NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING
PETROLEUM ENGINEERING PROGRAM

PP412 – NATURAL GAS AND CONDENSATES I

I. GENERAL INFORMATION

CODE	**:**	PP412 Natural Gas and Condensates I
SEMESTER	**:**	7
CREDITS	**:**	3
HOURS PER WEEK	**:**	4 (Theory–Practice)
PREREQUISITES	**:**	Reservoirs I
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Petroleum and Natural Gas Engineering

II. COURSE OUTCOMES

At the end of the course, students:

1. Identify and recollect relevant data and information of gas wells for determining gross reserves, proved reserves and possible reserves.
2. Apply mathematical models and solve problems of fluid flow in reservoirs and pipes.
3. Integrate mathematical models with field test data and understand the dynamic behavior of reservoir.
4. Formulate optimum development schemes maximizing recovery factor.

III. LEARNING UNITS

1. Analysis of phase-diagrams / Classification of gas wells.
2. Estimation of reserves in a gas well: volumetric equation, mass balance equation / Reserves prediction and estimation / Reservoir future behavior.
3. Reserves estimation by mass balance / Application of declination curve method P/Z / Numeric examples.
4. Materials balance general equation: gas reservoirs / Non-normal pressure in gas reservoirs (Hammerlind) / Graphic techniques / Straight line method
5. Reservoir water input / Estimation of reservoir size.
6. Production declination curves applied to gas wells / Curves classification / Effective and nominal declination / Normal declination.
7. Harmonic and hyperbolic declination / Numeric examples of real cases.
8. Measurement of natural gas volume / Measurement methods / Volumetric method / turbine meters and others / Orifice meters.
9. Deduction of basic and general equation applied to natural gas orifice meters / Application to liquid measurements / Examples.
10. Gas flow in pipes (mono-phase) / Weymouth equation / Computation of friction losses in pipes / Reynolds number / Relative and absolute rugosity / Moody graphs.
11. Gas flow in series, parallel and combined pipes / Application of Weymouth equation for gas pipe design.
12. Two-phase flow in gas pipes / Flow profile for gas transport and distribution / Iterative approximation of Gould-Tex-Katz / Beggs and Grill correlation.
13. Gas flow in reservoirs and aquifers action / Pressure loss at well head / General equation of non-dimensional flow / Aline source Solution.
14. Drainage radius / Solution in stable state / Partially completed wells / Superposition principle.

IV. METHODOLOGY

The course takes place in theory and practice sessions. In the theory sessions, the teacher presents concepts and applications. In practice sessions, the design of natural gas pipelines for different environmental and well conditions are completed and analyzed. At the end of the course, students complete a project and defend it. Student's active participation is promoted.

V. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PC) / 3

EP: Mid-term Exam EF: Final Exam
PC: Practical Work

VI. BIBLIOGRAPHY

1. Chi U. Ikoku
   Natural Gas Production Engineering
   Krieger Publishing Company, Malabar, Florida, USA, 2008.
2. Donald Katz, Robert Lee
   Natural Gas Engineering: Production and Storage. McGraw Hill.