Course Syllabus

1	**Course title**	General chemistry for chemical engineers
2	**Course number**	0313101
3	**Credit hours**	3
	Contact hours (theory, practical)	(3,0)
4	**Prerequisites / corequisites**	-
5	**Program title**	Bachelor degree in Chemical Engineering
6	**Program code**	0303
7	**Awarding institution**	The University of Jordan
8	**School**	Science
9	**Department**	Chemistry
10	**Course level**	1st year
11	**Year of study and semester (s)**	All
12	**Other department(s) involved in teaching the course**	N/A
13	**Main teaching language**	English
14	**Delivery method**	☒ Face to face learning ☐ Blended ☐ Fully online
15	**Online platforms(s)**	☐ Moodle ☒ Microsoft Teams ☐ Skype ☐Zoom ☐Others……
16	**Issuing/Revision Date**	7th October 2025

17 Course Coordinator:

Name: **Professor Ehab AlShamaileh** Contact hours:
Office number: Chemistry 024 Phone number: 079xxxxxx
Email: ehab@ju.edu.jo

18 Other instructors:

None so far

19 Course Description:

General chemistry for chemical engineering is an introductory course in general chemistry and intended for first year university students from Engineering. This class covers basic topics including: naming simple compounds, stoichiometry, basic reactions in aqueous solutions and solution stoichiometry, properties of gases and kinetic molecular theory, basic quantum theory and the electronic structure of the atoms, atomic periodic properties, ionic bonding, covalent bonding, molecular geometry, and hybridization of atomic orbitals, inter-molecular interactions and chemical properties that are affected by these interactions. hemical kinetics and reaction rates and reaction mechanisms. Chemical equilibrium. Acids and bases. Acid-base equilibrium. Solubility and complex ion equilibria. Thermodynamics and equilibrium.

20 Course aims and outcomes:

A- Aims:

1. To instill in students a sense of enthusiasm for chemistry, an appreciation of its application in different contexts and to involve them in a satisfying experience of learning and studying.
2. To provide students with a broad and balanced foundation of chemical knowledge.
3. To develop in students the ability to apply their chemical knowledge and skills to the solution of problems in chemistry.
4. To develop in students a range of transferable skills, in chemical and allied chemical employment related to course content.
5. To provide students with a knowledge and skills to further in chemical engineering.

B- Course Learning Outcomes (CLOs): Upon successful completion of this course students will be able to:

Part-1: Atoms, Molecules, and Ions

- Explain the postulates of Dalton's atomic theory
- Apply the results of early atomic experiments to define the three subatomic particles and isotopes
- Interpret the atomic structure and determine atomic mass and define isotopes
- Express chemical formulas in molecular, empirical, and structural form
- Derive names for common types of compounds using a systematic approach
- Write and balance chemical equations

Part-2: Calculations with Chemical Formulas and Equations

- Relate formula mass, moles, and the numbers of atoms or molecules
- Determine empirical and molecular formulas, determine mass percentage for each element
- Determine amounts of reactants and products in a reaction. Recall the concept of limiting reactant
- Calculate theoretical and percent yield

Part-3: Chemical Reactions

- Classify matter to electrolytes and non-electrolytes. Predict the solubility of ionic compounds in water
- Classify chemical reactions in solutions
- Use molarity to calculate solution concentrations and perform dilution calculations
- Describe titrations and gravimetric data and apply stoichiometry to both
- Determination of oxidation number for atoms in substances in redox reactions

Part-4: The Gaseous State

- Define pressure and pressure units
- Derive the ideal gas law from the three empirical gas laws
- Use the ideal gas law to do stoichiometric calculations
- Validate Daltons law for gas mixtures
- Explain the postulates of the kinetic-molecular theory
- Compute rates of effusion and diffusion

Part-5: Quantum Theory of the Atom

- Apply quantum mechanics to the electrons in an atom
- Deduce Quantum Numbers and relate them to the atomic orbitals in an atom

Part-6: Electron Configurations and Periodicity

- Write electron configurations of atoms by considering building up principle, Pauli exclusion principle and Hund's rule
- Express the electron structures of cations, anions, and ionic compounds
- Describe and explain the observed trends in atomic size, ionization energy, and electron affinity of the elements

Part 7: Ionic and Covalent Bonding

- Describe ionic bonds, write electron configurations of Ions and compare ionic radii. Understand bond strength and

lattice energies
- Define covalent bond, electronegativity of atoms and polar bonds
- Create Lewis symbols and structures
- Quantify formal charges and resonance using the Lewis structure
- Determine bond length and bond order
- Calculate enthalpy of reactions using theoretical methods i.e.: Bond Enthalpy

Part 8: Molecular Geometry and Chemical Bonding Theory
- Interpret VSEPR theory and polarity
- Summarize valence bond theory
- Describe atomic orbital hybridization
- Describe multiple covalent bonding and resonance

Part 9: States of matter and properties of solutions
- • Classify the states of matter and their phase transitions
- • Identify the properties of liquids
- • Classify the intermolecular interactions and the relation with the liquid properties
- • Identify the properties of solutions • Identify the colligative properties

Part 10: Chemical kinetics and rate of reactions
- • Definition of reaction rates
- • Determine the factors the affect the rate of a reaction
- • Apply Arrhenius equation
- • Relate the reaction mechanism with the rate of the reaction

Part 11: Chemical equilibrium
- • Describing the chemical equilibrium
- • Using equilibrium constant
- • Identifying the changes that occur on chemical equilibria

Part-12: Acids and bases
- • Defining the acid and base concepts
- • Determining the acid and base strengths
- • Describe the autoionization of water
- • Identify the pH value of solutions

Part-13: acid-base equilibria
- Defining weak acids and bases
- Identifying the common ion and its effect
- Apply equilibrium equation for buffer solutions

Part-14:: Solubility and Complex-Ion Equilibria
- • Define the solubility product constant
- • Validate the solubility and the effect of common ions.

SO / CLO	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)	SO (6)	SO (7)
1		✓					
2		✓					
3	✓	✓					
4	✓	✓					
5	✓	✓					
6	✓	✓					
7	✓	✓					
8	✓	✓					

21. Topic Outline and Schedule:

Week	Lecture	Topic(s)	Teaching Methods/Platform	Evaluation Methods	References
1	1.1	2.3 Nuclear Structure and Isotopes 2.4 Atomic Weights	In class	Written exam	Darrel Ebbing and Steven gammon,
	1.2	2.8 Naming Simple Compounds	In class	Written exam	Darrel Ebbing and Steven gammon,
	1.3	2.9 Writing Chemical Equations, 2.10 Balancing Chemical Equations.	In class	Written exam	Darrel Ebbing and Steven gammon,
2	2.1	3.1 Molecular Weight and Formula Weight 3.2 The Mole Concept	In class	Written exam	Darrel Ebbing and Steven gammon,
	2.2	3.3 Mass Percentages from the Formula 3.4 Elemental Analysis: Percentages of Carbon, Hydrogen, and Oxygen	In class	Written exam	Darrel Ebbing and Steven gammon,
	2.3	3.5 Determining Formulas 3.6 Molar Interpretation of a Chemical Equation	In class	Written exam	Darrel Ebbing and Steven gammon,
3	3.1	3.7 Amounts of Substances in a Chemical Reaction	In class	Written exam	Darrel Ebbing and Steven gammon,
	3.2	3.8 Limiting Reactant, Theoretical and Percentage Yields	In class	Written exam	Darrel Ebbing and Steven gammon,
	3.3	4.1 Ionic Theory of Solutions and Solubility Rules; 4.2 Molecular and Ionic Equations 4.3 Precipitation Reactions	In class	Written exam	Darrel Ebbing and Steven gammon,
4	4.1	4.4 Acid-Base Reactions 4.5 Oxidation-Reduction Reactions	In class	Written exam	Darrel Ebbing and Steven gammon,
	4.2	4.6 Balancing Simple Oxidation–Reduction Equations 4.7 Molar Concentration	In class	Written exam	Darrel Ebbing and Steven gammon,
	4.3	4.8 Diluting Solutions 4.10 Volumetric Analysis	In class	Written exam	Darrel Ebbing and Steven gammon,

5	5.1	5.3 The Ideal Gas Law 5.4 Stoichiometry Problems Involving Gas Volumes	In class	Written exam	Darrel Ebbing and Steven gammon,
	5.2	5.5 Gas Mixtures: Law of Partial Pressures	In class	Written exam	Darrel Ebbing and Steven
	5.3	7.5 Quantum Numbers and Atomic Orbitals	In class	Written exam	Darrel Ebbing and Steven gammon,
6	6.1	8.1 Electron Spin and Pauli Exclusion Principle 8.2 Building-Up Principle and the Periodic Table	In class	Written exam	Darrel Ebbing and Steven gammon,
	6.2	8.3 Writing Electron Configurations Using the Periodic Table	In class	Written exam	Darrel Ebbing and Steven gammon,
	76.3	8.4 Orbital Diagrams of Atoms, Hund's Rule 8.6 Some Periodic Properties (Without electron affinity)	In class	Written exam	Darrel Ebbing and Steven gammon,
7	7.1	9.1 Describing Ionic Bonds 9.2 Electron Configurations of Ions	In class	Written exam	Darrel Ebbing and Steven gammon,
	7.2	9.3 Ionic Radii 9.4 Describing Covalent Bonds 9.5 Polar Covalent Bonds and Electronegativity	In class	Written exam	Darrel Ebbing and Steven gammon, General
	7.3	9.6 Writing Lewis Electron-Dot Formulas 9.7 Delocalized Bonding: Resonance	In class	Written exam	Darrel Ebbing and Steven gammon,
8	8.1	9.8 Exceptions to the Octet Rule; 9.10 Bond Length and Bond Order	In class	Written exam	Darrel Ebbing and Steven gammon,
	8.2	10.1 The Valence-Shell Electron-Pair Repulsion (VSEPR) Model; 10.2 Dipole Moment and Molecular Geometry	In class	Written exam	Darrel Ebbing and Steven gammon,
	8.3	10.3 Valence Bond Theory; 10.4 Description of Multiple Bonding	In class	Written exam	Darrel Ebbing and Steven gammon,
9	9.1	11.1 Comparison of Gases, Liquids, and Solids, 11.2 Phase Transitions	In class	Written exam	Darrel Ebbing and Steven gammon,
	9.2	11.5 Intermolecular Forces: Explaining Liquid Properties.	In class	Written exam	Darrel Ebbing and Steven gammon,
	9.3	12.1 Types of Solutions, 12.2 Solubility and the Solution Process	In class	Written exam	Darrel Ebbing and Steven gammon,
10	10.1	12.3 Effects of Temperature and Pressure on Solubility, 12.4 Ways of Expressing Concentration	In class	Written exam	Darrel Ebbing and Steven gammon,
	10.2	13.1 Definition of Reaction Rate, 13.2 Experimental Determination of Rate	In class	Written exam	Darrel Ebbing and Steven gammon,
	10.3	13.3 Dependence of Rate on Concentration, 13.4 Change of Concentration with Time	In class	Written exam	Darrel Ebbing and Steven gammon,

11	11.1	13.5 Temperature and Rate, Collision and Transition-State Theories,	In class	Written exam	Darrel Ebbing and Steven gammon,
	11.2	13.6 Arrhenius Equation; 13.9: Catalysis	In class	Written exam	Darrel Ebbing and Steven gammon,
	11.3	14.1 Chemical Equilibrium-A Dynamic Equilibrium, 14.2 The Equilibrium Constant	In class	Written exam	Darrel Ebbing and Steven gammon,
12	12.1	14.3 Heterogeneous Equilibria: Solvents in Homogeneous Equilibria, 14.4 Qualitatively Interpreting the Equilibrium Constant	In class	Written exam	Darrel Ebbing and Steven gammon,
	12.2	14.5 Predicting the Direction of Reaction, 14.6 Calculating Equilibrium Concentrations	In class	Written exam	Darrel Ebbing and Steven gammon,
	12.3	14.7 Removing Products or Adding Reactants, 14.8 Changing the Pressure and Temperature 14.9 Effect of Catalyst	In class	Written exam	Darrel Ebbing and Steven gammon, General
13	13.1	15.1 Arrhenius Concept of Acids and Bases, 15.2 Bronsted–Lowry Concept of Acids and Bases	In class	Written exam	Darrel Ebbing and Steven gammon,
	13.2	15.3 Lewis Concept of Acids and Bases, 15.4 Relative Strengths of Acids and Bases	In class	Written exam	Darrel Ebbing and Steven gammon,
	13.3	15.5 Molecular Structure and Acid Strength, 15.6 Autoionization of Water	In class	Written exam	Darrel Ebbing and Steven gammon,
14	14.1	15.7 Solutions of a Strong Acid or Base, 15.8 The pH of a Solution.	In class	Written exam	Darrel Ebbing and Steven gammon,
	14.2	16.1 Acid-Ionization Equilibria, 16.2 Polyprotic Acids	In class	Written exam	Darrel Ebbing and Steven gammon,
	14.3	16.3 Base-Ionization Equilibria, 16.4 Acid–Base Properties of Salt Solutions	In class	Written exam	Darrel Ebbing and Steven gammon,
15	15.1	16.6 Buffers.	In class	Written exam	Darrel Ebbing and Steven gammon,
	15.2	17.1 The Solubility Product Constant, 17.2 Solubility and the Common-Ion Effect	In class	Written exam	Darrel Ebbing and Steven gammon,
	15.3	17.3 Precipitation Calculations.	In class	Written exam	Darrel Ebbing and Steven gammon,

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLO	Period (Week)	Platform
Midterm exam	30	Chapter 1+2+3+4	1+2	Week # 7	On campus

					computerized exam
Semester work exam	20	Chapter 5+7+8	3-5	Weak # 11	On campus computerized exam
Final exam	50	All Chapters	1-8	Final exams week	On campus computerized exam

23 Course Requirements

None

24 Course Policies:

A- Attendance policies:
Students should attend at least 85% of the total number of the lectures.

B- Absences from exams and submitting assignments on time:
Students who miss an exam must submit and acceptable excuse and then a makeup exam will be appointed.

C- Health and safety procedures:
Followed according to university regulations.

D- Honesty policy regarding cheating, plagiarism, misbehavior:
Followed according to university regulations.

E- Grading policy: 1. Mid exam 30%; 2. Semester work 20%; 3. Final exam: 50%; Letter grade scale is adopted.

F- Available university services that support achievement in the course:
Central library, personal computer labs at different locations in the university, e-learning site, faculty member's website.

25 References:

A- Required book (s), assigned reading and audio-visuals: General Chemistry, 11th ed., D. Ebbing & S. Gammon, Brooks Cole, 2017.

B- Recommended books, materials, and media:
1) Chemistry, 9th ed., S. Zumdahl & S. Zumdahl, Brooks Cole, 2013.
2) 2. General Chemistry, The essential concept, 7th ed., R. Chang, McGraw-Hill, 2016.

26 Additional information:

This course is required by students in chemical engineerinmg at the University of Jordan. The number of students registered in General Chemistry for Engineering (0313101) course in 1st semester 2025/2026 is ~ 150 student in 2 sections.

Name of Course Coordinator: **Professor Ehab AlShamaileh** Signature: --*Eηαβ*- Date: 7-10-2025

Head of Curriculum Committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature:----------

Head of Curriculum Committee/Faculty: ---------- Signature: ----------

Dean: ---------- Signature: ----------