NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROCHEMICAL ENGINEERING PROGRAM

PP415 – RESERVOIRS II

I. GENERAL INFORMATION

CODE	**:**	PP415 Reservoirs II
SEMESTER	**:**	9-10
CREDITS	**:**	5
HOURS PER WEEK	**:**	6 (Theory–Practice)
PREREQUISITES	**:**	PP324 Reservoirs I
CONDITION	**:**	Elective
DEPARTMENT	**:**	Petroleum and Natural Gas Engineering

II. COURSE DESCRIPTION

The course prepares the student in the application of concepts and mathematical models that describe the behavior of hydrocarbon reservoirs in order to compare exploitation alternatives and select that maximizing oil and gas production. The mathematical models are based on parameters related to physical properties of reservoir rocks and fluids. The dynamics of fluids in the reservoir is analyzed through PVT tests.

III. COURSE OUTCOMES

At the end of the course, students:

1. Evaluate the petro-physical properties of rock as porosity, permeability and fluid saturation.
2. Determinate the properties of fluids by PVT tests, calculating the composition, formation volume factor, viscosity, calorific capacity and solubility rate.
3. Explain the different types of recovery mechanisms in oil and gas reservoirs. Apply mass balance equations and calculate hydrocarbons volume.
4. Define and categorize resources and reserves.
5. Develop methods for estimating hydrocarbon reserves.
6. Apply Monte Carlo analysis to perform risk analysis and decision making under uncertainty in reserves estimation.
7. Estimate the economic value and market value of reserves.

IV. LEARNING UNITS

1. ROCKS AND FLUIDS PROPERTIES. REVISION

Petro-physical evaluation / Determination of properties of the rock / Porosity, permeability and fluid saturation / Wettability, capillary pressure and permeability rates / PVT tests / Determination of hydrocarbons properties / Composition, compressibility and density / Specific gravity, compressibility factor, viscosity and calorific capacity / Formation volume factor / Solubility rates and liquid performance.

2. RECOVERY MECHANISMS AND THE EQUATION OF MASS BALANCE

Impulsion mechanisms in oil reservoirs / Mechanisms of rocks compaction and fluids expansion / Gas in solution, gas layers, water drive / Gravitational segregation and combined mechanisms / Impulsion mechanisms in gas reservoirs / Volume depletion and water impulsion / General mass balance equation / Assumptions and HAVLENA & ODEH

method / Application to deposits of gas in solution / Methods of Turner, Tracy and Muskat / Application to deposits with water drive (Tracy method) / Application to gas fields.

3. RESERVE CATEGORIZATION, CLASSIFICATION AND VALUATION

Definition and categorization of resources and reserves / Methods for reserves estimation / Analogies, volumetric and mass balance / Analysis of curves declination / Simulation of reservoirs / Uncertainty in estimation of reserves (analysis Monte Carlo) / Valuation of reserves / Cash flows, profitability and sensitivity rates.

4. EVALUATION WORKSHOP. PETROLEUM OR GAS RESERVOIR

Practical work.

V. LABORATORY AND PRACTICAL EXPERIENCES

Laboratory 1: Fluids and rocks properties.
Laboratory 2: Recovery mechanisms and equation of mass balance.
Laboratory 3: Categorization, classification and valuation of reserves.
Laboratory 4: Evaluation workshop of an oil or natural gas field.

VI. METHODOLOGY

The course takes place in theory, practice and computer laboratory sessions. In theory sessions, the teacher presents concept, methods and applications. In practice sessions, various problems are solved and their solution analyzed. In computer laboratory sessions, students execute software application for reservoir analysis. At the end of the course, students work in group to complete and defend the final project. Student's active participation is promoted.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PC + PL) / 4

EP: Mid-term Exam EF: Final Exam
PC: Practical Work PL: Laboratory Practice

VIII. BIBLIOGRAPHY

1. T. AHMED
   Reservoir Engineering Handbook.
2. B. CRAFT & M. HAWKINS.
   Applied Petroleum Reservoir Engineering.