Programme	B.Sc. (Engg.) Energy Engineering	Course Code	NS 114	Credit Hours	2 + 1 = 3
Course Title	**General Chemistry**				

Course Introduction

This course is designed to equip the students with a strong understanding of the core principles and concepts of chemistry, which are essential for grasping the expansive field of energy engineering. Comprehending the fundamentals of chemistry will enable students to understand and innovate within diverse energy systems and technologies. Students will gain insights into the arrangement and behavior of atoms, the nature of chemical bonds, and the systematic classification of elements. The curriculum extends to cover fundamental laws of physical chemistry, providing a solid foundation in chemical kinetics, and the principles governing chemical reactions. Students will also cover electrochemistry, exploring the chemical processes that produce electrical energy and their applications in batteries, fuel cells, and other energy systems. Organic chemistry, another critical area, will introduce students to the structure, properties, and reactions of organic compounds for understanding the chemistry behind biofuels, polymers, and other energy-related materials. Lastly, the Units III and IV are mapped with SDG-9 and SDG-12, respectively, as the concepts of Electrochemistry such as voltaic cells, fuel cells, and electrolysis are fundamental to developing sustainable energy technologies and improving industrial processes. Furthermore, the fundamentals of Organic Chemistry are key to creating sustainable materials and processes that minimize environmental impact and promote efficient use of resources.

Mapped SDGs	SDG-9: Industry, Innovation, and Infrastructure SDG-12: Responsible Consumption and Production

Learning Outcomes

1. **Recognize** the principles and concepts of chemistry, including atomic structure, chemical bonding, and periodicity (C2)
2. **Demonstrate** a fundamental understanding of basic laws of physical chemistry, electrochemistry, and organic chemistry with special reference to chemical reactions and energy systems (C3)

Course Content		Assignments/Readings
Week 1	**Unit-I: Chemistry – The Central Science** 1.1. Matter and its Properties 1.2. Development of the Periodic Table and Periodic Properties 1.3. Periodic Trends and Chemical Reactivity 1.4. Chemical Bonds (Ionic and Covalent Bonding) 1.5. Bond Polarity and Electronegativity	The teacher may assign home assignments/problem-based learning/reading materials/learning activity etc.

Week 2	1.6. Molecular Shapes 1.7. Valence Shell Electron Pair Repulsion Model 1.8. Molecular Shape and Molecular Polarity 1.9. Hybrid Orbitals and Multiple Bonds 1.10. Molecular Orbitals	
Week 3	**Unit-II: Chemistry of Physical States** 2.1. Gases: Simple Gas Laws 2.2. The Ideal Gas Law 2.3. Gases in Chemical Reactions: Stoichiometry 2.4. Kinetic Molecular Theory	
Week 4	2.5. Liquids, Solids, and Intermolecular Forces 2.6. Intermolecular Forces 2.7. Vaporization and Vapor Pressure 2.8. Phase Diagrams	
Week 5	2.9. Crystalline Solids 2.9.1. Unit Cells and Basic Structures 2.9.2. Fundamental Types 2.9.3. Band Theory 2.10. Types of Solutions and Solubility 2.11. Energetics of Solution Formation	
Week 6	2.12. Solution Equilibrium and Factors Affecting Solubility 2.13. Vapor Pressure of Solutions 2.14. Freezing Point Depression, Boiling Point Elevation, and Osmosis	
Week 7	2.15. Chemical Kinetics 2.15.1. Rate of a Chemical Reaction 2.15.2. The Rate Law: The Effect of Concentration on Reaction Rate 2.15.3. The Integrated Rate Law: The Dependence of Concentration on Time	
Week 8	2.16. The Effect of Temperature on Reaction Rate 2.17. Reaction Mechanisms 2.18. Catalysis	
Week 9	**Unit-III: Electrochemistry** 3.1. Basic Concepts 3.2. Balancing Oxidation/Reduction Equations	

	3.3. Voltaic (or Galvanic) Cells: Generating Electricity from Spontaneous Chemical Reactions	
Week 10	3.4. Standard Reduction Potentials 3.5. Cell Potential 3.6. Free Energy	
Week 11	3.7. Equilibrium Constant 3.8. Batteries: Using Chemistry to Generate Electricity 3.8.1. Dry Cell Batteries	
Week 12	3.8.2. Lead-Acid Storage Batteries 3.8.3. Fuel Cells 3.8.4. The Fuel Cell Breathalyzer	
Week 13	3.9. Electrolysis: Driving Nonspontaneous Chemical Reactions with Electricity 3.9.1. Predicting the Products of Electrolysis 3.9.2. Stoichiometry of Electrolysis 3.10. Corrosion: Undesirable Redox Reactions	
Week 14	**Unit-IV: Organic Chemistry** 4.1. Hydrocarbons (Alkanes, Alkenes, and Alkynes) 4.1.1. Alkanes 4.1.2. Alkenes 4.1.3. Alkynes 4.2. Hydrocarbon Reactions	
Week 15	4.3. Aromatic Hydrocarbons 4.4. Functional Groups 4.4.1. Alcohols	
Week 16	4.4.2. Aldehydes and ketones 4.4.3. Carboxylic Acids and Esters 4.4.4. Ethers and Amines 4.4.5. Polymers	

Textbooks and Reading Material

1. Tro, N. J., Fridgen, T. D., Shaw, L., & Boikess, R. S. (2022). Chemistry**:** A Molecular Approach (6th Edition). Boston: Pearson.
2. Brown, T. L. (2020). Chemistry: The Central Science (14th Edition). Pearson Education.
3. Vogel, A. I., Furniss, B. S. (2011). Vogel's Textbook of Practical Organic Chemistry. Kiribati: Longman.
4. Atkins, P., Paula, J. D., & Keeler, J. (2018). Physical Chemistry (11th Edition). Oxford University Press.
5. Eliaz, N., & Giledai, E (2021) Physical Electrochemistry: Fundamentals, Techniques, and Applications (2nd Edition). Wiley.

6. Smith, M. B. (2020). March's Advanced organic chemistry: reactions, mechanisms, and structure (8th Edition). John Wiley.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Individual Assignments
4. Quiz upon Completion of Each Unit

Assignments: Types and Number with Calendar

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Activity	-	Quiz 1	-	Assignment 1	-	-	-	Quiz 2

Week	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Activity	-	-	-	Assignment 2	Quiz 3	-	-	Quiz 4

The abovementioned schedule of assignments/quizzes/presentations is tentative. The schedule will be provided to the students at the start of semester.

Assessment

Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written assessment at the mid-point of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc.
2.	Sessional Assessment	25%	This assessment may include classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written assessment at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc.