Sultan Qaboos University
College of Engineering

COURSE OUTLINE

Course Code and Title: CIVL 4046 Fluid Mechanics
Instructor: Dr. Ahmad Sana
Section 10/11, 20/21
Lecture Time Sat. and Wed. 10:00-11:50 (Sec. 10 and 11)
Mon. 10:00-11:50 (Sec. 20), Wed. 14:15-16:05(Sec. 21)
Place CMT/C15 (Sec.10 and 11), CMT/A12 (Sec. 20 and 21)
Office Hours Sat. to Tue. 12:00-12:50, Sun. and Tue. 9:00-9:50
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1. Catalog Course Description

This basic course provides the student with a working knowledge of the fundamental principles governing fluid mechanics and fluid flow. Lectures covering the properties of fluids, fluid statics, basic flow concepts, similitude, dimensional analysis, ideal fluid flow and fluid measurements. These lectures are supplemented by laboratory studies.

2. Required Background:

Prerequisites by course: CIVL 3216

Prerequisites by topic:

Fundamentals of algebra and arithmetic, Basic principles of physics, Principles of basic engineering mechanics.

Post-requisites: CIVL 3066, CIVL 4136, CIVL 4146, CIVL 5346

Equivalent Courses: MECH4151, MEIE4141, MEIE4151, MECH3027

3. Textbook & Suplemental Materials:

Textbook:

Engineering Fluid Mechanics by Crowe, Elger, Williams and Roberson, 9th Ed., John Wiley, 2010.

Supplemental Materials:
1. Fluid Mechanics- Fundamentals and Applications by Cengel and Cimbala, 1st Ed., McGraw-Hill, 2006
2. Fundamentals of Fluid Mechanics by Munson, Young and Okiishi, 2nd Ed., 1990.

Lecture Notes: Can be downloaded from http://ahmadsana.tripod.com

4. Course Objectives (to be linked to program outcomes):

The objectives of this course are to give the student a fundamental knowledge of:
1. Estimation of various fluid properties from available equations and measure them in the laboratory
2. Calculation and measurement of hydrostatic forces on plane and curved surfaces
3. Application of Reynolds transport theorem to fluid flow phenomena
4. Application of continuity equation to steady and unsteady flow phenomena
5. Analysis of steady pipe flow using Bernoulli's equation
6. Determination of forces acting in a flowing fluid using momentum equation
7. Calculation of the energy in a flowing fluid
8. Calculation of discharge carrying capacity and friction loss in the conduits under laminar and turbulent flow conditions

5. Course Outcomes:

Upon the successful completion of this course, students are expected to develop the following skills/understanding (letters in parentheses denote the program outcomes):
1. Know how to estimate various fluid properties from available equations **[a]**
2. Know how to measure mass density, fluid viscosity and hydrostatic forces in the laboratory and analyze the results using common software **[a,b,g,k]**
3. Know how to calculate and measure hydrostatic forces on plane and curved surfaces **[a,b,g,k]**
4. Ability to apply Reynolds transport theorem to fluid flow phenomena **[a]**
5. Ability to apply continuity equation to steady and unsteady flow phenomena **[a]**
6. Ability to analyze steady flow phenomena using Bernoulli's equation **[a,b,g,k]**
7. Understand how to determine forces acting in a flowing fluid using momentum equation **[a,b,g,k]**
8. Know how to calculate the energy in a flowing fluid **[a,b,g,k]**
9. Ability to calculate the discharge carrying capacity and friction loss in the conduits under laminar and turbulent flow conditions **[a,b,g,k]**

6. Course Contents:

The following topics will be covered in this course:

No.	Topic

1. Fluid properties: Density, specific weight, specific gravity, ideal gas law, viscosity, bulk modulus of elasticity, surface tension, vapor pressure.
2. Fluid statics: Pressure variation in a stationary fluid, pressure variation in atmosphere, measurement of pressure, hydrostatic force on plane and curved surfaces, buoyancy, stability of immersed and floating bodies.
3. Flowing fluids and pressure variation: Descriptions of fluid motion; streamlines, streaklines and pathlines, laminar and turbulent flow, one-two and three dimensional flow, acceleration, Euler's equation, pressure distribution in rotating flows, Bernoulli equation along a streamline, applicattions of Bernoulli equation, Reynolds transport theorem.
4. Control volume approach and continuity equation: Lagrangian and Eulerian approach, rate of flow, control volume approach, Continuity equation and its applications.
5. Momentum equation: Derivation, interpretation, applications.
6. Energy equation: general form, energy equation for pipe flow, differences between Bernoulli and energy equations, hydraulic and energy grade lines.
7. Dimensional analysis and similitude: Buckingham pi theorem, similitude.
8. Flow in conduits: classifying flow, developing and fully developed flow, standard pipe sizes, stress distribution in pipe flow, laminar and turbulent flow in pipes, friction factor and combined head loss.

7. Instructional Methods:

Lectures presentation, Tutorial problems, Laboratory experiments

8. Course Assessment:

The degree of student achievement in this course will be assessed as follows:

1. Homework   [5%]
2. Quizzes (Three)   [15%]
3. Laboratory Reports (Five)   [15%]
4. Laboratory Quiz (One)   [5%]
5. Mid-Term Examination   [20%]
6. Final examination   [40%]

9. Student Responsibilities

The student is referred to the Undergraduate University Regulations for more details on the following topics:

- Group work: Students are encouraged to work together on homework problems, but all the work submitted must be the student's own work.
- Attendance: In accordance with the University Regulations, it is the student's responsibility to be punctual and to attend all classes.
- Academic misconduct: academic misconduct is defined as the use of any dishonest or deceitful means to gain academic advantage or benefit.

10. Professional Contribution:

This is a core course that has the goal of developing the understanding and skills in the fluid mechanics for use in Civil Engineering applications. It is a three-credit hours course on Engineering Topics.

11. Useful Sites:

The following professional societies and centers have many useful links:

- www.asce.org

12. Student outcomes (ABET criterion 3)

The course covers the following student outcomes:

a.2   Demonstrate proficiency in application of Science in solving CE problems:
Physics.
Chemistry.

a.3   Demonstrate proficiency in application of engineering principles.

b.2   **Conduct experiments**
- Become familiar with the equipment
- Follow the proper and safe procedure to collect data.

b.3   **Process Data**
- Carry out necessary calculations.
- Check data variability.
- Tabulate and plot results.

b.4   **Analyze data and Interpret results**
- Identify trends.
- Compare with specification or predictive equations.
- Draw conclusions.

g.1   **Produce well-organized reports**
- Produce a technical report in a proper format, i.e. abstract, TOC, objectives, method, results, discussions and conclusions, references
- Use of graphs and tables to explain and support the written information
- Summarize the key findings and conclusions

g.2   **Use clear and correct language**
Demonstrate good command of English writing in terms of proper spelling, grammar and punctuations

k.2   Use modern equipment in engineering laboratories and field exercises

k.3   Use modern codes and standards in solving engineering problems.

13. Weekly Teaching Schedule:

Week	Date	Material to be Covered	Home work	Quiz	Test
1.		Course outline			
		Introduction			
2.		Introduction			
		Properties of fluids	1		
3.		Properties of fluids			
		Properties of fluids	2		
4.		Pressure and fluid statics			
		Pressure and fluid statics	3		
5.		Pressure and fluid statics			
		Pressure and fluid statics	4		
6.		Pressure and fluid statics			
		Flowing fluids and pressure variation	5	**1**	
7.		Flowing fluids and pressure variation			
		Flowing fluids and pressure variation	6		
8.		Control volume approach and continuity Eq.			
		Control volume approach and continuity Eq.	7		
9.		**Mid-Term Examination**			**1**
		Momentum euqation	8		
10.		Momentum euqation			
		Momentum euqation	9	**2**	
11.		Energy euqation			
		Energy euqation	10		
12.		Energy euqation			
		Dimensional analysis and similitude	11		
13.		Dimensional analysis and similitude			
		Flow in conduits	12		
14.		Flow in conduits			
		Flow in conduits	13	**3**	
15.		Flow in conduits			
		Flow in conduits			
16.		**Final Examination:** 18/5/13 11:30-14:30			**2**

Note: Schedule is subject to change. Any changes will be announced during the semester.