1E5 CHEMISTRY [5 credits]

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Module organisation
The module runs for the first semester (12 weeks) of the academic year and comprises of three lectures and a one-hour tutorial each week together with an associated laboratory programme of four three-hour laboratories (total contact time of 48 hours per student).

Module description, aims and contribution to programme
The general level of the module is higher than the Leaving Certificate course, though the coverage of the syllabus is less detailed and not so comprehensive. Every effort is made to present the module in a format suitable to students who have not completed a chemistry course at school, as well as to those who have attained good marks in the Leaving Certificate examination.

Learning outcomes
Upon completion of this module, students will be able to:
1. Explain chemical equations, balance them, and make calculations based on them relating to stoichiometry and molarity;
2. Relate trends in the periodic table (in both elements and their compounds) with the underlying trends in electronic and atomic structure;
3. Perform calculations on the rates of reaction and to relate reaction kinetics to the details of the reaction mechanism;
4. Perform calculations on chemical equilibria of different nature (acid-base, complexation, gas reactions, solubility, etc.);
5. Be able to read and interpret basic phase diagrams of pure substances and binary mixtures;
6. Explain the properties of ideal and near-ideal solutions and carry out calculations using colligative properties;
7. Perform calculations of electrochemical potentials and relate them to thermodynamic quantities;
8. Explain chemical reactivity (thermodynamic and kinetic) in terms of valency, electronegativity and electronic structure;
9. Relate some of the macroscopic properties of materials to the nature of the electronic structure and bonding at the molecular/atomic level;
10. Carry out basic experimental procedures on aspects of chemical reactions and to appreciate the need for safety and safety procedures in the laboratory.
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 strategies

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

Associated laboratory/project programme

Experiment 1: Acids and Bases
Experiment 2: Spectrophotometry
Experiment 3: Thermochemistry
Experiment 4: Crystal Structures

Assessment

Assessment is by means of a formal written two-hour examination which contributes 80% towards overall end-of-year grade. The other 20% is comprised of practical work.
**Required textbook**

The recommended text for this module is:


The material is also covered in:


*Chemistry for Engineering Students*, Brown and Holme, 1st edition, Thompson

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


**Further information**

[http://www.tcd.ie/Engineering/Courses/BAI/JF_Subjects/1E5/](http://www.tcd.ie/Engineering/Courses/BAI/JF_Subjects/1E5/)