|  |  |
| --- | --- |
| **Ministry of Education and Training**  **HCMC University of Technology and Education**  **Faculty of Chemical and Food Technology** | **SOCIALIST REPUBLIC OF VIETNAM**  **Independence – Freedom – Happiness**  \*\*\*\*\*\*\* |

**UNDERGRADUATE PROGRAMME**

**Programme:** Bachelor degrees

**Curriculum programme**:

**COURSE SYLLABUS**

**1. Course Title: General Chemistry Course Code: GCHE130103**

**2. Course unit value:** 3 credits

**Class schedule**: 15 weeks (3:0:6)

**3. Instructors:**

1/ Main instructor:

2/ Co-instructors:

**4. Course requirements:**

**Prerequisite:** none

**5. Course Description:**

This course equips students with the basics of chemistry as a foundation for deeper studying in different areas of science and technology.

This module helps students to understand the structures of atoms and molecules, develop the ability to solve basic quantitative problems related to chemical thermodynamics, reaction kinetics, chemical equilibrium, properties of solutions and electrochemistry.

This is the foundation for students to acquire basic knowledge of the natural sciences in order to meet the needs of higher education or further studying in different areas of science and technology.

**6. Course Goals**

|  |  |  |
| --- | --- | --- |
| ***Goals*** | ***Goal description***  *(Students are provided with)* | **Program learning outcomes** |
| **G1** | Basic scientific knowledge in chemistry and chemical engineering. |  |
| **G2** | Ability to analyse, explain and calculate in order to solve problems relating to chemistry in engineering and in everyday life. |  |
| **G3** | Communication skills |  |
| **G4** | Ability to generate ideas about a chemical engineering problem |  |

**7. Course Learning Outcomes**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Learning outcomes** | | **Description**  *At the end of the course, students are able to* | **CDIO Learning Outcomes** |
| **G1** | G1.1 | Present some knowledge about atoms and molecules (according mainly to the VB theory), the relationship between structure and properties. | 1.1 |
| G1.2 | Describe the relationship between the nature of the elements and their position in the periodic table. | 1.1 |
| G1.3 | Present the thermodynamic criteria for spontaniety of a chemical reaction. | 1.1 |
| G1.4 | Present the concepts of reaction rate, its expression and the effects of different parameters to reaction rate | 1.1 |
| G1.5 | Describe the concept of irreversible reactions, reversible reactions, equilibrium, equilibrium constant, and principles of equilibrium shifting. | 1.1 |
| G1.6 | Demonstrate the principles of transforming chemical energy into electricity. | 1.1 |
| **G2** | G2.1 | Calculate the thermodynamic parameters to conclude about the spontaneity a chemical reaction. | 2.1.1 |
| G2.2 | Calculate the values of different types of solution concentration. Calculate some physical properties of non-electrolyte and electrolyte solutions. | 2.1.1 |
| G2.3 | Calculate Galvanic cell potentials. Determine the direction and equilibrium constant of a chemical reaction in a galvanic cell. | 2.1.1 |
| G2.4 | Proactively search for materials, self-study and present visually and orally a content related to chemistry | 2.2.3 |
| **G3** |  | Communicate in writing | 3.2.3 |
| **G4** |  | Apply the learned theory to explain real-life issues. | 4.3.2 |

**8. Course policies**

Students are required to

* attend at least 80% of class meetings
* do at least 80% of assignments
* do at least 80% of tests in class
* actively participate in classroom activities

**9. Materials**

**- Text books (in Vietnamese)**

1. Nguyễn Đức Chung, ***General chemistry***, Ho Chi Minh City National Univercity Publisher.

2. Nguyễn Đức Chung, ***Excercies in general chemistry*** **1**, Ho Chi Minh City National Univercity Publisher.

3. Nguyễn Đức Chung, ***Excercies in general chemistry*** **2**, Ho Chi Minh City National Univercity Publisher.

***- Reference:***

1. Nguyễn Đình Chi, **Theoretical b*asics of chemistry, part 1***, Science and Engineering Publishing House.

2. Nguyễn Hạnh, **Theoretical b*asics of chemistry, part 2***, Science and Engineering Publishing House.

3. Nguyễn Đình Soa, ***Hóa đại cương***, Ho Chi Minh City Bach Khoa University Publisher.

4. Nguyễn Ngọc Thích, Đỗ Hoàng, ***Hóa đại cương***, Ho Chi Minh City University of Technology and Education Publisher.

**10. Grading and Assessment**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **№** | **Content** | **Time** | **Assessment**  **tools** | **Assessed learning outcomes** | **Percentage (%)** |
| **Progressive evaluation** | | | | G1.3-1.5, G2.1,  G2.4,  G3, G4. | **50** |
| The forms and the frequency of on-going assessments depend on each lecturer but there must be at least 3 times of assessment and all the course learning outcomes must be assessed. | | | | | |
| **Final examination** | | |  |  | **50** |
|  | -From chapter 3 to chapter 7,  - Duration: 75 min. |  | Multiple Choice Test | G1.3-1.6,  G2.1-2.3 | 50 |

**11. Grading Scale: 10**

**12. Course Outline**

|  |  |  |
| --- | --- | --- |
| **Week** | **Content** | **Course LO** |
|  | **Chapter 1: Atomic structure and The Periodic table of Chemical Elements** | **G1.1**  **G1.2** |
| **Electrons in an atom, quantum numbers and orbitals**  1.1. Electronic shells of atoms  1.1.1.Bohr model of atoms  1.1.2. Wave properties of microscopic particles  1.1.3. Uncertainty Pinciple  1.1.4. Schodinger wave equation  1.1.5. Quantum numbers and their meaning  1.1.6. Multielectron atoms |  |
|  | **Chapter 1: Atomic structure and The Periodic table of Chemical Elements (cont.)** | **G1.1**  **G1.2** |
| 1.2. The periodic law and The periodic table  1.2.1. The periodic law  1.2.2. Nuclear charges and The periodic law  1.2.3.The Periodic table of Chemical Elements  1.2.4. The periodic table and electron configurations  1.3. Periodic trends in properties of atoms  Atomic and ionic radii  Ionization energies  Electron affinities  Oxidation numbers |  |
|  | **Chapter 2: CHEMICAL BONDING** | G1.1 |
| 2.1. Introduction  2.1.1. Molecules and chemical bonds  2.1.3. Covalent bond according to Lewis  2.1.4. exception The octet rule  2.2. Energy of Covalent bonds  2.2.1. Energy of Covalent bonds  2.2.2. The length and the bond angle of covalent bonds  2.3. Valence shell electron pair repulsion theory (VSEPR theory)  2.4. Valence bond theory (VB theory)  2.4.1. Hydrogen molecule according to Heitler - London  2.4.2. Covalent bonds according to Heitler - London  2.4.3. Types of orbital overlapping  2.4.4. Hybridization of atomic orbitals  2.4.5. Some molecules with π-bonds  2.4.6. Unlocalized π-bonds |  |
|  | **Chương 2: CHEMICAL BONDING (CONT.)** | G1.1 |
| 2.5. Molecular orbital (MO) theory  2.5.1. Basics of the theory 2.5.2. Tổ hợp tuyến tính hai AO s  2.5.3. Linear of two p-AO  2.5.4. Energy diagram of MO  2.5.5. Binary molecules A2  2.5.6. Binary molecules AB  2.5.7. Some other examples |  |
| 5-6 | **Chapter 3: CHEMICAL THERMODYNAMICS** | G1.3, G2.1, G4 |
| 3.1. The law of conservation of energy  3.1.1.System  3.1.2.State  3.1.3.State function  3.1.4.Process  3.1.5. Spontaneous and non-spontaneous processes  3.1.6. Equilibrium process  3.1.7. Reversible and irriversible processes  3.1.8. Energy  3.1.9. The law of conservation of energy – The first law of thermodynamics  3.1.10. Internal energy and enthalpy  3.1.11. Heat capacity  3.1.12. Ideal gases and the first law.  3.2. Thermochemistry  3.2.1. Reaction heat effect  3.2.2. Standard heat effect of chemical reactions  3.2.3. Heat of formation – Heat of combustion  3.2.4. Hess’s law and its  3.3. Spontaneity of a process  3.3.1. The second law of thermodynamics  3.3.2. Mathematical expression of the second law  3.3.3. Properties and the meaning of entropy  3.3.4. Entropy of an isolated system  3.3.5. Entropy change of a reversible process  3.3.6. Entropy change of a chemical reaction  3.3.7. Combining the first and the second laws  3.3.8. Isothermal-isobar potential (G) 3.3.9. Biến thiên thế đẳng áp phản ứng (∆G)  3.3.10. Standard isobar potential change for reactions (∆Go) |  |
| 7-8 | **Chapter 4: CHEMICAL KINETICS** | G1.4, G2.4, G4 |
| 4.1. Reaction rate  4.2. Concentration efect  4.2.1. The law of mass action  4.2.2. First-order reaction  4.2.3. Second-order reaction  4.2.4. Zeroth-order reaction  4.3. Temperature effect  4.3.1. Temperature effect  4.3.2. Arrhenius equation  4.4. Catalysis  4.3.1. Catalysts  4.3.2. Catalysts and thermodynamic equilibrium |  |
| 9-10 | **Chapter 5: CHEMICAL EQUILIBRIUM** | G1.5, G2.4, G4 |
| 5.1. Reversible reaction  5.2. Equilibrium constant  5.3. Equilibrium in heterogeneous systems  5.4. Spontaneity direction of reversible reactions – van’t Hoff isothermal equation  5.5. Equilibrium shift  5.6. Effects of temperature  5.7. Effects of pressure  5.8. Effects of adding a reactant or product |  |
| 11-14 | **Chapter 6: SOLUTIONS** | G2.2, G2.4, G4 |
| 6.1. Dispersion systems – Solutions  6.2. Ways of expressing composition of a solution  6.3. Heat effect of dissolution  6.4. Solubitity  6.4.1. Temperature effect  6.4.2. Pressure effect  6.5. Osmotic pressure of solutions  6.5.1. Diffusion  6.5.2. Osmosis  6.5.3. Osmotic pressure  6.6. Vapour pressure of solutions  6.6.1. Saturated vapour pressure of pure liquids  6.6.2. Saturated vapour pressure solutions containing nonvolatile solutes  6.7. Boiling point and freezing point of solutions  6.7.1. Boiling point of a liquid  6.7.2. Boiling point of a solution solutions containing nonvolatile solutes  6.7.3. Freezing point of a liquid  6.7.4. Freezing point of a solution  6.8 Theory of electrolytes – Electrolyte solutions  6.8.1. Abnormal properties of solutions of acids, bases and salts 6.8.2. Theory of electrolytes  6.8.3. Strong and weak electrolytes  6.8.4. Percent of ionization – Ionization constant  6.8.5. Equilibrium solutions of weak electrolytes  6.8.6. Strong electrolytes in solutions  6.9. Concepts of acids and bases  6.9.1. Basics concepts  6.9.2. Acid-base property of water  6.10. Slightly soluble electrolytes  6.10.1.Solubility product constant  6.10.2. Solubility product constant and solubility  6.10.3. Formation and dissolution of a slightly soluble electrolyte |  |
| 15 | **Chapter 7: ELECTROCHEMISTRY** | G1.6, G2.3, G2.4, G4 |
| 7.1. Redox reactions  7.2. Electrodes  7.3. Galvanic cells  7.4. Standard electrode potentials  7.4.1. Standard reduction electrode potential  7.4.2. The meaning of standard reduction potential  7.5. Electrical work and Nernst’s equation  7.5.1. Electrical work of galvanic cells  7.5.2. Nernst’s equation |  |

**13. Ethics requirements**

- Cheating is not allowed.

- Lesson preparation is required.

A student must accomplish his homework, tests, and exam **by himself**. Cheating on any of these tasks will result in **grade 0** for it. In serious cases, the cheating student will not be allowed to pass this course.

Lesson preparation is required **before** coming to lectures.

**14. Approval Date:** date/month/year

**15. Endorsement**

|  |  |  |
| --- | --- | --- |
| **Dean of Faculty**  **Dr. Võ Thị Ngà** | **Head of Department**  **Võ Thị Thu Như, M.Eng** | **Compiler(s)**  **Võ Thị Thu Như, M.Eng** |

**16. Updating Process of Syllabus**

|  |  |
| --- | --- |
| **1st Revision:** Updated content: date/month/year | **(**signature & full name)  Head of Department: |

|  |  |
| --- | --- |
| **2nd Revision:** Updated content: date/month/year | **(**signature & full name)  Head of Department: |