



National University of Engineering (UNI)

School of Civil Engineering
Syllabus 2026-II

1. COURSE

BCH101. Chemistry I (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: BCH101. Chemistry I
2.2 Semester	: 1 st Semester.
2.3 Credits	: 5
2.4 Hours	: 3 HT; 2 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: None

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Chemistry provides the foundation for understanding the composition, structure, and properties of matter – knowledge required across computing, and engineering programs alike as part of a rigorous grounding in the natural sciences. This course introduces the basic principles of general chemistry and extends them to chemical equilibrium and electrochemistry, together with the applied chemistry of water, polymers, and cement, topics that recur in materials science, environmental analysis, and engineering practice.

5. GOALS

- Understand the structure of matter at the atomic and molecular level.
- Apply the principles of stoichiometry to perform chemical calculations.
- Understand the different types of chemical bonds and their influence on the properties of substances.
- Apply chemical equilibrium, including acid-base and solubility equilibria, to predict the behavior of aqueous systems.
- Apply electrochemical principles to analyze corrosion of metals and reinforced concrete.
- Relate the composition and properties of water, polymers, and cement to their applications in materials science and civil engineering.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Familiarity)

7. TOPICS

Unit 1: Matter and Energy (8 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Classification of matter: elements, compounds, and mixtures • The scientific method and the international system of units	• Describe the properties of matter and energy and classify a given substance [Familiarity] • Perform unit conversions in engineering chemistry problems [Usage]
Readings : [Bro+17], [CG16]	

Unit 2: Basic Atomic Structure (10 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Structure of the atom, atomic number, mass number, and isotopes • Quantum model of the atom and electron configuration	• Describe the structure of the atom and its subatomic particles [Familiarity] • Determine the electron configuration of an atom and relate it to its chemical properties [Usage]
Readings : [Bro+17], [CG16]	

Unit 3: Chemical Bonding (10 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Ionic, covalent, and metallic bonding • Molecular geometry and its relationship to substance properties	• Describe the different types of chemical bonding [Familiarity] • Predict molecular geometry and relate bond type to material properties [Assessment]
Readings : [Bro+17], [CG16]	

Unit 4: Stoichiometry (10 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Molar mass, the mole concept, and balancing chemical equations • Stoichiometric calculations, limiting reagent, and percent yield	• Calculate the molar mass of a compound and balance chemical equations [Usage] • Determine the amount of reactants and products in an engineering process using stoichiometric calculations [Assessment]
Readings : [Bro+17], [CG16]	

Unit 5: States of Matter (10 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Properties of gases, liquids, and solids, and phase changes • Ideal gas laws and phase diagrams	• Describe the properties of the different states of matter and their phase changes [Familiarity] • Apply ideal gas laws to engineering problems [Usage]
Readings : [Bro+17], [CG16]	

Unit 6: Environmental and Water Chemistry (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- Water quality parameters (pH, hardness, dissolved oxygen, BOD) for infrastructure design - Fundamentals of water treatment and major air and water pollutants	- Interpret water quality parameters for the design of treatment systems [Usage] - Identify pollutants relevant to sanitary and environmental infrastructure projects [Familiarity]
Readings : [Bro+17], [CG16]	

Unit 7: Polymers and Geosynthetics (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- Classification of polymers: thermoplastics, thermosets, and elastomers - Geosynthetics: geotextiles, geomembranes, and geogrids, and their applications in civil works	- Classify a polymer by its structure and thermal behavior [Usage] - Select the appropriate geosynthetic for a given civil engineering application [Usage]
Readings : [CG16], [MZ17]	

Unit 8: Chemical Equilibrium (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- The equilibrium constant K_c and its relation to stoichiometry - Le Chatelier's principle and its effect on industrial chemical processes	- Write the equilibrium constant expression for a reaction of engineering interest [Usage] - Predict the shift of a chemical equilibrium in an engineering process [Assessment]
Readings : [Bro+17], [CG16]	

Unit 9: Ionic Equilibrium and Salt Hydrolysis (12 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- Calculating the pH of strong and weak acids and bases - Salt hydrolysis and its effect on the pH of water and soils	- Calculate the pH of solutions relevant to environmental quality control [Usage] - Predict the effect of salt hydrolysis on the pH of water and soils [Assessment]
Readings : [Bro+17], [CG16]	

Unit 10: Salts, Solubility, and Precipitation Equilibria (6 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
The solubility product K_{sp} and predicting precipitation	Predict the formation of precipitates or scale in engineering water systems [Usage]
Readings : [Bro+17], [CG16]	

Unit 11: Electrochemistry and Electrolysis (8 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- Redox reactions, galvanic cells, and electrode potentials - Electrochemical corrosion of metals and of reinforcing steel in reinforced concrete, and protection methods	- Calculate the potential of a galvanic cell and predict the spontaneity of a redox reaction [Usage] - Analyze corrosion conditions in engineering structures and propose protection methods [Assessment]
Readings : [Bro+17], [CG16]	

Unit 12: Cement Chemistry (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
- Chemical composition of Portland cement and its main compounds - Cement hydration reactions and their relation to concrete strength development	- Describe the chemical composition of Portland cement [Familiarity] - Explain the relationship between cement hydration and concrete strength development [Usage]
Readings : [MZ17], [CG16]	

8. WORKPLAN

8.1 Methodology

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

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

[CG16] Raymond Chang and Kenneth A. Goldsby. *Chemistry*. McGraw-Hill Education, 2016.

[Bro+17] Theodore L. Brown et al. *Chemistry: The Central Science*. Pearson, 2017.

[MZ17] Michael S. Mamlouk and John P. Zanzewski. *Materials for Civil and Construction Engineers*. 4th. Pearson, 2017.