Identification	**Subject**	ENGR210 – Introduction to Fluid Mechanics – 6 ECTS credits
	Department	Petroleum Engineering
	Program	Undergraduate
	Term	Spring 2024
	Instructor	Rashad Nazaraliyev
	E-mail:	rashad.nazaraliyev@khazar.org
	Phone:	
	Classroom/hours	Thursdays, 8:30-11:50
	Office hours	9-11:00
Prerequisites	ENGR205	
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	• *"**Process Engineering A**" Heriot Watt University* • *"**Brief Introduction to Fluid Mechanics**" by Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch-A, Fifth Edition, published by Wiley Publication, 2010.* • *"**Chemical Engineering Volume 1**", J.M. Coulson, J.F. Richardson.* • *"**Fluid Mechanics with Engineering Applications**" by E. John Finnemore and Joseph B. Franzini, 10th. Edition, published by McGraw Hill, 2001.*	
Course outline	• The aim of the course is to demonstrate a thorough understanding of fluid statics and fluid dynamics, with particular application to chemical and process industries, relate pressure drop and flow rate in pipe flows; be able to calculate flow rates in channel flows, demonstrate an understanding of the principles and limitations of current flow metering systems, demonstrate an understanding of the different choices available in pump selection for process applications and be able to specify in detail a centrifugal pump for a given duty, apply mathematical analysis to fundamental fluid flow problems, demonstrate competence in the practical application of fluid flow theory, demonstrate an industrial awareness of equipment to convey and measure the flow of liquids and gases, demonstrate experience in working with fluid conveying and measuring equipment.	
Course objectives	The course helps students to gain a basic understanding of properties of fluids and how to measure them. These knowledge lead to determination of behaviour of fluids in various conditions. This course aims to introduce the topic of fluid mechanics covering fundamental theory of fluid flow, fluid statics and its use in selecting equipment suitable for fluid conveying. Students will work to formulate the models necessary to study, analyse, 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.	

<table>
<tr><td>Learning outcomes</td><td colspan="3">

Determination of basic characteristics of fluids,
Calculation of hydrostatic pressure at any given point in fluids,
Calculation of forces exerted by fluids,
Describing properties of fluid flows under various conditions,
Formulating conservation of mass, moment and energy for different systems of fluids,
Apply governing equations of fluid flows to different engineering problems,
Laminar/Turbulent flow
One dimensional pipe flow
Non-Newtonian fluid flow
Properties of multiphase mixtures

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<tr><td rowspan="6">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Experiential exercise</td><td></td></tr>
<tr><td colspan="2">Assisted work/Assignments</td><td>x</td></tr>
<tr><td colspan="2">Assisted lab work</td><td></td></tr>
<tr><td colspan="2">Quizzes</td><td>x</td></tr>
<tr><td colspan="2">Others</td><td></td></tr>
<tr><td rowspan="6">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td>TBA</td><td>30</td></tr>
<tr><td>Quizzes</td><td>TBA</td><td>10</td></tr>
<tr><td>Semester Projects</td><td>11.04.2024</td><td>20</td></tr>
<tr><td>Final Exam</td><td>TBA</td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">

Quizzes will be provided during the classes are based on the topic covered during the classes. Two or three quizzes will be provided during semester. Random quizzes during semester for instructor to decide the eligibility of student for the semester project.
Group based practical project supported by computer-based spreadsheet work serve to illustrate the practical significance of the theory taught in the classes. The project represents an individual/collective endeavor undertaken by students within the realm of scientific inquiry. The incorporation of projects into the curriculum serves the dual purpose of showcasing the subject's research endeavors to potential students and illuminating the ongoing scholarly activities within the field.
Midterm will be carried out in the week announced by the university. Time allocated will be announced close to the midterm. A midterm examination is a test administered approximately midway through an academic grading term, be it a quarter or semester. Its primary objective is to provide students with a clearer assessment of their progress within the course, enabling them to gauge their performance and understanding up to that point.
Final exam date and time will be defined by the University. A final examination is an evaluative assessment presented to students at the conclusion of an academic term or course of study. This assessment typically consists of a predefined set of questions or exercises designed to gauge students' proficiency and comprehension of the subject matter.
NO CELL PHONES are allowed during lecture. PLEASE turnthem off before lecture! (Not silent or vibrating mode). This is a university policy and accepted

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	by the department of PE, and violators will be reprimanded accordingly. • Participation and interaction in classes are more important than just attendance. • No late tasks/homework will be accepted. Homework is to be completed on an individual basis. Students may discuss homework with classmates, but students are responsible for their own work. If students have consulted classmates, please note the individuals name on the top of students' assignment. • No late assignments will be accepted without prior arrangement with the instructor for acceptable excuses. Medical and family emergency will be considered on case-by-case basis. Note that inability to participate in quiz or presentations will not be accepted, and YOU WILL NOT HAVE A SECOND CHANCE TO PRESENT YOUR RESULTS OR PARTICIPATE IN QUIZZES. IN CASE OF ABSENCE, YOU WILL HAVE TO PRESENT "ARAYIŞ" TO THE INSTRUCTOR. • Quizzes may be given **unannounced** throughout the term and will count as onehomework. There will be no make-up quizzes. • No make-up exams. If students miss an exam, a zero score will be assigned to the missed exam. • If students should miss class due to personal emergency or medical reasons, please notify the instructor by email immediately. A doctor's note will be required for make-up work. • Students are responsible for completing the reading assigned from the textbook related to the covered topics and for checking email regularly for important information and announcements related to the course. • Any form of plagiarism or cheating on a proposal, work plan, bibliography, presentation of literature review, final report will result in the cancellation of the work. In this case, the student will receive a mark of nought without any further consideration. After identification cheating or plagiarism, NO CHANCE will be given for correction and rewrite report. • University policy on academic honesty concerning exams and individual work will be strictly enforced. • TAKE YOUR RESPONSIBILITY! BE ON TIME!

Tentative Schedule

Week	Date/Day (Tentative)	Topics	Textbook/ Assignments
1		Introduction to Fluid and Fluid Statics 1.1.1 Forces between Atoms 1.1.2 Solids and Fluids 1.2 Units 1.2.1 Absolute Pressure and Gauge Pressure 1.2.2 Normal Stress and Shear Stress 1.2.3 Fluid Viscosity 1.2.4 Fluid Specific Gravity 1.2.5 Fluid Coefficient of Compressibility Tutorial Topic 1	HWU, Chapter 1
2		Hydrostatic Pressure Theorems 1.3.1 Hydrostatic Pressure Gradient 1.3.2 Hydrostatic Pressure Equality at the Same Level	HWU, Chapter 1

		1.4 Manometers 1.4.1 Inclined Manometer 1.5 Surface Tension And Wettability 1.5.1 Contact Angle and Wettability 1.5.2 Capillarity Tutorial Topic 1	
3		Introduction to Fluid Dynamics 2.2 Conservation of Mass 2.3 Conservation of Energy 2.3.1 Bernoulli's Equation Laminar and Turbulent Flow 2.4.1 Flow over a Flat Plane Surface 2.4.2 Transition to Turbulent Flow	HWU, Chapter 2
4		2.4.3 Pipe Flow 2.4.4 Newton's Law of Viscosity 2.4.5 Fluid Viscosity **Quiz**	HWU, Chapter 2
5		**Novruz Holiday**	
6		Laminar Flow in a Circular Pipe 2.5.1 Velocity Profile for Laminar Flow 2.5.2 Shear Stress Variation across Pipe 2.5.3 Volumetric Flow Rate for Laminar Flow 2.5.4 Laminar Flow Frictional Pressure Loss 2.6 Turbulent Flow in a Pipe 2.7 Tutorial Topic 2	HWU, Chapter 2
7		Frictional Pressure Loss and Flow Measurement 3.1 Introduction 3 3.2 Pressure Loss Through Straight Pipe 3.2.1 Laminar Flow Pressure Loss 3.2.2 Turbulent Flow Pressure Loss 3.2.3 Friction Factor Charts 3.2.4 Typical Absolute Roughness Values 3.2.5 Hydraulic Mean Diameter	HWU, Chapter 3
8		Pressure Loss Through Pipe Fittings 3.3.1 Lost Velocity Heads Method 3.3.2 Equivalent Length Method 3.4 Flow Measurement 3.4.1 Pitot Static Tube 3.4.2 Orifice Plate Meters 3.4.3 Venturi Meter 3.4.4 Linear Flow Meters 3.5 Tutorial Topic 3	HWU, Chapter 3
9		Pumping Systems and Pump Sizing 4.1 Introduction 4.2 Types of Pump or Turbine 4.2.1 Positive Displacement Pumps 4.2.2 Rotodynamic Pumps **Quiz**	HWU, Chapter 4
10		Pump Characteristics 4.3.1 Positive Displacement Pump Characteristic Curve 4.3.2 Centrifugal Pump Characteristics 4.3.3 Pump Head Curve 4.3.4 Pump Efficiency Curve	HWU, Chapter 4

		4.3.5 Pump NPSH 4.3.6 Typical Manufacturer's Pump Curve	
11		Pump Sizing 4.4.1 Generalized Pump Diagram 4.4.2 Pump Sizing Procedure 4.4.3 Relating Pump Head to Bernoulli's Equation 4.4.4 Pump Power Output and Power Input 4.4.5 Available Net Positive Suction Head 4.4.6 Pump System Curves and Duty Point 4.5 Tutorial Topic 4	HWU, Chapter 4
12		Non-Newtonian Fluid Introduction 5.1.1 Time-Independent Non-Newtonian Fluids 5.1.2 Time-Dependent Non-Newtonian Fluids 5.2 Mathematical Models 5.2.1 Power Law Fluids 5.2.2 Structural Understanding of Non-Newtonian Behaviour 5.2.3 Bingham Plastic Fluids Fitting a Model to Experimental Data 5.3.1 Identify Thixotropic or Rheopectic Fluid Behaviour 5.3.2 Identify Newtonian Fluid Behaviour 5.3.3 Identify Bingham Plastic Fluid Behaviour 5.3.4 Identify Power Law Fluid Behaviour	HWU, Chapter 5
13		Engineering Equations for Power Law Fluids 5.4.1 Velocity Profile of a Power Law Fluid in Laminar Flow 5.4.2 Friction Factor for Laminar Flow Power Law Fluids 5.4.3 Friction Factor for Turbulent Flow Power Law Fluids 5.5 Tutorial Topic 5 **Quiz**	HWU, Chapter 5
14		Multiphase Flow Introduction 6.1 Two Phase Gas-Liquid Flow 6.2 Two Phase Liquid-Solid Flow 6.3 Two Phase Liquid-Liquid Flow 6.4 Tutorial Topic 6	HWU, Chapter 6
15		Compressible Flow Introduction 7.1 Key Equations 7.2 Compressible Flow Through a Nozzle 7.3 Compressible Flow in a Pipe 7.4 Tutorial Topic 7	HWU, Chapter 7
16		**Final Exam**	

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