

**Science 4 (Chemistry)**

Basic Course Information			
Course Number	100002	Subject Category	Chemistry
Course Format	Lecture	Credit View and Number of Credits	3/3
Department	Chemistry	Student Category	Year 2
Period of Study	Semester 2	Classes per Week	2
Prerequisite	SCHEM10001 and CHEM10001		
Instructor	Dr. Tawfik Choukrouk	Dr. Larsson Wahlstrom	

**Course Objectives**  
 The course provides students with basic knowledge concepts of non-metallic elements and electrochemistry concerning basic reactions, application of electrochemical cell. Students are expected to develop an appreciation of the fundamental laws of thermodynamics and the application of these laws to chemical systems.  
 The course also tries to develop students' human skills, such as thinking, explaining, discussing and collaborating skills, through role and group works that are seen as opportunities for global engineers to create something new.

Evaluation/Level	Ideal Level of Achievement (Level 1)	Standard Level of Achievement (Level 2)	Unacceptable Level of Achievement (Level 3)
Understanding of non-metallic elements and electrochemistry	Theoretically understand and explain the concepts. Ability to correctly explain the concepts.	Only understanding of the basic terms and concepts.	Lacks the appropriate knowledge and understanding.
Understanding for engineering, terms and concepts of non-metallic elements and electrochemistry	Equation shows good understanding and graphs are labeled with sufficient details.	Equations show understanding and graphs are labeled with reasonable details.	Equations are limited or incorrect. Graphs are incomplete or absent.

**Intentional Learning Outcomes**  
**GL1** Wide knowledge on Science and Engineering and practical ability to apply them to solve problems in the society.  
**GL2** Creativity to make a new value with using the knowledge from various fields.  
**GL3** As an engineer, attitude to act with awareness of social roles and responsibility to make a better society.

Teaching Method	
Outline	The class is based on the contents learned in Chemistry 1 through Chemistry 3. Students learn basic concepts and principles of non-metallic elements and electrochemistry. The content and methods are designed to help the students to develop knowledge, problem solving skills and understanding.
Class Format	Lecture, exercise, and mini lab demonstration
Prerequisite	All materials will be covered in the design description. The students are required to keep photo copies or files of all submitted material to ensure further study by themselves.

Course Plan	Semester 2	Contents and Method of Course	Goals	Related MOO
1st - 7th week		Life Science 2 and Earth Science 2		
8th week		Wrap up for midterm examination	To review and summarize the key concepts and topics covered in the first half of the semester.	
9th week		Mid-term examination	Evaluation of students' comprehension	
10th week		Reflection for midterm examination	Review students' results and the midterm exam	
		<b>1. Non-metallic elements</b>		
11th week		1.1. Properties of non-metallic elements: C, O, N, S	1) Describe the properties of carbon, oxygen, nitrogen and sulfur. 2) Explain the importance and use of well-known non-metallic elements.	1-20, 1-22
12th week		1.2. Properties of halogens and inert gases	1) Describe the Group VII halogens, chlorine, bromine and iodine, as diatomic non-metals with general formula X <sub>2</sub> . Explain their properties in terms of atomic structure and periodicity. 2) Describe the colors and the trends in volatility of halogens, bromine and iodine. 3) Describe and explain the displacement reactions of halogens with other halides ions. 4) Predict the properties of other elements in Group VII, given information about the element. 5) Describe the Group VIII noble gases as monatomic, non-toxic gases and explain this in terms of electronic configuration.	1-20, 1-22
13th week		1.3. Industrial processing of ammonia and sulfur	1) Describe the production of ammonia and fertilizers. 2) Describe the use of NH <sub>3</sub> fertilizers to produce the ammonium nitrate. 3) Describe the production of sulfur and sulfuric acid.	1-20, 1-22
		<b>2. Electrochemistry</b>		
14th week		2.1. Oxidation number	1) Calculate oxidation numbers of elements in compounds and ions. 2) Use changes in oxidation numbers to help balance chemical reactions. 3) Explain and use the terms: redox, oxidation, reduction and disproportionation in terms of electron transfer and change in oxidation number. 4) Explain and use the terms: oxidizing agent and reducing agent. 5) Use a Roman numeral to indicate the magnitude of the oxidation number of an element.	
		2.2. Redox reaction	1) Calculate and balance redox equations in the presence of half-reactions. 2) Identify oxidizing agents and reducing agents. 3) Identify redox reactions by the color changes, electrode potentials, solubility, manganese ion, permanganate, Fe <sup>2+</sup> or sodium periodate solution.	1-20, 1-22
15th - 16th week		2.3. Galvani's voltaic cell	1) Sketch a voltaic cell and identify its cathode, anode and the direction in which electrons and ions move.	1-20, 1-22
		2.4. Standard reduction potential	1) Calculate standard emf cell potentials, E <sup>0</sup> cell, from standard reduction potentials. 2) Use reduction potentials to predict whether a redox reaction is spontaneous. 3) Relate E <sup>0</sup> cell to ΔG <sup>0</sup> and equilibrium constants.	1-20, 1-22
16th week		2.5. Electrolysis and Faraday's law	1) Predict the identities of substances formed during electrolysis from the state of electrode, nature of aqueous solution in the electrolytic cell, the concentration of ions and the relationship F = It between the Faraday constant, I, and the charge on the electrons, e. 2) Calculate and predict the products of electrolysis. 3) Describe the reactions in electrolytic cells.	1-20, 1-22
17th - 18th week		2.6. Applications of electrochemistry	1) Identify the components of a galvanic cell. 2) Describe the contribution of a hydrogen battery and explain how it works. 3) Describe the construction of a fuel cell and explain how it generates electrical energy. 4) Explain how corrosion occurs and how it is prevented by cathodic protection.	1-20, 1-22
19th week		Review students' results and the final exam	Evaluation of students' comprehension	
20th week		Return of examination scores and reflection	Review students' results and the final exam	

Topic	Examination	Practical	Workshop	Assess	Other
Electrochemistry	30	0	0	0	0
Life Science	0	0	0	0	0
Earth Science	0	0	0	0	0
Other	0	0	0	0	0
<b>Total</b>	<b>30%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>

Notes: 1) Subjects for evaluation: Science 4 (Chemistry) 20%