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

PQ222 – QUANTITATIVE CHEMICAL ANALYSIS

I. GENERAL INFORMATION

CODE	**:**	PQ222– Quantitative Chemical Analysis.
SEMESTER	**:**	4
CREDITS	**:**	4
HOURS PER WEEK	**:**	7 (Theory–Practice-Laboratory)
PREREQUISITES	**:**	PQ211 Qualitative Chemical Analysis,
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

The course prepares students in the application of quantitative methods for determining the absolute or relative abundance or concentration of one or several elements, compounds and substance present in a sample. Student learn and apply gravimetric, volumetric, instrumental, potentiometric and spectrophotometric methods for analyzing and determining the amount of the products of chemical reactions, as well as for identifying chemical elements or organic or inorganic compounds.

III. COURSE OUTCOMES

At the end of the course, students:

1. Properly and safely use analytical instruments for data acquisition in chemical analysis.
2. Use statistics methods for validating and processing experimental data obtained by different experimental means.
3. Understand and apply gravimetric, volumetric, potentiometric and spectrophotometric methods for the quantitative analysis of chemical reactions, chemical elements and compounds.
4. Understand, discuss and interpret the results of the chemical analysis.

IV. LEARNING UNITS

1. TREATMENT OF EXPERIMENTAL DATA . USE OF STATISTICS

Experimental error: significant errors, types of errors, propagation and uncertainty / Precision and accuracy / Repeatability / Statistics / Central measures / Standard deviation / Gaussian error curve / T Student / Linear and nonlinear regression / Data management.

2. SYSTEMATIC STUDY OF BALANCE AND GRAVIMETRIC ANALYSIS

Systematic study of equilibrium: load balance, mass balance / Systematic study of balance / Dependence of the solubility with respect to Ph. / Gravimetric analysis: examples of gravimetric analysis / Precipitation processes / Calculations in the gravimetric analysis application domain.

3. VOLUMETRIC ANALYSIS

Introduction / Titration curves / End point indicators / Methods of Mohr, Volhard and Fajans / Analytical applications.

4. **COMPLEXES ANALYSIS, COMPLEXOMETRY**
   Concept of complex / Complexation reactions / Types of complex / Analytic applications: volumetry of complexes / Complexometry / Use of potentiometric indicators / EDTA.

5. **POTENTIOMETRIC ANALYSIS**
   Redox reactions / Galvanic and electrochemical cells / Standard potential / Thermodynamic potentials of the Nernst equation / Electrochemical cells / Spontaneous reactions / Redox titration curve / Redox indicators / Auxiliary reagents / Oximetry / Yodemetry.

6. **SPECTROPHOTOMETRIC METHODS**
   Introduction and overview / Molecular spectrophotometry / Instrumentation and analytical applications.

V. LABORATORY

Session 1: Glass material calibration.
Session 2: Preparation of patron solutions based on primary solid patrons.
Session 3: Gravimetric analysis.
Session 4: Volumetric Analysis.
Session 5: REDOX volumetry.
Session 6: Potentiometric analysis.
Session 7: Spectrophotometry.

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory, faculty presents and analyzes concepts and methods. In practice sessions diverse problems related to gravimetric analysis, volumetric analysis, potentiometric analysis, and spectrophotometric methods are solved, as well as their application in actual industrial plants. In laboratory sessions, students perform tests and verify expected outcomes and results. After each laboratory experience, students submit a report describing procedures and summarizing results and conclusions. Student active participation is promoted.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PP) / 3

EP: Mid-term Exam EF: Final Exam
PP: Average of Practical Works

VIII. BIBLIOGRAPHY

1. DOUGLAS A. SKOOG.
   Fundamentals of Analytic Chemistry, Thomson, 2004
2. WILLARD, HOBART H.
   Quantitaive Analytic Chemistry, Mexico, 2000.