Faculty of Engineering

Department of Mechanical Engineering

COURSE OUTLINE

MECH 345 – Mechanics of Fluids

Term –SPRING 2016(201601)

Instructor	Office Hours
Dr. Mohsen Akbari	Days: Wednesdays
Phone: (250)721-6038	Time: 4 -5 pm, email for other times
E-mail:makbari@uvic.ca	Location: EOW 331

List all prerequisites and co-requisites: Math 200, Calculus of Several Variables

LECTURE DATE(S)

Section: A01 /CRN 22194	Days: Tuesdays, Wednesdays, and Fridays	Time: 8:30 am - 9:20 am	Location: Engineering Comp Science Bldg 125

TUTORIAL SECTIONS

Section: T /CRN 22200	Days:	Time:	Location:
T01	Tuesdays	3:30 pm - 4:20 pm	Engineering Comp Science Bldg 125

LAB SECTIONS

Section: B (Multiple)	Days:	Time:	Location:
Insert additional rows if required	(or leave blank and state how/when labs will be scheduled)		
B01	Mondays	4:00 pm - 6:50 pm	Engineering Lab Wing A140
B02	Tuesdays	4:30 pm - 7:20 pm	Engineering Lab Wing A140
B04	Fridays	12:30 pm - 3:20 pm	Engineering Lab Wing A140
B05	Fridays	5:00 pm - 7:50 pm	Engineering Lab Wing A140

Lab times and locations are also available from the timetable through Sign in to UVic, My Page**.**

TA Name	E-mail	Office
Sean Blaney	blaney@uvic.ca	
Premakumara Govindappa	premg@uvic.ca	
Valérie Losier	vlosier@uvic.ca	
Virag Mishra	virag@uvic.ca	
Markus Sommerfeld	msommerf@uvic.ca	
Boyu Wang	boyuwang@uvic.ca	

Required Text	Optional Text
Title: Fluid Mechanics	Fluid Mechanics

Learning Outcomes next page

Author: YA Cengel, JM Cimbala.	FM White
Publisher/Year: McGraw Hill/2014	McGraw Hill/2016
Reference Materials:	

COURSE OBJECTIVES: Verbose description of the material being covered in the course. How does the course build/relate to other courses in the program.

Students in Unified will learn to:

- Explain the physical properties of a fluid and their consequence on fluid flow, expressed in terms of Mach and Reynolds numbers
- Understand the conservation principles of mass, momentum, and energy for fluid flow
- Apply the basic applied-mathematical tools that support fluid dynamics
- Create conceptual and quantitative models of inviscid, steady fluid flow over simple bodies (airfoils, wings) and in channels

LEARNING OUTCOMES: At the end of this course, students will be able to:

Students successfully completing this course will demonstrate the following outcomes by homework and exams:

At the end of this course, students will be able to:

- Articulate the broad range of situations in nature and technology, which involve fluid mechanics, and explain the basic flow analysis techniques used for investigation and for design.
- Demonstrate an understanding of the basis and utility of flow classifications such as steady /unsteady, internal/external, laminar/turbulent, 1-, 2- or 3-dimensional. Appropriately use these classifications, together with approximations, such as continuum flow, inviscid flow, incompressible flow or creeping flow, for flow analysis. Demonstrate understanding of the limits of their applicability.
- Apply the concepts of vector fields (velocity, force, acceleration), scalar fields (pressure, density, temperature), and vector differential and integral calculus to engineering analysis of fluids systems, through the interpretation and proper use of flow kinematics and dynamics.
- Properly apply system and control volume methods based on conservation of mass, momentum, and energy, to the analysis and design of engineering fluids systems
- Properly apply statics to fluids at rest or Newton's Second Law to fluids in rigid body motion (hydrostatics), using integral and differential calculus, to determine pressure variation, forces and moments on submerged surfaces, buoyancy and the stability of floating bodies.
- Properly apply mass, momentum, and energy conservation to steady internal (pipe) flows, correctly interpret and apply laminar and turbulent flow models, and estimate head loss and power requirements in piping systems.
- Apply integral methods, and basic empirical and theoretical models, to the analysis of boundary layer flows, and to evaluate drag on bodies in fluid flow.
- Apply basic principles of dimensional homogeneity to engineering analysis, and apply dimensional analysis and similitude for compact data representation, design of experiments, and classification of flow regimes using dimensionless parameters.
- Demonstrate professionalism, and respectful interaction with faculty and colleagues in class discussions, group work and laboratory projects.
- Demonstrate capabilities of thoughtful engineering communication through written work.

Weight & Date(s) of Assessments:	Weight	Date
Assignments:	% 5 (bonus)	10 assignments (each 0.5%)
Labs	%15	
Pop quizzes	% 15	
Mid-term	%25	Date: Feb 23rd, 2016
Final Exam	% 45	Date: TBA

ASSIGNMENTS (Include Assignment Schedule) (Description & Method of Delivery)

Homework assignments will be assigned on a weekly basis. The assignments will be collected and evaluated as a bonus. Individual in-class quizzes based on the problems that are conceptually similar to the homework assignments. The quizzes will be conducted in a written format with open books and notes. Computers and wireless devices will not be permitted.

Assignment #	Modules	Start	Due (in class)
1	1,2: Basic concepts fluid static	Jan-12	Jan-19
2	3,4: Hydrostatic pressure	Jan-19	Jan-26
3	5,6: Rigid body motion and buoyancy	Jan-26	Feb-02
4	8-10: CV, Reynolds Transform	Feb-02	Feb-16
5	11,12: Bernoulli, HGL, EGL	Feb-16	Feb-23
6	13-15, NS eq., Exact solutions	March-01	March-08
7	16,17: Dimensional Analysis and approximate solutions	March-08	March-15
8	18,19: Internal flow: Laminar and turbulent flows	March-15	March-22
9	20,21: Internal flow: piping, Moody chart, piping network	March-22	March-29
10	22, 23: External flow	March-29	Final

LABORATORIES (Description & Method of Delivery)

Four experiments will be performed during the course. Students will work in groups of four to complete the experiments. Description of the experiments, lab group assignments and schedule for each group will be provided for the students.
During each lab session, the students will write individual in-class reports consisting of answers to questions addressing the underlying concepts and procedures for the experiment performed that day.
After completing each experiment, each group of five students will write a group report, which will be due two weeks after completing the experiment.

Lab #	Modules	Start	Due
1	Center of Pressure and Hydrostatic Force on a Submerged Body	Jan 11th	Next lab session
2	Linear Momentum Experiment	Jan 25th	Next lab session
3	The Energy Equation in a Venturi-Type Flow	Feb 15th	Next lab session
4	Friction in Laminar and Turbulent Pipe Flow	Feb 29th	Next lab session

PROJECTS: (Description & Method of Delivery)

No projects for this course

NOTE:

Failure to complete all laboratory requirements will result in a grade of N being awarded for the course. Failure to pass the final exam will result in a failing grade for the course.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

"**Attendance**

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time….

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course."UVic Calendar, (2015) http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/Atte.html

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty,
to adhere to and promote standards of professional behaviour that support an effectivelearning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.http://www.uvic.ca/engineering/current/undergrad/index.php#section0-23

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/PoAcI.html

Course Schedule(remove example text)

Module	Topics	Date/Week
1	• Introduction • Basic concepts and definitions • Properties of fluids	Jan-05/W1 Jan-06/W1 Jan-08/W1
2	• Fluid static • Hydrostatic pressure on submerged plane surfaces • Hydrostatic pressure on submerged curved surfaces	Jan-12/W2 Jan-13/W2 Jan-15/W2
3	• Buoyancy and stability • Fluids in Rigid-body motion	Jan-19/W3 Jan-20/W3 Jan-22/W3
4	• Properties of velocity field • Flow analysis • Control surface (CS) and Control Volume (CV)	Jan-26/W4 Jan-27/W4 Jan-29/W4
5	• Reynolds Transform Theorem • CV analysis of mass and linear momentum with examples • CV analysis of and angular momentum with examples	Feb-02/W5 Feb-03/W5 Feb-05/W5
Reading Break	Feb-08- Feb-12/W6	
6	• Conservation of energy and energy efficiency, • Bernoulli Equation • HGL and EGL, applications of BE	Feb-16/W7 Feb-17/W7 Feb-19/W7
7	• Differential analysis of fluid flow: conservation of mass, special cases • Conservation of momentum	Feb-23/W8 Feb-24/W8 Feb-26/W8
8	• NS eq. • Exact solutions: Couette flow, fully developed flow in round pipes, sudden motion of an infinite flat plate	March-01/W9 March-02/W9 March-04/W9
9	• Dimensional analysis, dimensionless parameters Re, etc, Pi Theoreom, Geometric similarity, kinematic similarity, dynamic similarity • Nondimensionalization of equations of motion, approximate solutions: creeping flow, inviscid flow, irrotational flow	March-08/W10 March-09/W10 March-11/W10
10	• Internal flow: laminar flow • Internal flow: turbulent flow	March-15/W11 March-16/W11 March-18/W11
11	• Internal flow: Piping, Moody chart, minor losses, piping network • Internal flow: Flow rate and velocity measurement	March-22/W12 March-23/W12 March-25/W12
12	• External flow: Boundary layer approximation, Lift, Drag, friction and pressure drag • External flow: Flow over flat surfaces, cylinders, spheres, and airfoils	March-29/W13 March-30/W13 April-01/W13