Fluid Mechanics I

AE 341 **Course Outline** **Spring Semester 2003**

Lecturer: Joseph Majdalani, Ph.D.

Section No.: **Lecture Times:**
Lecture Location: **Course Call Number:**

Office Hours:
Contacts: (1) email: ; (2) office:
Homepage:

Textbook: Frank M. White, Fluid Mechanics, Fourth Edition, McGraw-Hill, Inc., 1999.

References:
1. R. W. Fox, and A. T. McDonald, Introduction to Fluid Mechanics, Fourth Edition, John Wiley and Sons, Inc., 1992.
2. David C. Wilcox, Basic Fluid Mechanics, First Edition, DCW Industries, Inc., 1997.
3. Frank M. White, Fluid Mechanics, Third Edition, McGraw-Hill, Inc., 1994.
4. Bruce R. Munson, Donald F. Young, and Theodore O. Okiishi, Fundamentals of Fluid Mechanics, Second Edition, John Wiley & Sons, Inc., 1994.
5. Merle C. Potter, and David C. Wiggert, Mechanics of Fluids, Second Edition, Prentice Hall, Inc., 1997.
6. Joseph B. Franzini, and E. John Finnemore, Fluid Mechanics with Engineering Applications, Ninth Edition, McGraw-Hill, Inc., 1997.

Prerequisites: Calculus 3 and either Statics & Dynamics or Dynamics.

Objectives: This course introduces juniors in civil and mechanical engineering to the basic priniciples underlying the behavior of liquids and gases at rest and in motion; it also enables them to analyze simple fluid-flow systems. This course is a prerequesite to other courses in civil and energy engineering.

Scope: *AE 341* is an introductory fluid mechanics course that must serve the needs of mechanical, civil, environmental, chemical, aerospace, and aeronautical engineering undergraduates. As such, it is intended to provide a very strong foundation in the fundamentals to prepare students for more specialized fluids-related courses in both the ME and CE curricula (including hydraulics and wind engineering in CE; aerodynamics and compressible fluid mechanics in ME). These fundamentals must include a strong emphasis on the integral form of the conservation laws (mass, momentum, and energy), use of Bernoulli's equation, similitude, and hydrostatics. These concepts comprise the bulk of the course and, along with their applications, are the main elements tested in the Fundamentals of Engineering Exam.

Main Topics:

1. Fluid properties.
2. Fluid statics.
3. Velocity field, acceleration field, Reynolds transport theorem.
4. Elementary fluid dynamics, the Bernoulli equation.
5. Finite control volume analysis for mass, linear momentum, and mechanical energy.
6. Similitude, dimensional analysis and modeling.
7. Laminar and turbulent flow in conduits of circular and noncircular cross-sections.
8. Laminar and turbulent boundary layers.

Relationship of Course to Program Objectives:

Partial fulfillment of the following Program Objectives:

1. Develop the creative and critical thinking skills essential in identifying, structuring, and solving complex problems.
2. Firmly ground students in the fundamentals of mathematics, the basic sciences, and the engineering sciences necessary to pursue a successful career in mechanical engineering.
3. Develop graduates who can communicate effectively in written and graphical forms.
4. Provide open-ended challenges for the design of mechanical and thermal systems.
5. Instill an attitude that learning is a lifelong process.

Relationship of Course to ABET Criterion 3 Program Outcomes:

Helps prepare students to meet outcomes a, e, and k.

Grading and Exams: The final grade is based on the best score earned under any one of the four options described below. In addition, class participation, proper demeanor, and genuine efforts to improve can also affect the final assessment.

Option 1	**Option 2**	**Option 3**	**Option 4**
Homework: 15%.	Homework: 15%.	Notebook: 10%.	Notebook: 10%.
Exam I: 15%.	Best 2 Exams: 30%.	Homework: 15%.	Homework: 15%.
Exam II: 15%.	Final: 55%.	3 Exams: 45%.	Best 2 Exams: 30%.
Exam III: 15%.		Final: 30%.	Final: 45%.
Final: 40%.			

Fluid Mechanics I

Lecture		Date	Topics		Text
1	January	13	Introduction		--
2		15	Preliminary Concepts	*Week 1*	1.1–1.2, 1.14
3		17	Preliminary Concepts		1.3–1.6, 1.13
4		20	Martin Luther King Day		HOLIDAY
5		22	Streamline, Streakline, Pathline	*Week 2*	1.8–1.9
6		24	Viscosity		1.7
7		27	Pressure & Manometry		2.1–2.3
8		29	Manometry	*Week 3*	2.4
9		31	Plane Submerged Surfaces		2.5
10	February	3	Plane Submerged Surfaces		2.7
11		5	Curved Submerged Surfaces	*Week 4*	2.6
12		7	Curved Submerged Surfaces		2.8
13		9	Euler's Equation		p. 227, 4.9
14		10	Bernoulli's Equation	*Week 5*	3.7
15		12	Streamline Approach		3.7, 6.10
16		14	Exam I		
17		17	The Reynolds Tansport Theorem	*Week 6*	3.1–3.2
18		21	The Reynolds Tansport Theorem		3.1–3.2
19		24	Integral Mass		3.3
20		26	Integral Mass	*Week 7*	3.3
21		28	Integral Momentum		3.4
22	March	3	Integral Momentum		3.4
23		5	Integral Momentum	*Week 8*	3.4
24		7	Integral Momentum		3.4
25		17	Integral Momentum		3.4
26		19	Differential Mass Derivation	*Week 9*	4.1–4.2
27		21	Exam II		
28		24	Differential Mass Problems		
29		26	Navier-Stokes Equations	*Week 10*	4.3
30		28	Navier-Stokes Equations		4.3
31		31	Cylindrical Navier-Stokes		4.3, 6.4
32	April	2	Cartesian Navier-Stokes	*Week 11*	4.3, p. 359
33		4	Energy Equation Derivation		3.6
34		7	Entrance Length & Major Loss		6.1–6.4
35		9	Minor Head Loss	*Week 12*	6.7
36		11*	Strategies		6.5
37		14	Pipe Flow Problems		6.5–6.8
38		16	Pipe Flow Problems	*Week 13*	6.5–6.8
39		18	Easter		HOLIDAY
40		21	Easter		HOLIDAY
41		23	Pipe Flow Problems	*Week 14*	6.5–6.8
42		25	Similarity and Similitude		5.1–5.2
43		28	Buckingham Pi Theorem		5.3
44		30	Scaling of Forces	*Week 15*	5.4–5.5
45	May	2	Closure –Course Evaluation		
46		7	FINAL EXAM		1:00–3:00

*Final day to withdraw with a W