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| **Identification** | **Subject**  | PETE 303: Physics of Oil and Gas Reservoirs- 3 credits |
| **Department** | Petroleum and Natural Gas Engineering |
| **Program** | UnderGraduate |
| **Term** | Fall, 2016 |
| **Instructor** | Masoud Mehrizadeh |
| **E-mail:** | mmehrizadeg@khazar.org |
| **Phone:** | +994554625367 |
| **Classroom/hours** | Tuesday & Friday, 17:00 – 18:30 |
|  | **Office hours** |  |
| **Prerequisites** |  |
| **Language**  | English |
| **Compulsory/Elective** | Required |
| **Required textbooks and course materials** | ***Core textbooks:***Amyx, J.W., Bass, D.M. and Whiting, R.L., Petroleum Reservoir Engineering (Chapters 2 and 3), 3rd edition, McGraw-Hill Book Company, New York, NY, 1960. Tarek Ahmed, Reservoir Engineering Handbook (Chapters 4 and 5), 2nd edition, GulfProfessional Publishing, 2001***Supplementary material:*** Class Lecture Handouts and Additional Reading Materials |
| **Course outline** | The course is designed for undergraduate students. Hence, understanding of basic concepts is assumed a priori. Some similar topics will be covered but with the deep analysis in order to guide students for the future research directions. Homework assignments are crucial for the course and designed to encourage individual study. Quizzes will be provided during the classes. |
| **Course objectives**  | A study of the physical properties of reservoir rocks and the reservoir rock-fluid system as they relate to the production of oil and gas, or systematic theoretical study of physical properties of petroleum reservoir rocks; porosity, relative and effective permeability; fluid saturations, capillary characteristics, compressibility, resistivity; and fluid-rock interaction. This course provides students a detailed understanding of the rock and rock-fluid properties of oil and gas reservoirs; an understanding of the Darcy equation and how to apply it to various geometrics; an understanding of laboratory measurements of rock and rock-fluid properties; and a basic understanding of fluid flow in porous media. |
| **Learning outcomes** | **By the end of the course the students should be able:*** Define porosity, total porosity, effective porosity, primary and secondary porosity; discuss the factors which affect porosity, analyze uncertainty in measuring bulk volume
* Define the coefficient of isothermal compressibility of reservoir rock and describe methods for determining values of formation compressibility.
* Reproduce the Darcy equation in differential form, explain its meaning, integrate the equation for typical reservoir system, Horizontal and vertical flow, absolute permeability, effective permeability, single phase flow of incompressible, slightly compressible and compressible fluid in linear and radial porous media, weighted, harmonic, and geometric average permeability, discuss the Klinkenberg effect, calculate the effect of fractures and channels, turbulence flow near the well bore, and describe methods for determining values of absolute permeability.
* Define fluid saturations, describe method of determining fluid saturation in reservoir rocks and show relationship between fluid saturation and capillary pressure.
* Define resistivity, electrical formation resistivity factor, resistivity index, saturation exponent, and cementation factor and show their relationship and describe laboratory measurement of electrical properties of reservoir rocks.
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| **Teaching methods** | **Lecture**  | X |
| **Group discussion** | X |
| **Experiential exercise** |  |
| **Simulation** |  |
| **Case analysis** |  |
| **Course papers** |   |
| **Others** |  |
| **Evaluation**  | **Methods** | **Date/deadlines** | **Percentage (%)** |
| **Midterm Exam** |  | 30 |
| **Case studies** |  |  |
| **Class Participation** |  | 5 |
| **Assignment and quizzes** |  | 20 |
| **Project** |  |  |
| **Presentation/Group Discussion** |  |  |
| **Final Exam** |  | 45 |
| **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.* **Withdrawal (pass/fail)**

A student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year. * **Cheating/plagiarism**

Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.* **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 |  | Introduction to the course and reservoir rock.  | Handbook, Ch. 2 |
| 2 |  | Porosity | Handbook, Ch. 2 |
| 3 |  | Porosity measurements | Handbook, Ch. 2 |
| 4 |  | Rock Compressibility | Handbook, Ch. 2 |
| 5 |  | Permeability | Handbook, Ch. 2 |
| 6 |  | Darcy Equation and Fluid Potential | Handbook, Ch. 2 |
| 7 |  | Application of darcy equation for fluid flow  | Handbook, Ch. 2 |
| 8 |  | Measurement of permeability  | Handbook, Ch. 2 |
| 9 |  | Electrical Properties - Resistivity | Handbook, Ch. 2 |
| 10 |  | **Midterm Exam** |  |
| 11 |  | Heterogeneity | Lecture Notes |
| 12 |  | Wettability | Handbook, Ch. 3 & Lecture Notes |
| 13 |  | Capillary Pressure - Introduction | Handbook, Ch. 3 & Lecture Notes |
| 14 |  | Capillary Pressure | Handbook, Ch. 3 & Lecture Notes |
| 15 |  | Relative Permeability – Part 1 | Handbook, Ch. 3 & Lecture Notes |
| 16 |  | Relative Permeability – Part 2 | Handbook, Ch. 3 & Lecture Notes |
|  | TBA | **Final Exam** | TBA |

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