Identification	Subject	PETE338, Fluid Mechanics for Petroleum Engineers, 6 ECTS
	Department	Petroleum Engineering
	Program	Undergraduate
	Term	Spring 2026
	Instructor	Mangushev Rufat
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	Phone:	
	Classroom/hours	11 Mehseti str. (Neftchilar campus) TBD
	Office hours	TBD
Prerequisites	Introduction to fluid mechanics	
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	*Core textbooks:* • Allen, Myron B. The Mathematics of Fluid Flow Through Porous Media. John Wiley & Sons, 2021. • Zimmerman, Robert W. Fluid Flow in Porous Media. World Scientific Publishing, 2018. *Additional textbooks:* • Archer, J.S. and Wall, C.G. (1986) Petroleum engineering: principles and practice I. Petroleum engineering 1 Title 1.	
Course outline	This course is designed for the master students. Course addresses Reservoir Management: Two-phase flow in pipes occurs frequently in refineries, oil and gas production facilities and petrochemical units. The accurate design of such processing plants requires that numerical algorithms be combined with suitable models for predicting expected pressure drops.	
Course objectives	**Objective of the Course:** This class provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications. The student will demonstrate the understanding of these fundamentals by solving problems dealing with fluid properties, fluid statics, pressure on plane and curved surfaces, buoyancy and floatation, kinematics, systems, control volumes, conservation principles, ideal incompressible flow, impulse- momentum, and flow of a real fluid. Quizzes will be provided during the classes based on the topic covered previously. Four quizzes will be provided during semester Quizzes will be provided during the classes based on the topic covered	

	previously. Two quizzes will be provided during semester.	
	Presentation	
	Each student has one presentation during this course. Students should make a presentation on given topics and present to other students on week 13.	
	Project objectives	
	Students should research about given topic from book. Students should hand in two reports in .docx and .PDF format about their research and presentation. Deadline for handing in all reports and presentations by e-mail is week 13.	
Learning outcomes	By the end of the course the students should be able to learn: • Characteristics and properties of fluid • Basic characteristics of fluids in motion • Flow properties of fluids • Balance equations • The perfect fluid • Derive expressions that describe velocity profiles of non-Newtonian fluids in pipelines • Derive expressions that describe flowrate of compressible fluids • Derive expressions that describe flow through porous materials • Apply and use conventional fluid flow models: pressure losses across packed beds, critical pressure ratio for choked flow, two phase pressure drop. • Develop numerical schemes to solve partial differential equations in 2D steady and transient examples.	
Teaching methods	**Lecture**	x
	Group discussion	x
	Experiential exercise	x
	Simulation	x
	Case analysis	x
	Course paper	x
	Others	

Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Midterm Exam		30
	Case studies		
	Class Participation		
	Assignment and quizzes		10
	Project		15
	Presentation/Group Discussion		10
	Final Exam		35
	Others		
	Total		100

Policy	▪ **Preparation for class** There will be 2 quizzes worth 3 points each and 4 assignments worth 1 point each. Quizzes are of random pop-up nature (not more than 30 minutes per quiz). Midterm exam will consist of variety of types of questions including, but not limited to multiple choice, calculations, open questions, true-false questions, etc. Multiple choice questions are not limited to a single correct answer. Different weights will be assigned to different midterm questions depending on their difficulty. Group project is a 30 pages long report on a specific novel topic that will be assigned on week 3 of the classes and will be due on week 13 (10 weeks in total). Presentation will be based on the group project. All parts of the course will be evaluated based on zero tolerance towards cheating, plagiarism and use of AI in any form other than inspirational. Inspirational use of AI constitutes topic suggestion, material (books/articles) search, and nothing more. ▪ **Withdrawal (pass/fail)** This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is expected to achieve a mark of at least 60% to pass. In case of failure, they will be required to repeat the course the following term or year. ▪ **Cheating/plagiarism** Cheating or other plagiarism during the Mid-term and Final Examinations will lead to paper cancellation. ▪ **Professional behavior guidelines** The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/ Assignments
1	Week 1	• Introduction • General energy Equation • Supplemental Material	[1.1]
2	Week 2	• Evaluation of friction Loss • Single Phase Flow • Two Phase Flow Concepts	[1.2]
3	Week 3	• Principal of Two-Phase Flow • Downward Vertical 2 Phase Flow • Upward Vertical 2 Phase Flow	[2.7]

4	Week 4	• Fluid Property Correlations • Vertical Flow • Flow Regimes	[1.4]
5	Week 5	• Evaluation of Pressure Loss Prediction Methods • Flow in Annuli	[1.5]
6	Week 6	• Three-Phase Flow • Downward Vertical 3 Phase Flow • Upward Vertical 3 Phase Flow • Temperature Prediction • Temperature Gradient • Horizontal Flow	[2.7]
7	Week 7	• Inclined Flow • Multiphase flow • Buckley–Leverett equation • Darcy's law for multiphase flow • Slip ratio (gas–liquid flow) • Mass flow meter	[1.6]
8	Week 8	• **Midterm Exam**	
9	Week 9	• Flow Through Restriction • Orkiszewski correlation • Griffith correlation • Griffith and Wallis correlation • Duns and Ros correlation	[1.7]
10	Week 10	• Duns and Ros modified by Ros correlation • Hagedorn and Brown correlation • Armand correlation • Pressure profiles in two-phase geothermal wells	[1.7]
11	Week 11	• Performance of flow correlations based on error distribution • Performance of flow correlations based on wellhead conditions	[1.8]
12	Week 12	• Performance of flow correlations based on wellhead enthalpy • Performance of flow correlations based on fluid flow regime	[1.8]

13	Week 13	**Project and Presentation Submission**	
14	Week 14	• Geothermal wellbore simulation	[1.9]
15	Week 15	• A two-phase flow model for geothermal wells in the presence of non-condensable gas	[1.10]
	TBA	**Final Exam**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.