NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES
CHEMISTRY PROGRAM

CQ252 – PHYSICAL-CHEMISTRY II

I. GENERAL INFORMATION

CODE	:	CQ252 – Physical-chemistry II
SEMESTER	:	4
CREDITS	:	05
HOURS PER WEEK	:	07 (Theory – Laboratory)
PREREQUISITES	:	CQ251 Physical-chemistry I
CONDITION	:	Mandatory

II. COURSE DESCRIPTION

The subject of Physical-chemistry II is aimed at the students of the Chemistry program and has a theoretical and practical nature. The thematic of the subject gives the opportunity to understand concepts and physical principles in chemical systems in such a way that it can be applied in any field.
The course develops the topics of ideal and real solutions of non-electrolytes and electrolytes, of electrochemical systems and non-equilibrium processes. Transversally, in the corresponding topics, the dangers of environmental contamination are noted and how to apply the acquired knowledge to solve problems taking into account the least possible environmental impact.

III. COURSE OUTCOMES

By the end this course the student will:

- Understand the facts, concepts, principles and theories related to the content of the subject, demonstrating it by solving conceptual problems and processes.
- Interpretation and synthesis of the abundant information related to chemical systems and relating it to industrial processes, but considering the preservation of the environment.
- Express numerical calculations adequately, including analysis of errors, estimating orders of magnitude and correct use of measurements units.
- Handle materials and chemical reagents, safely, taking into account their physical and chemical properties and the specific use that will be given, assessing the safety specifications that correspond to each reagent.
- Organize in a systematic and reliable way the information coming from observations and measurements, chemical properties, events, changes, so that traceability is obtained in said information.
- Interpret the data derived from the observations and measurements of the experiments, in terms of their theoretical or practical importance.
- Explain, based on the knowledge acquired, the anomalous results in chemical systems, resorting, if necessary, to the discussion in work teams.

- Predict the behavior of some simple chemical systems, using the scientific method or conceptual reasoning.

IV. LEARNING UNITS

1. INTERMOLECULAR FORCES / 8 HOURS

Definition / Attraction and repulsion energy. Ion-dipole force / Induced Ion-dipole force / Dipole-dipole force. Hydrogen bond / Induced dipole-dipole force / Induced dipole-induced dipole force / Repelling force. Resulting intermolecular energies.

2. IDEAL AND REAL SOLUTIONS OF NON-ELECTROLYTES / 12 HOURS

Counting methods / Addition and multiplication rules / Permutations and combinations / Probability / Random experiments, sample space and events / Operations with events / Conditional probability / Total probability / Bayes theorem / Tree diagram / Independent events.

3. ELECTROLYTES SOLUTIONS / 12 HOURS

Electric potential and electrochemical potential of electrolytes / Colligative properties of electrolytes / Arrhenius theory of electrolytic dissociation, its scope and limitations. Classification of electrolytes / Debye-Huckel theory. Ionic force and average ionic activity coefficient. Ionic association.

4. IONIC CONDUCTIVITY / 12 HOURS

Electronic Conductivity in electrolytes / Transfer and transfer numbers / Hittorf Rule. Specific electroconductivity and electronics equivalents / Conductance dependence with the concentration / Determination of the dissociation constant by the conductimetric method / Dependence of the electroconductivity with the temperature / Kohlraush's Law / Fundamental aspects of the electrolytic dissociation theory of strong and weak electrolytes / Onsager equation.

5. ELECTROCHEMISTRY / 12 HOURS

Electrical and Electrochemical Potential / Electromotive force and electrode potentials / Electrodes of first and second class / Oxidation-reduction electrodes and their potentials. Nernst's formula and its derivation / Membrane potential / Membrane electrodes.
Chemical binding potential / Chemical cells with and without transport / Concentration cells in the electrode and in the electrolyte / Application of the Gibbs-Helmholtz equation to galvanic systems / Determination of physical-chemical magnitudes and of the activity coefficients by the electrochemical method / Chemicals sources of electric power.

6. CHEMICAL CINETHICS / 12 HOURS

Simple and compound reactions / Reaction order and molecularity / Kinetic equations of irreversible reactions of zero order, first order, second order, n^{th} order. Reversible reactions, parallel reactions, consecutive reactions / Kinetics research methods and mechanism of chemical reactions / Temperature Influence on the reaction speed of / Arrhenius equation / Activation energy and its calculation from experimental data. Theory of active shocks. Theory of the activated complex.

7. CHEMICAL CINETHICS / 12 HOURS

Surface Chemistry / Interfaces / Surface tension / Capillarity / Adsorption: Physisorption, Chemisorption / BET Isotherm: Multipoint technique / Homogeneous, heterogeneous and enzymatic catalysis.

V. LABORATORIES AND PRACTICAL EXPERIENCES

1. Laboratory 1: Partial molar volume
2. Laboratory 2: Colligative properties
3. Laboratory 3: Weak electrolyte activity
4. Laboratory 4: Average ionic activity coefficient

5. Laboratory 5: Viscosity
6. Laboratory 6: Electrical Conductivity
7. Laboratory 7: Chemical kinetics
8. Laboratory 8: Adsorption

VI. METHODOLOGY

The subject is developed in theory sessions, classroom and laboratory practices. In the theory sessions the teacher presents the phenomenon, concepts, laws and applications. The student will be evaluated continuously through the resolution of cases and applications. In the laboratory sessions the student manipulates instruments and equipment of the chemistry laboratory, learns to analyze data, graphics, points adjustments and with the obtained results, present a laboratory report. In all the sessions the participation of the student is promoted.

VII. EVALUATION FORMULA

Calculation of the final grade (FG):

$$FG = \frac{1 * PE + 2 * FE + 1 * PA}{4}$$

PE: Partial Exam
FE: Final Exam.
PA: Practices Average

VIII. BIBLIOGRAPHY

- Levine, N. IRA. “Fisicoquímica” Volumen 1. Editorial McGraw-Hill Iberoamericana S.A. España 2004.
- Atkins P.W. “Fisicoquímica” Editorial Addison-Wesley Iberoamericana. Tercera Edición. E.U.A. 2003.
- Engel Thomas. “Química Física”. Editorial Pearson. 2006