

EM324 Fluid Mechanics

**United States Naval Academy**  
**Mechanical Engineering Department**  
**EM324 Fluid Mechanics**

**Catalog Description:** EM324 Fluid Mechanics **Credit:** 4 (3-2-4)

An introductory course in fluid dynamics stressing both the integral and differential forms of the conservation laws of fluid flow. Engineering applications are made to hydrostatics and to ideal and real fluid flows. Laboratory experiments and problems sessions complement the lectures.

**Prerequisites:** SM212

**Corequisites:** EM319 or equivalent.

**Textbooks:** Fundamentals of Fluid Mechanics by Munson, Young, and Okiishi; John Wiley & Sons, 4th Edition (2002).

Supplemental Textbooks:

- (1) Student Solutions Manual for Fundamentals of Fluid Mechanics, by Munson, Young and Okiishi; John Wiley & Sons, 4rd Edition (2002).
- (2) Schaum's Outline Series Theory and Problems of Fluid Dynamics.
- (3) Schaum's Solved Problems Series 2500 Solved Problems in Fluid Mechanics and Hydraulics.
- (4) FE Review Manual, by Lindeburg, Professional Publications, (2000).

**Course Director:** Prof. Karen A. Flack

**Objectives :**

1. To teach students the fundamentals of fluid properties, fluid statics and fluid dynamics with applications to a broad range of problems.<sup>a,b</sup>
2. To teach students the fundamentals of fluid topics related to naval applications.<sup>a,b,c</sup>
3. To demonstrate fluid phenomena through experimentation and design, and the methods of experimental dimensional analysis.<sup>a,b</sup>
4. To teach students the mathematical tools necessary to solve complex fluids problems.<sup>a,c</sup>
5. To develop students technical presentation skills through written and oral lab reports.
6. To develop students team problem solving skill through design and projects, problem sessions and laboratory exercises.<sup>c,d</sup>

**Course Content:**

	<b>Topic:</b>	<b>Hours:</b>
1.	Mathematics	4
2.	Fluid Properties	4
3.	Hydrostatics, Hydraulics	7
4.	Buoyancy and Stability	1
5.	Fluid Kinematics	3
6.	Bernoulli Equation	6
7.	Integral Conservation Equations, Mass and Momentum	5
8.	Viscous Flow, Navier-Stokes Equations	5
9.	Computational Fluid Dynamics	3
10.	Dimensional Analysis	5
11.	Pipe Flow	8
12.	Boundary Layers	3
13.	Lift and Drag	3
14.	Turbomachinery	6
15.	Open channel flow	2

**Evaluation:**

1. Quizzes  Yes \_\_\_ No
2. Homework  Yes \_\_\_ No
3. Exams  Yes \_\_\_ No
4. Laboratory Reports  Yes \_\_\_ No
5. Oral Presentations  Yes \_\_\_ No
6. Design Reports/Notebooks  Yes \_\_\_ No
7. Prototypes/Demonstrations \_\_\_ Yes  No
8. Projects \_\_\_ Yes  No
9. Any other evaluation tools used \_\_\_ Yes  No

**Acquired Abilities :**

- 1.1 Students will demonstrate an understanding of fluid properties including the measurement of the property and its dependence on pressure and temperature. (1,2,3,4)
- 1.2 Students will demonstrate the ability to solve hydrostatic problems involving manometers, hydrostatic forces on planar and curved surfaces, and hydraulics. (1,2,3,4)
- 1.3 Students will demonstrate the ability to solve fluid dynamic problems involving conservation of mass, momentum, and energy for viscous and inviscid flow. (1,2,3,4)
- 2.1 Students will demonstrate the understanding the naval related topics of ship stability, aerodynamics, turbomachinery and fluid transport. (1,2,3,4)
- 3.1 Students will demonstrate and understanding dimensional analysis used in fluids experiments. (1,2,3,4)
- 3.2 Students will demonstrate the ability to collect data and analysis experimental results. (4,5)
- 4.1 Students will demonstrate the ability to use differential and vector calculus to solve fluids problems. (1,2,3)

5.1 Students will demonstrate the ability to clearly present laboratory results and design projects in written and oral reports.(4,5,6)

6.1 Students will demonstrate the ability to contribute to laboratory and design teams. (4,5,6)

Date of Latest Revision: 21 OCT 2004

<sup>1</sup>

Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Program.

<sup>2</sup>

Numbers in parenthesis refer to the evaluation methods used to assess student performance.