Syllabus of Petrophysics

Credits：3

Hours：48(Experimental hours included)

Experimental hours：10

Specialty of course: Mandatory

Subject group：Petroleum Engineering; PetroleumGeology;

Petroleum Geophysics

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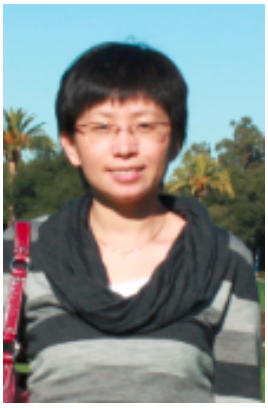

Textbook:

[1] Fundamentals of Petrophysics. Shenglai Yang. Petroleum Industry Press, 2011.
[2] Advanced Petrophysics (Volume I, II, III). Peters PhdPe, EkwereJ.Live Oak Book Company, 2012.
[3] Petrophysics. DjebbarTiab.Gulf Professional Publishing. 2003.
[4] Fundamentals of the Petrophysics of Oil and Gas Reservoirs. Martin Scrivener. Scrivener Publishing, 2012.

Grading:

Quiz, homework, class presentation, project, final exam.

(I) The Objectives and Tasks

This course is a basic course of the major, whose task is to help students to grasp basic concepts, theories, calculations and experimental skills, with the purpose of laying solid foundation for undergraduates. The students are required to learn the physical properties of reservoir rocks, reservoir fluids, determination method and engineering application. The students are also required to understand and grasp the interfacial phenomena, the seepage mechanism in porous media and their applications in petroleum engineering.

(II) Basic Requirements

1、Grasp the basic concepts of the physical parameters of oil, gas and water, their determination method and empirical formula. Grasp the physical properties of the fluids and the law of phase change (composition, phase state, phase equilibrium, phase properties at high pressure)

2、Grasp the phase properties of the reservoir rock (porosity, permeability, saturation, specific surface etc.) and their factors.

3、Understand the interfacial phenomena, capillary pressure, multiphase distributionin the porous media. Grasp the mechanism of the multiphase flow of oil, gas and water (including wettability,capillary pressure, relative permeability, etc.). Explain the basic phenomena in reservoir engineering.

4、Use the physical parameters for the calculations in respect of reservoir engineering.

(III) Course content

Introduction 1. Why to Exploit Oil & Gas 2. The contents and tasks ofPetrophysics 3. History of Petrophysics 4. The Aim and learning Methods for Petrophysics
Chapter 1 Chemical Composition and Properties of Reservoir Fluids 1.1 The Chemical Composition of Oil 1.2 Physical Properties and Classification of Crude Oil 1.3 The Chemical Composition of Natural Gas 1.4 The Classification of Oil & Gas Reservoirs

Chapter 2 Natural Gas Physical Properties at High Pressure

2.1 The Apparent Molecular Weight and Density of Natural Gas

2.2 The Equation of State for Natural Gas and the Law of Corresponding State

2.3 The Physical Properties of Natural Gas at High Pressure

2.4 Water Vapor Content of Natural Gas and the Gas Hydrate

Chapter 3 Phase State of Reservoir Hydrocarbons and Gas-Liquid Equilibrium

3.1 The Phase Behavior of Reservoir Hydrocarbon Fluids

3.2 Gas-Liquid Equilibrium

3.3 The Solution and Separation of the Gas in an Oil-Gas System

3.4 Calculation of Oil-Gas Separation Problems Using Phase-State Equations

Chapter 4 High-Pressure Physical Properties of Reservoir Fluids

4.1 High-Pressure Physical Properties of Reservoir Oil

4.2 High-Pressure Physical Properties of Formation Water

4.3 Measurement and Calculation of High-Pressure Physical Parameters of Reservoir Oil & Gas

Chapter 5 Porosity of Reservoir Rocks

5.1 Constitution of Sandstone

5.2 Pores within Reservoir Rocks

5.3 Porosity of Reservoir Rocks

5.4 Compressibility of Reservoir Rocks

5.5 Fluid Saturation in Reservoir Rocks

Chapter 6 Permeability of Reservoir Rocks

6.1 Darcy's Law and Absolute Permeability of Rock

6.2 Gas Permeability and Slippage Effect

6.3 Influencing Factors for Rock Permeability

6.4 Permeability of Fractured and Vuggy Rocks

6.5 Ideal Modelsof Rock Structure

6.6 Sensibility of Sandstone Reservoir Rocks

Chapter 7 Other Physical Properties of Reservoir Rocks

7.1 Electrical Conductivity of Fluids-Bearing Rocks

7.2 Thermal Properties of Reservoir Rocks

7.3 Acoustic Characteristics of Reservoir Rocks

Chapter 8 Interfacial Phenomena and Wettability 8.1 Interfacial Tension between Reservoir Fluids 8.2 Interfacial Adsorption 8.3 Wettability of Reservoir Rocks
Chapter 9 Capillary Pressure and Capillary Pressure Curve 9.1 Concept of Capillary Pressure 9.2 Measurement and Calculation of Capillary Pressure Curves 9.3 Essential Features of Capillary Pressure Curve 9.4 Applications of Capillary Pressure Curve
Chapter 10 Multiphase Flow through Porous Medium and Relative Permeability Curve 10.1 Characteristics of Multi-Phase Flow through Porous Media 10.2 Two-Phase Relative Permeability 10.3 Three-Phase Relative Permeability 10.4Applications of Relative Permeability Curves

(IV) Hours Allocation

Chapter	Hour Allocation
Introduction	1
Chapter1 Chemical Composition and Properties of Reservoir Fluids	1
Chapter 2 Natural Gas Physical Properties at High Pressure	3
Chapter 3 Phase State of Reservoir Hydrocarbons and Gas-Liquid Equilibrium	6
Chapter 4 High-Pressure Physical Properties of Reservoir Fluids	4
Chapter 5 Porosity of Reservoir Rock	4
Chapter 6 Permeability of Reservoir Rocks	4
Chapter 7 Other Physical Properties of Reservoir Rocks	1
Chapter 8 Interfacial Phenomena and Wettability	4
Chapter 9 Capillary Pressure and Capillary Pressure Curve	5
Chapter 10 Multiphase Flow through Porous Medium and Relative Permeability Curve	5

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(V) Experimental Classes（10 Hours）

The main contents are the measurements of the porosity, permeability, saturation, specific surface, capillary pressure, viscosity of oil, water-flooding experiments etc.

Requirements： To prove the basic theories and observe the physical phenomena in the experiments. Grasp the basic method and skills of scientific experiments and improve the hands-on ability.

Number	Experiments Contents	Hours
No. 1	Porosity and saturation of reservoir rocks	2
No. 2	Permeability and specific surface measurements	2
No. 3	Physical properties of fluids (composition of natural gas, oil viscosity etc.）	2
No. 4	Interfacial tension measurements (de Nouy Ring method)	2
No. 5	Water-flooding experiments	2
		Total 10

(VI)Examination（2 hours）