr><td>Instructor’s Information</td><td colspan="6">Email: chienshing@ccu.edu.tw
Office: 523 (ME Department, 5F)</td></tr>
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Course Outlines		Teaching Hours				Core Competence
Unit Title	Contents	Lectures	Demo	Practice	Other	
1. Introduction	Definition of a fluid. Continuum approach to model a fluid flow.	3				D1, D2, D4
2. Fundamental principles	Basic variables. Dimensional analysis. Fluid statics.	6				D1, D2, D4
3. Conservation equations	Review of vector calculus. Control volumes. Lagrangian and Eulerian frame of reference. Conservation of mass, momentum, and energy. Substantial derivative.	9				D1, D2, D4
4. Flow Kinematics	Flow lines, vorticity, circulation, Vorticity and rate of strain. Stream function and velocity potential.	6				D1, D2, D4
5. Inviscid flows	Laplace equation. Bernoulli's equation. 2-D potential flow solutions. Kutta-Joukowski theorem. Kutta condition. Kelvin's circulation theorem.	9				D1, D2, D4
6. Viscous flows	Exact solutions, high-Re flows (boundary layers), low-Re flows (Stokes, creeping flow)	9				D1, D2, D4

Achievable Core Competence		Achievable Objective
D1	Expertise in the field of mechanical and opto-mechanical integration engineering	Possesses advanced professional knowledge in fluid mechanics analysis
D2	Ability to plan and execute special research projects in the field of mechanical and opto-mechanical integration engineering	Ability to plan and execute research projects in fluid mechanics analysis and related fields
D4	Ability to think creatively and solve mechanical and opto-mechanical integration engineering problems independently	Ability to think innovatively and independently solve problems related to fluid mechanics analysis

The core competence of the Institute

D1 has expertise in the field of mechanical and opto-mechanical integration engineering

D2 Ability to plan and execute special research projects in the field of mechanical and opto-mechanical integration engineering

D3 Ability to write scientific papers and presentations

D4 Ability to think creatively and solve mechanical and opto-mechanical integration engineering problems independently

D5 Ability to coordinate and integrate cross-disciplinary personnel

D6 Good international outlook

D7 has team spirit and the ability to lead, manage, plan and communicate

D8 Ability of lifelong self-learning and growth

D9 Understand the importance of engineering ethics, social responsibility and sustainable development

Weekly teaching plan				
Course Time	Course Location	Grading	Office hour	Teaching quality evaluation method
Fridays, 10am-1pm	Engineering Hall B, Room 213	○ Homework: **40%** ○ Midterm Exam: **30%** ○ Final Exam: **30%**	Fridays, 2-4pm or by appointment	Questionnaire
Weeks	Teaching & Homework Progress			Note
1	Introduction			
2	Introduction			
3	Fundamental principles			
4	Fundamental principles			
5	Conservation equations			
6	Conservation equations			
7	Flow Kinematics			
8	Flow Kinematics			
9	Review of Week 1-8			Midterm
10	Inviscid flows			
11	Inviscid flows			
12	Inviscid flows			
13	Inviscid flows			
14	Viscous flows			
15	Viscous flows			
16	Viscous flows			
17	Viscous flows			
18	Review of Week 1-17			Final exam