University of Engineering and Technology
School of Computer Science
Syllabus of Course – Academic Period 2017-I

1. **Code and Name:** CQ121. General Chemistry
2. **Credits:** 3
3. **Hours of theory and Lab:** 3 HT;
4. **Professor(s)** Dr. Alejandra Ratti Parandelli
   - Dr. Filosofía, ASTATE, EEUU, 2010.

Dr. María De Fátima Fernandez Lamarque

- Dr. Filosofía, LSU, EEUU, 1996.

Mg. Melissa Barrera Tomas

- Mag. Ciencias, UQAM, Canadá, 2016.

Mg. Angela Pinedo Flores

- Mag. Ciencias, PUCP, Perú, 2016.

Mg. Rocío Giovanna Hoyos Diaz

- Mag. Educación, USMP, Perú, 2016.

Mg. Carmen Luz Zegarra Urquia

- Mag. Química, PUCP, Perú, 2008.

Mg. Max Jorge Carlos Salazar

- Mag. Ciencias, USP, Brasil, 2015.

Mg. Marco Antonio Gusukuma Higa

- Mag. Ingeniería Industrial, UNI, Perú, 2014.

Meetings after coordination with the professor

5. **Bibliography**

[AS83] Paul Ander and A. Sonnessa. *PRINCIPIO DE QUIMICA*. Editorial LIMUSA Mexico, 1983.

[Bab83] Babor-Ibarz. *QUIMICA GENERAL MODERNA*. 8th ed. EDITORIAL MARIN S.A., BARCELONA, 1983.

[Bru92] Mahan Bruce. *QUIMICA CURSO UNIVERSITARIO*. FONDO EDUCATIVO INTERAMERICANO, USA, 1992.

[Cha99] Raymond Chang. *QUIMICA*. 4th ed. Mc Graw Hill,Mexico, 1999.

[Mas98] Willian Masterson. *QUIMICA GENERAL SUPERIOR*. INTERAMERICANA, Mexico, 1998.

[WCD92] Kennet W. Whitten, Kennet D. Calley, and Raymond E. Davis. *QUIMICA GENERAL*. 3rd ed. Mc Graw Hill,Mexico, 1992.

6. **Information about the course**

(a) **Brief description about the course** This course is useful in this career so the student learns to show a high degree of mastery of the laws of General Chemistry

(b) **Prerrequisites:**

(c) **Type of Course:** Mandatory

7. Competences

- Train and present to the student the basic principles of chemistry as a natural science encompassing its most important topics and their relationship with everyday problems.

8. Contribution to Outcomes

d) An ability to function on multidisciplinary teams. (**Usage**)

h) A recognition of the need for, and an ability to engage in life-long learning. (**Usage**)

9. Competences (IEEE)

C20. Ability to connect theory and skills learned in academia to real-world occurrences explaining their relevance and utility.⇒ **Outcome d,h**

10. List of topics

1. QU1. Thermodynamics
2. QU2. Chemical balance
3. QU3. Studies that Contributed to the Development of Atom Theory
4. QU4. Theories of the atom
5. QU5. Periodic Table
6. QU6. Chemical bond
7. QU7. Gases
8. QU8. Intermolecular Forces and Liquids
9. QU9. Solids
10. QU10. Solutions
11. QU11. Stoichiometry

11. Methodology and Evaluation
Methodology:

Theory Sessions:
The development of the theoretical sessions is focused on the student, through his active participation, solving problems related to the course with the individual contributions and discussing real cases of the industry. The students will develop throughout the course a project of application of the tools received in a company.

Lab Sessions:
Practical sessions are held in the laboratory. Laboratory practices are performed in teams to strengthen their communication. At the beginning of each laboratory the development of the practice is explained and at the end the main conclusions of the activity in group form are highlighted.

Oral Presentations :
Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

Reading:
Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is considered as the mark of a qualified practice. The use of the UTEC Online virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.
Evaluation System:

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12. Content

Unit 1: QU1. Thermodynamics (4)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand and work with the principles of thermodynamics. • Abstracting the concepts of gas transformations from nature.	• Thermodynamic systems and their classification. Thermodynamic variables and state functions. • States of a system. States of equilibrium. Extensive and intensive variables. • Thermal equilibria. Zero Principle of Thermodynamics • First Law of thermodynamics. Heat capacity. Reversible processes and maximum work. • Internal energy of ideal gases. Adiabatic transformations. Thermo-chemistry. Law of Lavoisier and Place, Law of Hess. Kirchhoff's Law. • Second law of thermodynamics. Entropy. Efficiency of a reversible cycle. • Free energy. Third Law of Thermodynamics.
Readings : [Cha99], [WCD92]	

Unit 2: QU2. Chemical balance (4)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Describe, know and apply the concepts of chemical balance. • Resolve problems.	• Concept. Balance constant. • Law of action of the masses. • Homogeneous equilibria. Heterogeneous equilibria. Multiple Balances. • Factors Affecting Chemical Balance.Le Chatelier's principle.
Readings : [Cha99], [WCD92]	

Unit 3: QU3. Studies that Contributed to the Development of Atom Theory (4)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Describe the behavior and characteristics of waves. • Understand qualitatively and quantitatively the corpuscular behavior of electromagnetic waves. • Solve problems.	• Properties of waves. • Electromagnetic radiation. Characteristic. Spectrum • Quantum Theory of Max Planck. • Photoelectric effect. • Relation between matter and energy. • X-ray, cathode ray and canals. • Exercises and problems
Readings : [Cha99]	

Unit 4: QU4. Theories of the atom (6)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand and interpret classical atomic models. • Understand the fundamentals of modern atomic theory. • Know the basic concepts of quantum mechanics. • Solve problems.	• Postulates of Dalton. Atomic model of Thomson. • Rutherford's experiment, Rutherford's atomic model. Inconsistency. • Bohr's atomic model. Spectrum of emission of the hydrogen atom. • Modern atomic theory. Duality of matter. • Heisenberg uncertainty principle. • Atomic orbitals. Schrodinger equation. • Quantum mechanical description of the hydrogen atom. Quantum numbers. • Electronic configuration. Pauli Exclusion Principle. • Hund's rule. Exceptions. • Paramagnetism and diamagnetism. Screen Effect. • Exercises and problems.
Readings : [Bab83], [WCD92]	

Unit 5: QU5. Periodic Table (4)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand the structure of the periodic table. • Know the properties of the elements. • Solve problems.	• Periodic law. • Periodic law. Description of the periodic table. Period and group. Location of an item. • Periodic properties: Atomic radius, ionic radius, ionization energy, electron affinity. Electronegativity. • Variation of chemical properties. • Exercises and problems.
Readings :	

Unit 6: QU6. Chemical bond (3)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Know and understand the theories of valence and chemical bonds. • Know and understand the molecular orbital theory. • Solve problems	• Valence theory. Evolution. • Octet Rule. • Lewis Theory. • Ion and electrovalent bond. • Formation of the element between the elements s and the elements p. The ionic energies of the crystalline netting. • Born Haber Cycle. • Covalent bond. Sharing electron pairs. • Formal charge and Lewis structure. Concept of resonance. • Exceptions to the octet rule. Forces in covalent bond • Theory of the repulsion of electronic pairs of the valence level (RPENV). • Concept of hybridization. Hybridization sp, sp2, sp3 and other types of hybridization. • Molecular Orbital Theory. • Exercises and problems.
Readings : [Bru92], [AS83]	

Unit 7: QU7. Gases (4)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Know the basic concepts of ideal gases. • Understand and apply the kinetic theory of gases. • know concepts of diffusion and effusion of gases. • Understand the concepts of real gases. • Solve problems.	• Definition. Pressure of a gas. • Laws of gases: by Boyle, Gay-Lussac and Charles. Equation of an ideal gas. • Dalton's partial pressure law. • Kinetic theory of gases. Distribution of molecular velocities. Average Free Path. • Graham's Law of Diffusion and Effusion. • Real gas. Van der Waals equation. • Exercises and problems.
Readings : [AS83], [Mas98]	

Unit 8: QU8. Intermolecular Forces and Liquids (3)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand basic concepts of intermolecular forces. • Know and apply concepts of vaporization and boiling. • Know and apply concepts of surface tension and phase changes. • Solve Problems.	• Definition. Evaporation and vapor pressure at steady state. • Measurement of vapor pressure and heat of vaporization. Boiling point and latent heat of vaporization. • Intermolecular forces; Dipole-dipole forces, ion-dipole, stray, force and van der Waals radius. Hydrogen bond. • Viscosity. Surface tension and capillary action. • Phase changes. • Ejercicios y problemas.
Readings : [Mas98], [Bab83]	

Unit 9: QU9. Solids (3)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand basic concepts of crystalline solid structures. • Know and apply concepts of phase changes and equilibrium. • Solve problems .	• Definition. Packing of spheres. Efficiency of packaging. Compact packing. • Use of X-rays in the study of the structure of crystals. • Classes of crystal structures: ionic crystals. Covalent, molecular, metallic. Metal Link Amorphous crystals. • Phase changes. Liquid-vapor balance. Heat of vaporization and boiling point. • Liquid-solid equilibrium. Solid-vapor equilibrium. Phase diagram of water and carbon dioxide. • Exercises and problems.
Readings : [Mas98], [Bab83]	

Unit 10: QU10. Solutions (3)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Understand basic concepts of molecular dissolution. • Know and apply concepts of concentration and solubility. • Solve problems	• Definition. Molecular vision of the dissolution process. • Dissolutions of liquids in liquids. Dissolutions of solids in liquids. • Units of concentration: percentage by mass, molar fraction, molarity, molality Normality. • Effect of temperature on solubility, solubility of solids and temperature, fractional crystallization. • Solubility of gases and temperature. Effect of pressure on the solubility of gases. • Colligative properties of solutions. Colloidal Dispersions. • Exercises and problems.
Readings : [Mas98], [Bab83]	

Unit 11: QU11. Stoichiometry (3)	
Competences Expected: C20	
Learning Outcomes	**Topics**
• Know basic concepts of chemical reactions • Know and apply weight and volume laws. • Resolve problems .	• Chemical reaction. Expressions of chemical reactions in the form of equations. Characteristics of a chemical equation. • Types of chemical reactions: Precipitation, acid-base, oxide-reduction. Number of reagents and products. • Stoichiometric relations: moles, mass and volume. • Weight and Volume Laws. • Limiting Reagent. Yield of reactions. • Exercises and problems.
Readings : [Mas98], [Bab83]	