

《油气田开发工程概论》教学大纲

一、基本信息

课程名称：油气田开发工程概论

课程代码：160203G002

总学时：32

实验学时：0

开课学院：石油学院

课程性质：选修

英文课程名称：Introduction to Oil and Gas Field Development Engineering

总学分：2

课内学时：32

上机学时：0

适用专业：全校专业

先修课程：无

二、课程简介

本课程主要包括油层物理学，渗流力学，油田开发设计和开发调整，采油工程技术原理。本课程以加强基础理论、基本知识和基本技能为出发点，对油气田开发工程的基本内容进行全面而又扼要地介绍，注重突出油气田开发工程与相关专业的衔接关系，立足于从理论联系实际方面培养学生分析问题和解决问题的能力。通过本课程的学习，使学生全面认识油田开发过程各环节的技术及原理：了解油藏流体与岩石的基本物理性质；了解油藏工程涉及的勘探开发程序、储量计算、油田开发方案编制及开发调整等基本内容；了解采油工艺方法与基本原理、相关的油水井措施等内容；了解提高采收率的基本原理与方法；了解油气田开发方向前辈事迹和石油精神。旨在为学生拓展专业方向发展打下油气田开发工程背景的学习基础。

三、教学目标

通过本课程系统学习，要求学生全面认识油田开发过程各环节的技术及原理：了解储层基本物理性质；了解油藏工程设计中涉及的开发方案、动态分析、开发调整等各项技术内容；了解采油工艺方法及原理；了解提高开发效果的措施技术等。

目标 1：了解油藏流体、岩石的基本物理性质；

目标 2：了解油田勘探开发程序、储量计算的基本内容；

目标 3：了解油藏驱动类型、开发方案编制及开发调整的基本内容；

目标 4：了解不同采油技术的原理及应用条件；

目标 5：了解油田注水开发、压裂、酸化等增产工艺技术原理；

目标 6：了解提高石油采收率技术及原理；

目标 7：了解油气田开发方向前辈事迹，领悟石油精神。

四、教学内容与学习要求

（可按章节顺序或教学单元顺序编写，要详细说明具体教学内容、教学重点和难点，应清楚地表达知识、技能的范围和深度，充分反映课程的知识 and 技能要求，体现课程特点。）

章节/教学单元		教学内容、重点、难点	学时	学习要求
第一章：绪论	第一节 石油工程的主要内容	课程内容概况	1	☑记忆
	第二节 油气藏的形成与类型	油藏的基本概念基本类型	1	☑记忆
第二章 油藏流体的	第一节 油气的化学性质	油气元素组成，化合物组成	2	☑理解
	第二节 油气的相态	单组分多组分相图分析		☑理解
	第三节 地层原油的高压物性	原油的高压物性	2	☑记忆

章节/教学单元		教学内容、重点、难点	学时	学习要求
物理性质	第四节 天然气的高压物性	天然气的高压物性		☑记忆
	第五节 地层水的高压物性	地层水的高压物性		☑记忆
第三章 油藏岩石的物理性质	第一节 油藏岩石的孔隙度和流体的饱和度	岩石孔隙结构，孔隙度的影响因素	1	☑记忆
	第二节 油藏岩石的压缩系数	岩石的压缩系数	1	☑记忆
	第三节 油藏岩石的渗透率	岩石的渗透性及影响因素	2	☑记忆
	第四节 油藏岩石的润湿性和油水微观分布	润湿性毛管力和相对渗透率		☑记忆
第四章 油田开发设计基础	第一节 油田勘探开发程序	油田勘探开发程序	1	☑记忆
	第二节 储量计算	储量计算方法		☑记忆
	第三节 油藏驱动方式及其开采特征	油藏驱动方式及其开采特征	1	☑理解
	第四节 油田开发层系的划分与组合	层系划分意义、原则和方法	1	☑理解
	第五节 砂岩油田的注水开发	注水时机、注水方式、井网		☑理解
	第六节 油田开发方案的编制	开发方案的编制	1	☑记忆
第五章 采油方法	第一节 自喷采油	自喷采油不同流动过程的特点、规律	1	☑记忆
	第二节 气举采油	气举采油原理、过程、启动压力	1	☑记忆
	第三节 有杆泵采油	机杆泵特点、泵效及影响因素	2	☑理解
	第四节 抽油机平衡与泵效	平衡与泵效计算	2	☑记忆
第六章 注水工程	第一节 水源、水质及注水系统	水源及水处理	1	☑记忆
	第二节 注水井吸水能力及分析	注水指示曲线特征	1	☑记忆
	第三节 分层注水技术	分层注水技术		☑记忆
第七章 油水井增产增注技术	第一节 水力压裂技术	压裂工艺、支撑剂、压裂液性质	2	☑理解
	第二节 油层酸化技术	油层酸化技术特点及适用范围	2	☑理解
第八章 提高采收率原理	第一节 采收率及其影响因素	采收率及其影响因素	2	☑记忆
	第二节 提高采收率的基本方法	不同提高采收率技术的基本特点和适用性	2	☑记忆

注：在“学习要求”一栏补充选项，可以多选，无要求可不填，也可自定要求。**记忆**，指能从记忆库中找到相关的知识、概念、术语或材料与当前的信息进行比较、确认，能记住并能不加理解的列出、描述这些知识、概念、术语或材料；**理解**，指能对所学的内容作归纳、分类、解释、总结、推断和一定程度的发挥；**应用**，指能选择正确的程序应用、实施所学到的内容，并能进行必要的计算或决断；**综合分析**，指

能将所学的内容分解并找出它们的相互关系和构成，或能计划、创造、建造、有改变的重构，或能作评论、总结、估计、预测、评估、论证和答辩。

五、教学方法

本课程提倡学生广泛阅读参考书和参考文献，实行课堂讲授、自学、实训练习与课堂讨论相结合的教学方法，达到教师精讲、学生宽学多练的学习目的。

六、考核方式

考核方式:开卷考试

分数构成：满分100分，结课考试 60%，平时成绩 40%，平时成绩包括：随堂测验20分，考勤10分，小组汇报10分。

七、教材与参考书

（一）教材

《现代石油工程导论与前沿技术》，1 版次，李军、薛永超、张辉，中国石油大学出版社，出版年 2017 度，ISBN：978-7-5636-5618-9。

（二）参考书目或文献

《油气田开发工程基础》，1 版次，杜殿发、谷建伟，石油工业出版社，出版年 2009 度，ISBN：9787502173364。

《油层物理学》，1 版次，杨胜来、魏俊之，石油工业出版社，出版年 2007 度，ISBN：9787563615018。

《油藏工程原理》，2 版次，李传亮，石油工业出版社，出版年 2011 度，ISBN：9787502185800。

《采油工程原理与设计》，1 版次，张琪，中国石油大学出版社，出版年 2006 度，ISBN：7-5636-1197-5。

制定人：刘敦卿

审核人：刘红现

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«Introduction to Oil and Gas Field Development Engineering» Syllabus

I. Basic Information

Course Name: Introduction to Oil and Gas Field Development Engineering

Course No.: 160203G002

Total Credits: 2

Total Hours: 32

Lecture Hours: 32

Lab Hours: 0

Computer Lab Hours: 0

Offering College: Petroleum School

Corresponding Majors: All

Prerequisite: None

Course Type: Elective

II. Course Introduction

The main contents of this course include reservoir physical oil and gas field development basic oil recovery engineering technology principle enhanced oil recovery principle. Based on the strengthening of basic theories, basic knowledge and basic skills, this course introduces the basic content of oil and gas field development engineering in a comprehensive and concise manner, focusing on highlighting the connection between oil and gas field development projects and related majors, which aims to cultivate student's capability to analyze and solve problems based on the theoretical and practical aspects.

III. Course Objective

Through this course system, students are required to fully understand the technology and principles of all aspects of the oilfield development process: understanding the basic physical properties of the reservoir; understanding the technical contents involved in the development of the reservoir engineering design, dynamic analysis, development adjustment, oil recovery process methods and principles, and stimulation methods to improve development results.

1. Understand the basic physical properties of reservoir fluids and rocks;
2. Understand the basic content of oilfield development and design;
3. Understand the reservoir dynamic analysis method and development adjustment;
4. Understand the principles and application scope of different oil recovery technologies;
5. Understand the development technology of oilfield water injection;
6. Understand the principle of fracturing acidification, increasing production and increasing injection technology in oil and water wells;
7. Understand the technology and principles of enhanced oil recovery.

IV. Contents and Requirements

Chapter/Unit		Contents and Key Points	hrs	Requirements
Chapter 1 Introduction	Section 1 The main content of petroleum engineering	Course content overview	1	☑Memory
	Section 2 Formation and type of oil and gas reservoirs	Basic concepts and types of reservoirs	1	☑Memory
Chapter 2 Physical	Section 1 Chemical properties of oil and gas	Oil and gas element composition	2	☑Comprehension

Chapter/Unit		Contents and Key Points	hrs	Requirements
properties of reservoir fluids	Section 2 Phase state of oil and gas	Single component multicomponent phase diagram analysis		☑Comprehension
	Section 3 High pressure physical properties of formation crude oil	High pressure physical properties of crude oil	2	☑Memory
	Section 4 High pressure physical properties of natural gas	High pressure physical properties of natural gas		☑Memory
	Section 5 High pressure physical properties of formation water	High pressure physical properties of formation water		☑Memory
Chapter 3 Physical properties of reservoir rocks	Section 1 Reservoir rock porosity and fluid saturation	Rock pore structure, influencing factors of porosity	1	☑Memory
	Section 2 Compressive coefficient of reservoir rock	Compressibility of rock	1	☑Memory
	Section 3 Reservoir rock permeability	Rock permeability and its influencing factors	2	☑Memory
	Section 4 Wettability of reservoir rocks and microscopic distribution of oil and water	Wettability, capillary force and relative permeability		☑Memory
Chapter 4 Oilfield development design basis	Section 1 Oilfield exploration and development program	Oilfield exploration and development procedure	1	☑Memory
	Section 2 Reserve calculation	Reserve calculation method		☑Memory
	Section 3 Reservoir driving method and its mining characteristics	Reservoir driving mode and its production characteristics	1	☑Comprehension
	Section 4 Division and combination of oilfield development layer	Significance, principle and method of strata division	1	☑Comprehension
	Section 5 Water injection development in sandstone oil fields	Water injection timing, water injection mode and well pattern		☑Comprehension
	Section 6 Preparation of oilfield development plan	Preparation of development plan	1	☑Memory
Chapter 5 Oil production method	Section 1 Self-spraying oil	Characteristics and laws of different flow processes in flowing oil recovery	1	☑Memory
	Section 2 Gas lift production	Principle, process and starting pressure of gas lift production	1	☑Memory

Chapter/Unit		Contents and Key Points	hrs	Requirements
	Section 3 Rod pump	Characteristics, efficiency and influencing factors of rod pump	2	☑Comprehension
	Section 4 Pumping unit balance and pump efficiency	Calculation for pumping unit balance and pump efficiency	2	☑Memory
Chapter 6 Water injection project	Section 1 Water source, water quality and water injection system	Water source and water treatment	1	☑Memory
	Section 2 Water absorption capacity and analysis of water injection wells	Characteristics of water injection indication curve	1	☑Memory
	Section 3 Layered water injection technology	Layered water injection technology		☑Memory
Chapter 7 Oil and Water Wells Increasing Production and Increasing Technology	Section 1 Hydraulic Fracturing Technology	Fracturing process, proppant and fracturing fluid properties	2	☑Comprehension
	Section 2 Oil layer acidification technology	Characteristics and application scope of reservoir acidizing technology	2	☑Comprehension
Chapter 8 Principles of Enhanced Oil Recovery	Section 1 Recovery factor and its influencing factors	Oil recovery and its influencing factors	2	☑Memory
	Section 2 Basic methods for enhancing oil recovery	Basic characteristics and applicability of different EOR technologies	2	☑Memory

V. Teaching Method

This course encourages students to read reference books and literature extensively, and implements a combination of classroom teaching, self-study, practical training and classroom discussion to achieve the goal of teachers' intensive teaching and students' extensive study and practice.

VI. Evaluation

Full mark: 100

Open test: 60%, Usual performance: 40%, among them, 10 points for attendance, 20 points for in-class test, 10 points for group report

VII. Textbook and Reference

(1) Textbook

《Introduction to modern petroleum engineering and advanced technology》, 1st edition, Li Jun, Xue Yongchao, Zhang Hui, China University of Petroleum Press, published in 2017, ISBN: 978-7-5636-5618-9.

(2) Reference

《Fundamentals of oil and gas field development engineering》, 1st edition, Du Dianfa, Gu Jianwei, Petroleum Industry Press, published in 2009, ISBN: 9787502173364.

《Reservoir physics》, 1st edition, Yang Shenglai, Wei Junzhi, Petroleum Industry Press,

published in 2007, ISBN: 9787563615018.

《Fundamentals of reservoir engineering》, 2nd Edition, Li Chuanliang, Petroleum Industry Press, published in 2011, ISBN: 9787502185800.

《Fundamentals and design of oil production engineering》, 1st edition, Zhang Qi, China University of Petroleum Press, published in 2006, ISBN: 7-5636-1197-5.