

Identification	Subject	Fluid Mechanics for Petroleum Engineers - PETE 338 - 6 ECTS
	Department	Petroleum Engineering
	Program	Undergraduate
	Term	Fall, 2026
	Instructor	Mangushev Rufat
	E-mail:	rufat.mangushev@gmail.com
	Phone:	
	Classroom/hours	41 Mehseti str. (Neftchilar campus) TBD
	Office hours	TBD
Prerequisites	Introduction to fluid mechanics	
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	Core textbook: - Xue, L., Guo, X., & Chen, H. (2021). Fluid Flow in Porous Media: Fundamentals and Applications. World Scientific. - Li, D., & Chen, J. (2021). Mechanics of Oil and Gas Flow in Porous Media. Springer.	
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	Generic 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 on one DVD is until final exam day. It should be noticed that students lectures or presentations will consider as references for their quizzes and exams.	

Learning outcomes	Upon successful completion of the course, students will be able to: Explain the fundamental physical properties of petroleum fluids and the basic principles governing fluid statics and fluid motion. Apply the principles of mass, momentum, and energy conservation to analyze fluid-flow problems encountered in petroleum engineering systems. Analyze fluid flow in pipes and conduits using the continuity equation, Bernoulli equation, momentum equation, and mechanical-energy balance. Distinguish between laminar, transitional, and turbulent flow and determine the influence of Reynolds number, friction, pipe roughness, and flow regime on pressure losses. Calculate pressure drops and head losses in petroleum production and transportation systems, including pipes, fittings, valves, and flow restrictions. Explain the principles of fluid flow through porous media and apply Darcy's law to single-phase flow in petroleum reservoirs. Analyze the effects of fluid and rock properties—including viscosity, permeability, porosity, pressure, and fluid saturation—on flow through reservoir formations. Apply appropriate mathematical models to analyze radial, linear, and steady/unsteady flow of reservoir fluids toward production and injection wells. Describe the fundamental principles of multiphase flow and evaluate the effects of phase interaction, relative permeability, pressure gradients, and flow regimes on petroleum production. Analyze basic gas and liquid flow in wellbores and surface production systems, including pressure-gradient and flow-rate relationships. Use appropriate analytical methods, engineering correlations, and computational tools to solve and interpret fluid-flow problems relevant to petroleum engineering. Evaluate fluid-flow problems and select appropriate assumptions, models, correlations, and boundary conditions, recognizing their limitations and applicability to real petroleum-engineering systems.		
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 The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions. Throughout the semester we will also have assignments.		

	▪ Withdrawal (pass/fail) This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally 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.
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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	[2.7]

		• Temperature Gradient • Horizontal Flow	
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.