NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROCHEMICAL ENGINEERING PROGRAM

PP412 – NATURAL GAS AND CONDENSATES I

I. GENERAL INFORMATION

CODE	**:**	PP412 Natural Gas and Condensates
SEMESTER	**:**	9-10
CREDITS	**:**	3
HOURS PER WEEK	**:**	4 (Theory–Practice)
PREREQUISITES	**:**	PP324 Reservoirs I
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

The course prepares students for analyzing natural gas wells in order to determine their parameters and main variables, estimate and valuate their reserves, develop performance tests, and determine their production capacity under actual operation conditions. Students also analyze separation operations and processes of natural gas, and design pipeline systems for gas natural transportation considering well and surrounding environment characteristics.

III. 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. Make production projections along time and determine production forecasts, as well as economic forecasts of the project.
3. Evaluate production capacity of gas wells under actual working conditions through wells deliverability tests.
4. Design pipelines for natural gas transport taking into account safety issues and environmental protection, fulfilling national and international norms and regulations.
5. Understand and analyze the separation operation and process of natural gas: dehydration, separation, drying, compression and expansion.

IV. LEARNING UNITS

1. RESERVES OF NATURAL GAS FIELDS

Reserves in natural gas reservoirs / Contingent resources / Prospective resources / Determination of reserves: Mass balance methods / Volumetric methods / Sensitivity analysis with Montecarlo method / Software simulations

2. PSEUDO-PRESSURE AND NON-DIMENSIONAL VARIABLES OF NATURAL GAS RESERVOIRS

Radial diffusivity equation / Pseudo-pressure in natural gas reservoirs / Al-Hussaini, Ramey and Crawford Transformations / Theoretical-experimental solution to Kirchoff equation / Simpson and trapeze methods / Correction with power equation.

3. DETERMINATION OF STATIC AND DYNAMIC PRESSURES IN GAS WELLS – DETERMINATION OF RESERVOIR STATIC PRESSURE

Behavior of gas wells / Calculation of equivalent gas of fluids produced in gas wells / Determination of down-well static pressure / Method of temperature average and gas deviation factor / Sukkar Cornell method / Cullender and Smith method / Applications / Determination of flow pressures in gas wells.

4. TESTS OF PRODUCTION WELLS

Gas well tests / Deliverability tests / Production capacity tests / Back pressure test / Isochronal test / Modified isochronal test / Normalized productivity index test / Productivity index modified test / Jones and Glaze tests / Gas well tests for determining reservoir parameters / Drawdown pressure tests / Multi-flow tests / Two flows tests / Build-up pressure tests / Reservoir equalization tests .

5. NATURAL GAS TRANSPORT

Gas flow in pipes / Gas pipelines design / Design criteria and bases RFQ / Pressure losses in pipes / Weymouth equation / Applications: Series pipes, parallel pipes, loops / Other equations used in industry / Construction of gas pipelines / Determination of gas market demand through sample analysis / Calculation of required pipe diameter / Topographic and altimetry determination of trace and rout to follow / Construction considerations according to Peruvian legislation.

6. PRIMARY TREATMENT OF NATURAL GAS

Separation and processes of natural gas / Dehydration / Design of separators / Gas natural drying / Determination of water content in gas natural flows / Solid absorbents / Design and operation of gas treatment towers / Gas natural dehydration using alcohol (diol) / Plant design and operation / Elimination of steam / Separation of condensates (natural gasoline).

7. COMPRESSION AND EXPANSION OF NATURAL GAS IN TRANSPORT OPERATIONS

Requirements of compression energy / Reciprocating compressors / Turbine-type compressors / Temperature behavior along compression process / Gas compression by steps / Calculation of required power.

V. 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.

VI. 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

VII. BIBLIOGRAPHY

1. Chi U. Ikoku
Natural Gas Production Engineering
Krieger Publishing Company, Malabar, Florida, USA, 2008.