Republic of the Philippines
POLYTECHNIC UNIVERSITY OF THE PHILIPPINES
COLLEGE OF SCIENCE

**Course Title** : **Chemistry for Engineers**

**Course Code** : **CHEM 20074**

**Course Credit** : **4 units (3 units lecture, 1 unit laboratory)**

**Pre-Requisite** : **General Chemistry I and II (SHS – STEM) or equivalent Bridge Subject**

**Course Description** : **The course entitled "Chemistry for Engineers" is patterned in such a way that important topics overlapped by the Chemis disciplines are emphasized. Topics include the chemistry of materials, thermodynamics, electrochemistry, nuclear chemis environment. Special topics related to the individual fields of engineering are integrated into the appropriate topics for eas understanding.**

| Institutional Learning Outcomes | Program Outcomes | Course Objec |
|---|---|---|
| 1. Creative and Critical Thinking | | At the end of the course, students<br>• Explain the chemical prin structures and bonding o lattices, polymers, nanom composite materials.<br>• Discuss the application o to the generation of ener thermodynamics, electroc chemistry.<br>• Discuss the chemical pro in the environment, and t in the balance of these sy<br>• Apply special concepts o semiconductors, engines systems, electric conduct and industrial chemicals f engineering. |
| 2. Effective Communication | | |
| 3. Strong Service Orientation | | |
| 4. Community Engagement | | |
| 5. Adeptness in the Responsible Use of Technology | | |
| 6. Passion to Life-Long Learning | | |
| 7. High Level of Leadership and Organizational Skills | | |
| 8. Sense of Personal and Professional Ethics | | |
| 9. Sense of Nationalism and Global Responsiveness | . | |

## COURSE PLAN

### Lecture

| Week | Topic | Learning Outcome/s | Methodology | Resources |
|---|---|---|---|---|
| Week 1 | **Introduction to the course contents, activities, and requirements.** | • Show interest and appreciation of the importance of knowing the course, prior prerequisites, and expectations. | Orientation<br>Review of the syllabus, learning activities and assessment<br>Getting to know activity | Course Syllabus |
| Weeks 2 – 4 | **Molecules and Materials**<br>• Metals<br>• Crystal Lattices<br>• Polymers<br>• Nanomaterials<br>• Composite Materials<br>• Cement and Concrete<br>• Semiconductors | • Describe the bonding and interactions formed between molecules of various materials and identify the effects to its properties.<br>• Construct simple models of metal and crystal bonding. | Class Lecture and Discussion<br>Modeling of Structures<br>Work – Along Exercises | Brown, L. S. and Holme, T. A. *Chemistry for Engineering Students,* 2nd ed., **2011**, Belmont: Brooks / Cole.<br>Chang, R. and Goldsby, K.A. *Chemistry,* 11th ed., **2013,** New York: McGraw – Hill.<br>Brown, T. L., et. al. *Chemistry: The Central Science,* 10th ed., **2011**, Pearson. |
| Weeks 5 – 8 | **Energy and Thermodynamics**<br>• Work and Heat<br>• First Law of Thermodynamics<br>• Enthalpy, Calorimetry<br>• Hess's Law<br>• Heat Engines<br>• Second Law of Thermodynamics<br>• Entropy and Gibbs' Free Energy<br>• Explosives<br>• Cooling Systems | • Discuss the representations of energy in a thermodynamic system.<br>• Apply descriptions and discussions of the Laws of Thermodynamics to different practical representations, like engines and refrigeration.<br>• Calculate values that represent heat flow, disorder and spontaneity of systems. | Class Lecture and Discussion<br>Work – Along Exercises | |
| Week 9 | **MIDTERM EXAMINATION** | • Illustrate mastery of previous topics through a written examination. | None | Reviewer for Weeks 2 – 8 Topics |

| Week | Topic | Learning Outcome/s | Methodology | Resources |
|---|---|---|---|---|
| Weeks 10 – 12 | **Electrochemistry**<br>• Redox Reactions<br>• Cells and Batteries<br>• Electrolysis<br>• Corrosion<br>• Electric Conduction and Resistance | • Identify the parts of a reduction - oxidation reaction, and how this type of reaction is balanced.<br>• Define the cell and its constituents, and relate the electrolysis and corrosion processes to the cell.<br>• Relate standard reduction potentials to the efficiency of an electrochemical cell. | Class Lecture and Discussion<br>Work – Along Exercises | Brown, L. S. and Holme, T. A. *Chemistry for Engineering Students,* 2nd ed., **2011**, Belmont: Brooks / Cole.<br>Chang, R. and Goldsby, K.A. *Chemistry,* 11th ed., **2013,** New York: McGraw – Hill.<br>Brown, T. L., et. al. *Chemistry: The Central Science,* 10th ed., **2011**, Pearson. |
| Weeks 13 – 14 | **Nuclear Chemistry**<br>• Nuclear Reactions<br>• Half – Life<br>• Fission and Fusion<br>• Decay Series | • Differentiate nuclear reactions from other reactions, and describe the types of nuclear reactions.<br>• Discuss the possible decay of a radioactive isotope until a stable isotope emerges.<br>• Identify nuclear fission and nuclear fusion, and describe its applications in the energy sector. | Class Lecture and Discussion<br>Work – Along Exercises | |
| Weeks 15 – 17 | **Chemistry of the Environment**<br>• The Atmosphere<br>• The Hydrosphere<br>• The Lithosphere<br>• Pollution<br>• Industrial Chemicals | • Describe chemical reactions that naturally takes place in the air, in water and in land and discuss the effects of pollution to these natural reactions.<br>• Demonstrate knowledge in the development of antipollution measures and methods. | Class Lecture and Discussion<br>Work – Along Exercises | |
| Week 18 | **FINAL EXAMINATION** | • Illustrate mastery of previous topics through a written examination. | None | Reviewer for Weeks 10 – 17 Topics |

## Laboratory

| Week | Topic | Learning Outcome/s | Methodology | Resources |
|---|---|---|---|---|
| Week 1 | **Chemical Safety** | • Apply laboratory protocols and rules in every laboratory activity.<br>• Practice correct laboratory attire and personal protective equipment.<br>• Identify key parts of a Material Safety Data Sheet and GHS Chemical Label.<br>• Recognize certain measures in case an emergency occurs. | Orientation on Laboratory Safety and Guidelines | Chemistry for Engineers Laboratory Manual |
| Week 2 | **Polymers** | • Discuss properties of various types of polymers.<br>• Test the effects of changing or adding certain variables to the properties of polymers. | Pre – Lab Discussion<br><br>Experimentation | |
| Week 3 | **Cement and Concrete** | • Report the viability of different materials as an aggregate in concrete.<br>• Analyze the effects of changing the ratios of the components in concrete making to the properties of the concrete made. | Pre – Lab Discussion<br><br>Experimentation | |
| Week 4 | **Discussion on Experiments on Molecules and Materials** | • Review the results of the previous experiments.<br>• Report on various observations recorded.<br>• Assess the compliance on laboratory protocols, laboratory attire and equipment, and the experimental processes. | Laboratory Evaluation | |

| Week | Topic | Learning Outcome/s | Methodology | Resources |
|---|---|---|---|---|
| Week 5 | **Calorimetry** | • Determine important values of molar enthalpies of various systems.<br>• Evaluate the efficiency of heat transfer in certain metals via their specific heat. | Pre – Lab Discussion<br>Experimentation | Chemistry for Engineers Laboratory Manual |
| Week 6 | **Heat of Combustion** | • Determine the heats of combustion of several fuels.<br>• Relate chain length of fuels to their heats of combustion. | Pre – Lab Discussion<br>Experimentation | |
| Week 7 | **Discussion on Experiments on Thermodynamics** | • Review the results of the previous experiments.<br>• Report on various observations recorded.<br>• Assess the compliance on laboratory protocols, laboratory attire and equipment, and the experimental processes. | Laboratory Evaluation | |
| Week 8 | **Batteries** | • Construct simple voltaic cells from common electrolytes and various metal electrodes.<br>• Devise a makeshift battery capable of lighting a LED light. | Pre – Lab Discussion<br>Experimentation | |
| Week 9 | **Corrosion** | • Define the corrosion process on several metals.<br>• Describe rusting and develop methods on its prevention. | Pre – Lab Discussion<br>Experimentation | |

| Week | Topic | Learning Outcome/s | Methodology | Resources |
|---|---|---|---|---|
| Week 10 | **Electroplating** | • Discuss the process of electroplating several metals.<br>• Relate the results of the experiment to previous experiments. | Pre – Lab Discussion<br><br>Experimentation | Chemistry for Engineers Laboratory Manual |
| Week 11 | **Discussion on Experiments on Electrochemistry** | • Review the results of the previous experiments.<br>• Report on various observations recorded.<br>• Assess the compliance on laboratory protocols, laboratory attire and equipment, and the experimental processes. | Laboratory Evaluation | |
| Weeks 12 – 16 | **Water Analysis** | • Develop skills in titration and standardization.<br>• Practice correct sampling techniques in the retrieval of water samples.<br>• Assess water quality of a specified area. | Pre – Lab Discussion<br><br>Sampling<br><br>Experimentation | |
| Weeks 17 | **Discussion on Experiments on Water Analysis** | • Review the results of the previous experiments.<br>• Report on various observations recorded.<br>• Assess the compliance on laboratory protocols, laboratory attire and equipment, and the experimental processes. | Laboratory Evaluation | |
| Week 18 | **Laboratory Practical** | • Illustrate mastery of laboratory skills through a practical examination. | None | |

## GRADING SYSTEM

**Lecture Grade**

70% Class Standing

- Recitation
- Assignments
- Seatworks
- Problem Sets
- Special Projects
- Chapter Examinations

30% Midterm / Final Examinations

**Laboratory Grade**

70% Laboratory Results

- Pre – Laboratory Activities
- Laboratory Proper
- Post – Laboratory Activities
- Group Reports
- Data Evaluation

30% Laboratory Practical

**Final Grade**

Final Grade = 0.75 (Lecture Grade) + 0.25 (Laboratory Grade)

Prepared by:

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