NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL ENGINEERING

GEOLOGICAL ENGINEERING PROGRAM

ME212 – CHEMICAL ANALYSIS

I. GENERAL INFORMATION

CODE	**:**	ME212 Chemical Analysis
SEMESTER	**:**	3
CREDITS	**:**	3
HOURS PER WEEK	**:**	5 (Theory–Practice–Laboratory)
PREREQUISITES	**:**	BQU01 Chemistry I
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Extractive Metallurgy

II. COURSE DESCRIPTION

The course prepares students in the application of qualitative and quantitative methods for the analysis of chemical reactions, their kinetics, outcomes, sensitivity, selectivity and specificity. Students analyze the concepts of chemical equilibrium, ionic equilibrium, thermodynamic equilibrium and heterogeneous equilibrium for analyzing diverse chemical compounds, including solutions and precipitates. Students also apply gravimetric, volumetric, instrumental and spectrophotometric methods for analyzing and determining the amount of the products of chemical reactions, as well as for identifying chemical elements, minerals and alloys.

III. COURSE OUTCOMES

At the end of the course, students:

1. Interpret the basic principles of chemical and ion balance and uses them for explaining chemical reactions and other natural phenomena.
2. Develop tests and experiments with the basic operations of separation of ions by a systematic march of ions.
3. Formulate experimental work plan for identifying cations and anions present in equilibrium systems.
4. Use statistics methods for processing experimental data obtained by different instrumental methods.
5. Apply gravimetric, volumetric, instrumental and spectrophotometric methods for the quantitative analysis of chemical reactions, chemical elements and compounds.

IV. LEARNING UNITS

1. INTRODUCTION TO CHEMICAL ANALYSIS

Objectives and methods of analytical chemistry / Sensitivity / Selectivity. / Specificity / Limit of identification / Dilution limit / Cations / Anions / Complexes in analytical chemistry.

2. CHEMICAL EQUILIBRIUM. PREDICTION OF REACTIONS IN SOLUTION

Concept of balance / Chemical systems and reactions / Non-ideal behavior of ions and molecules in solution / Activity / Activity coefficient / Ionic strength / Balance calculations.

3. **ACIDS AND BASES**
   Equilibrium calculations / Buffer solutions / Tampons. / Hydrolysis of salts / Weak polyprotic acid tampons. / Ampholytes.

4. **OXIDATION AND REDUCTION**
   Definitions / Reactions redox type / Electrode potential / Hydrogen electrode potential / Cell thermodynamics / Applications.

5. **SYSTEMATIC STUDY OF BALANCE AND GRAVIMETRIC ANALYSIS**
   Systematic study of equilibrium: load balance, balance of mass / Systematic study of balance / Dependence of the solubility with respect to Ph / Gravimetric analysis: examples of gravimetric analysis / Precipitation process / Calculations.

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

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

V. LABORATORY

Laboratory 1: Group classification of cations.
Laboratory 2: Separation and identification of Group I cations
Laboratory 3: Separation and identification of Group II cations.
Laboratory 4: Separation and identification of Group III cations.
Laboratory 5: Separation and identification of Group IV cations.
Laboratory 6: Separation and identification of group of anions.
Laboratory 7: Neutralization volumetry (acidity-metrics, alkalinity-metrics).
Laboratory 8: Applications of neutralization volumetry.
Laboratory 9: Volumetry with precipitates formation – Complex volumetry.

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory, faculty presents and analyze concepts and methods. In practice sessions problems related to different qualitative and quantitative analytical methods are analyzed and solved. In laboratory sessions, students perform experimental 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 promoted.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PL) / 3

EP: Mid-term Exam EF: Final Exam
PL: Average of Practical and Laboratory Works.

VIII. BIBLIOGRAPHY

1. Hamilton Leicester F. Simpson Stephen
   Calculations in Analytical Chemistry, McGraw Hill – Mexico, 2015
2. Alexeiev VN.
   Qualitative Chemical Analysis, 2010.