Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline

On successful completion of this module, students should be able to:

LO1. Explain chemical equations, balance them, and make calculations based on them relating to stoichiometry and molarity;
LO2. Relate trends in the periodic table (in both elements and their compounds) with the underlying trends in electronic and atomic structure;
LO3. Perform calculations on the rates of reaction and to relate reaction kinetics to the details of the reaction mechanism;
LO4. Perform calculations on chemical equilibria of different nature (acid-base, complexation, gas reactions, solubility, etc.);
LO5. Be able to read and interpret basic phase diagrams of pure substances and binary mixtures;
LO6. Explain the properties of ideal and near-ideal solutions and carry out calculations using colligative properties;
LO7. Perform calculations of electrochemical potentials and relate them to thermodynamic quantities;
LO8. Explain chemical reactivity (thermodynamic and kinetic) in terms of valency, electronegativity and electronic structure;
LO9. Relate some of the macroscopic properties of materials to the nature of the electronic structure and bonding at the molecular/atomic level;
LO10. Carry out basic experimental procedures on aspects of chemical reactions and to appreciate the need for safety and safety procedures in the laboratory.

Graduate Attributes: levels of attainment
To act responsibly - Introduced
To think independently - Introduced
To develop continuously - Introduced
To communicate effectively - Introduced

1 TEP Glossary
Module Content

**Introduction and General Chemistry**
- Chemical change; elements, compounds and mixtures; atomic theory; stoichiometry and chemical equations; atomic structure; electronic structure and the periodic table; bonding; elementary structural chemistry; metals, semiconductors and insulators.

**Physical Chemistry I**
- Thermodynamics: First law, internal energy, enthalpy; introduction to entropy, 2nd and 3rd Laws; criterion for chemical change; equilibrium constant for a chemical reaction, Gibbs free energy.

**Physical Chemistry II**
- States of matter: Gibbs phase rule, ideal solutions, colligative properties
- Chemical Equilibrium: Law of mass action; factors that influence the position of equilibrium. Ionic equilibria: ionic equilibria in aqueous solutions; strong and weak acids and bases; buffer solutions and indicators;
- Electrochemistry; molar conductivity and electrolyte solutions; electrode potentials; cells; electrolysis; emf and chemical equilibrium; and introduction to analytical chemistry;
- Chemical Kinetics: rates of reactions; order and molecularity; activation energy; kinetics and mechanisms; catalysis.

Teaching and Learning Methods

This module is taught using a combination of lectures, tutorials and laboratory-based experiments.
### Assessment Details

Please include the following:

- Assessment Component
- Assessment description
- Learning Outcome(s) addressed
- % of total
- Assessment due date

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Assessment Description</th>
<th>LO Addressed</th>
<th>% of total</th>
<th>Week due</th>
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<tbody>
<tr>
<td>End of semester examination</td>
<td>Written/Multiple Choice Examination</td>
<td>1-9 above</td>
<td>80</td>
<td>20</td>
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<tr>
<td>Laboratory sessions</td>
<td>Students attend 2 laboratory practicals (1 experiment online, 1 experiment on site in laboratory setting, 3 hours per experiment). Lab reports are assessed.</td>
<td>1-10 above</td>
<td>20</td>
<td>Reports due 1 week after each experiment undertaken</td>
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### Reassessment Requirements

### Contact Hours and Indicative Student Workload

<table>
<thead>
<tr>
<th>Contact hours: 48 hours</th>
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<tbody>
<tr>
<td>Independent Study (preparation for course and review of materials): 40 hours (approximately 30 hours reviewing lecture material and references to textbook, 10 hours answering tutorial questions)</td>
</tr>
<tr>
<td>Independent Study (preparation for assessment, incl. completion of assessment): 26 hours (6 hours preparing for labs and completing lab reports, 20 hours preparation for final exam)</td>
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### Recommended Reading List

Main text for the course:

Required textbook The recommended text for this module is:


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2 TEP Guidelines on Workload and Assessment

There is also a more detailed and advanced text by Atkins and Jones: Chemical Principles – the Quest for Insight, Freeman, 2nd edition. This will also cover the material presented in lectures, and may suit students who already have a strong background in Chemistry.

Some students who have not done Chemistry at school find that they benefit from access to a text that starts at a more elementary level. Two such texts that JF Engineering students have found valuable in recent years are: Chemistry, R Lewis and W Evans, MacMillan Foundations Fundamentals of Chemistry, DE Goldberg, McGraw-Hill Further information

<table>
<thead>
<tr>
<th>Module Pre-requisite</th>
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<tbody>
<tr>
<td>Module Co-requisite</td>
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<tr>
<td>Module Website</td>
<td><a href="http://www.tcd.ie/Engineering/Courses/BAI/JF_Subjects/1E5/">http://www.tcd.ie/Engineering/Courses/BAI/JF_Subjects/1E5/</a></td>
</tr>
<tr>
<td>Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.</td>
<td>School of Chemistry</td>
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<tr>
<td>Module Approval Date</td>
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<tr>
<td>Approved by</td>
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</tr>
<tr>
<td>Academic Start Year</td>
<td>September 27th 2021</td>
</tr>
<tr>
<td>Academic Year of Date</td>
<td>2021/2022</td>
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