Chemistry Modules for Visiting Students 2026/27

Chemistry affects every aspect of human lives, from clothing to the medicines that help millions of people. It plays an integral part in solving global challenges, such as food security, plastic pollution, developing alternative energies, and synthesising new medicines and materials.

The Chemistry modules in the Kingston degree course provide knowledge and skills relevant to industry, research and teaching. Students will gain practical skills in state-of-the-art laboratories, broaden their knowledge of environmental chemistry, and develop the academic and professional skills valued by employers.

Level 4 modules are introductory in nature and consider the fundamental aspects of the subject. They are designed to consolidate existing knowledge and provide a base upon which advanced chemistry concepts can be developed.

Level 5 modules provide a more in-depth look at inorganic, organic and physical chemistry and require prior study of chemistry. There are also modules covering experimental and analytical chemistry which will expand skills for interpreting the results of modern spectroscopic investigations.

Level 6 modules are more advanced and provide a more-specialised study of inorganic, physical and organic chemistry.

Please note that if you wish to take more than one CH* module from the Chemistry modules listed below, then it must be from the same level to ensure that there are no timetable clashes.

Updated April 2026/PJW

Entry requirements: GPA of 2.75 or above (out of 4.0) or equivalent

Pre-requisites:

- **Level 4:** prior study of introductory (freshman) level chemistry is required.
- **Level 5:** some study of chemistry at intermediate university-level is required.
- **Level 6:** substantial prior study of chemistry at intermediate level is required.
- **Level 5/6:** any specific pre-requisites for a module will be detailed in each module description.

Taught at: Penrhyn Road campus

KEY TO MODULE DESCRIPTORS

SUITABILITY OF MODULE FOR STUDENTS VISITING KU ON STUDY OPTION:

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

Please note that if you wish to take more than one CH* module from the Chemistry modules listed here, then it must be from the same level to ensure that there are no timetable clashes

Chemistry Modules for Visiting Students 2026/27

1: Indicates module is suitable for students visiting KU on Study Option 1 (Whole Year)

2: Indicates module is suitable for students visiting KU on Study Option 2 (Autumn)

3: Indicates module is suitable for students visiting KU on Study Option 3 (Spring)

Notes:

1. All modules are at undergraduate level.
2. Students enrolled on Study Option 1 are required to study the entire module.
3. whilst the University makes every effort to ensure that this information is correct at the time of updating (April 2026), it cannot accept responsibility for omissions or subsequent changes. Module availability and content may be subject to change, as part of the University's policy of continuous improvement and development.
4. Details of assessment for students enrolled on either Study Option 2 or 3 where provided are **indicative only** and may also be subject to change as part of the above policy.

Modules:

MODULE CODE	LEVEL	MODULE TITLE	SUITABILITY KEY
CH4004	4	Academic Skills for Molecular Sciences	1
CH4010	4	Chemical Foundations: from Atoms to Pharmaceuticals	1, 2, 3
CH4011	4	Chemical Frontiers: Quantum, Inorganic and Environmental Chemistry	1, 2, 3
CH4012	4	Essential Techniques in Chemical Synthesis and Analysis	1, 2
CH5002	5	Organic and Medicinal Chemistry	1, 2
CH5004	5	Future Trends in Synthetic and Analytical Chemistry	1, 2
CH5012	5	Aspects of Physical Chemistry	1, 2, 3
CH5013	5	Inorganic Chemistry: Trends, Coordination and Structures	1, 2, 3
CH6007	6	Advanced Analytical Science	1, 2
CH6015	6	Natural Product Chemistry and Sustainable Synthesis	1
CH6016	6	Advanced Materials and Industrial Chemistry	1, 2
CH6023	6	Physical Chemistry 2	1, 2
CH6033	6	Inorganic Chemistry 2	1, 3

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

Please note that if you wish to take more than one CH* module from the Chemistry modules listed here, then it must be from the same level to ensure that there are no timetable clashes

Chemistry Modules for Visiting Students 2026/27

Module Code: CH4004

Module Title: Academic Skills for Molecular Sciences

Credits:

- Full Year: 8 (US) 15 (ECTS)

Level: 4

Prerequisites: study of basic chemistry useful

Suitability:

- Study Abroad/International Exchange students for Study Option **1** only
- Not normally open to Erasmus students, due to its introductory level {4} (unless home institution agrees)

Content:

This is a core module at Kingston for all chemistry and pharmaceutical science degree programmes. The module aims to give students a thorough grounding in mathematics, statistics, key and transferable skills (e.g. exam strategy, effective use of calculators, library and referencing, avoiding plagiarism, problem solving and personal development planning etc) and IT skills.

This module will introduce students to Future Skills through engagement with *Navigate.* The module is further supported by themed tutor meetings enabling students to work on tasks to develop their graduate attributes.

➢ **Overall topics:**

- ***Study skills*** – effective note taking, information retrieval, referencing, avoiding plagiarism and other forms of academic misconduct, correct styles of English for scientific writing and reporting, and on exam and revision technique. This "learning how to learn" theme runs throughout the module and involves students reflecting on their personal learning styles and builds in opportunities for personal development in learning technique and effectiveness.

- ***Maths*** – numeracy, algebra, logarithms and exponentials, introduction to calculus. Statistical analysis of variables, probabilities and their application in biochemical and pharmaceutical sciences, including the correct use and setting up of graphs, tables. Units and dimensional analysis. Mole Concept booklet reinforces learning in amount of substance, molar mass, Avogadro's constant, the mole, calculation of concentrations, titrations and calculation of chemical yields.

- ***Stats*** – asking questions and developing testable hypotheses, experimental design, randomisation, natural variation, sampling and use of appropriate statistical tests: types of data, normal distribution and confidence limits, descriptive statistics, t-tests, correlation.

- ***IT*** – production of scientific documents and presentations using Microsoft Office and specialist scientific

software. Students will learn about information retrieval and how to assess the "quality" of online literature sources.

- ***Personal, Career and Professional development of graduate attribute***s – production of CVs, cover letters and reflective logs. Students will be enjoined to seek out aspirational role models in both the literature (diversifying the curriculum intervention) and in fields of relevant employment (LinkedIn intervention).

- ***Critical Thinking*** - Students will be taught how to become thoughtful, objective and reasoned thinkers through extensive use of the Critical Thinking Skills Toolkit. This Toolkit has been commended by employers in helping develop and enhance students' critical thinking skills.

- ***Presentation Skills*** – students will be taught how to communicate effectively in writing and orally demonstrating use of the desired graduate attributes with respect to communication skills in their disciplinary context.

- ***Group work and Collaborative Learning*** – students will undertake group work in which they will be assigned a problem to solve that they apply design thinking principles amongst a peer group and learn the skills of effective team-building using appropriate Codes of Conduct and forward planning.

Teaching: lectures, workshops and computing sessions

Assessment:

➢ Study Option **1**:

- In-class Test Portfolio - 2 x 10% MCQ tests of 40 mins duration each; 5 x 5% critical thinking tasks (35%)
- Study skills: note taking and Excel exercise - 1,500 words (25%)
- Group work assignment (2,500 words) involving compilation of a group report (40%)

Note: methods of assessment and weighting are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Module Code: CH4010

Module Title: Chemical Foundations: from Atoms to Pharmaceuticals

Chemistry Modules for Visiting Students 2026/27

Credits:

- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 4

Prerequisites: study of basic chemistry useful

Suitability:

- Study Options 1, 2, 3
- Not open to Erasmus students, as level 4 (unless home institution agrees)

Content:

This module is designed to refresh any previous study of key chemistry concepts such as atomic and molecular structure within various bonding models, expanding on the origin of molecular shape and introducing solid state chemistry. It also introduces the nomenclature and chemistry of organic functional groups, and the principles of functional group interconversions and synthesis. Finally, it introduces the laws of kinetics and thermodynamics and apply them to simple chemical and pharmaceutical systems.

➢ **Autumn Semester topics:**

❖ ***Atomic structure and fundamentals of inorganic chemistry***

- The structure of the atom in terms of protons, neutrons and electrons - quantum numbers and rules; Bohr's model
- Definitions of orbitals, pictorial representation of "s" and "p" orbitals, the hybrid orbitals of carbon and their role in the formation of single, double and triple bonds
- Electronic configurations for multi electron atoms - Pauli, Hund and aufbau principle; ionic and covalent bonding
- Lewis representations of molecules and how to construct them
- Valence shell electron pair repulsion theory
- Hydrogen bonding and van der Waal's interactions.

❖ ***Structure and Bonding in Organic Molecules***

This section of the module deals first with the electronic configuration of isolated atoms and the hybridisation of carbon (and other elements) when it becomes involved in covalent bonding; it then considers aspects of stereoisomerism - conformational, geometric and optical - observed in organic compounds**.**

❖ ***Chemistry of the Hydrocarbons***

This part of the module starts by explaining how mechanisms in organic chemistry may be described using so-called "curly arrows" to indicate the motion of electrons, either singly or in pairs; it then goes on to review the chemistry of the hydrocarbons (alkanes, alkenes, alkadienes, alkynes and aromatic compounds), describing their preparation and properties, with emphasis on reaction mechanisms when accounting for their chemical

properties and reactions.

- **Spring Semester topics:**
- ***Chemistry of Monofunctional Compounds***

This part of the module provides an overview of the preparation and properties of organic compounds containing one functional group (haloalkanes, alcohols, ethers, carbonyl compounds, carboxylic acids and their derivatives and finally, the amines); when discussing the chemical reactions of these compounds, particular emphasis is put on the reaction mechanisms that are involved, enabling students to rationalise and predict the outcomes of organic reactions rather than just memorising them.

- ***Introduction to kinetics and thermodynamics***

In this section, the three simplest rate orders are summarised before discussing energetics and then the four Laws of Thermodynamics (First, Second, Third and Zeroth). Thermodynamics covers: enthalpy of reactions, thermochemistry, thermodynamics, entropy, direction of change, spontaneous reactions, Gibbs free energy and equilibrium.

Teaching: weekly lectures, workshops and practical lab sessions

Assessment:

- Study Option **1**:

- 2-hour exam – April/May (40%)
- Portfolio of six small practical tests (30%)
- Assignment: MCQ quiz (physical chemistry) and long-answer questions (organic chemistry) (30%)

- Study Option **2**:

- Assignment: MCQ quiz and long-answer questions
- Portfolio of six small practical tests

- Study Option **3**:

- TBC

Note: methods of assessment and weighting are indicative only and may be subject to change

Last updated: 21/04/26

Return to top

Module Code: CH4011

Chemistry Modules for Visiting Students 2026/27

Module Title: Chemical Frontiers: Quantum, Inorganic and Environmental Chemistry

Credits:

- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 4

Prerequisites: study of basic chemistry useful

Suitability:

- Study Options 1 and 2 and 3
- Not normally open to Erasmus students, due to its introductory level {4} (unless home institution agrees)

Content:

This module delves into the fascinating world of molecular quantum mechanics. Students will explore key trends in the periodic table, focusing on select elements from groups 1, 13, and 17. Students will discover the captivating realm of coordination compounds and their unique properties. It also covers the critical topics of atmospheric and aquatic pollution, understanding their environmental impacts. Finally it connects student learning to the United Nations Sustainable Development Goals, gaining a global perspective on sustainability.

Topics:

➢ **Autumn Semester: Environmental Chemistry**

❖ ***Atmospheric Environmental Chemistry***

This topic will start off with an introduction to the structure and chemical composition of the atmosphere, including the principal atmospheric pollutants and their sources. The module will then explore major atmospheric environmental problems such as acid rain, photochemical smog, enhanced greenhouse effect, stratospheric ozone destruction and global warming.

❖ ***Environmental Chemistry of the Hydrosphere and Lithosphere***

This topic starts with an introduction to the natural environment and its subdivision into the atmosphere, hydrosphere, lithosphere and biosphere. The chemistry and physical characteristics of water bodies in relation to the environment and the composition of soil and the its role in environmental chemistry will be discussed. The second part of the topic will focus on the range of pollutants found in the lithosphere and biosphere, looking at both organic and inorganic examples of these.

➢ **Spring Semester: *Aspects of Inorganic Chemistry*; *Quantum Mechanics***

❖ ***Aspects of Inorganic Chemistry***

In this section, trends in the periodic table are illustrated by coverage of the chemistry of Group 1, 13 (triels) 17

(halogens) and 18 (noble gas) elements. Oxidation states and basic redox chemistry are revised. An introduction to coordination chemistry is provided. Types of ligands, the nomenclature and isomerism of inorganic complexes is covered.

❖ ***Quantum Mechanics***

In this part, the fundamentals of quantum mechanics are introduced and applied to simple chemical situations such as bonding and spectroscopy. Following this, the historical context of quantum mechanics, which highlights the failure of classical theory to explain a number of important phenomena (such as atomic spectroscopy, the photoelectric effect and black body radiation) will be discussed. The idea of matter waves as described by De Broglie, is then introduced and applied to particles. Finally, the module considers how the confinement of a particle leads to the quantization of energy and develop this idea to explore the structure of atoms and molecules, bonding and spectroscopy.

Teaching: lectures, workshops/seminars, tutorials and practicals

Assessment:

➢ Study Option **1**:

- End of year exam (40%)
- Online practical MCQ test (40%)
- 2 x coursework assignments (20%)

➢ Study Option **2**:

- Online practical MCQ test (80%)
- Written coursework (20%)

➢ Study Option **3**:

- Exam (33%)
- Practical MCQ test (33%)
- Written coursework (33%)

Note: methods of assessment and weighting are indicative only and may be subject to change

Last updated: 21/04/26

Return to top

Module Code: CH4012

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

Please note that if you wish to take more than one CH* module from the Chemistry modules listed here, then it must be from the same level to ensure that there are no timetable clashes

Kingston University London

Chemistry Modules for Visiting Students 2026/27

Module Title: Essential Techniques in Chemical Synthesis and Analysis

- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 5

Prerequisites: introductory university-level study of chemistry

Suitability: Study Options 1 and 2

Content:

This module comprises two main strands. The first of these begins with basic concepts and skills necessary to underpin the rest of the theory. Thereafter is mainly concerned with separation methods.

These include classical distillation and recrystallisation, various chromatographic techniques, and small-scale analytical chromatographic techniques such as gas chromatography and high-performance liquid chromatography. This part of the course culminates with 'hyphenated' techniques such as gas chromatography-mass spectrometry and high-performance liquid-gas chromatography.

The second strand deals with spectroscopic analysis of unknown materials. After an introduction concerning the nature of electromagnetic radiation, the techniques of infrared spectroscopy, proton and carbon-13 nuclear magnetic spectroscopies, and mass spectrometry are introduced. The strand culminates with a set of 'combined structure problems' which simulate a professional situation where unknown organic compounds are identified solely from their spectroscopic data. Practicals and theory will serve to exemplify some of the United Nations Sustainable Development Goals (UN SDGs) in particular GOAL 12: Responsible Consumption and Production.

➢ **Topics:**

- Basic laboratory techniques and manipulations and understanding thereof.
- Purification techniques.
- Laboratory manipulations and chromatography.
- Simple theory of the origins of spectroscopic phenomena and their 'selection rules': the UV phenomenon in terms of promotion of pi- electrons, the IR phenomenon in terms of bond oscillations, and the NMR phenomenon in terms of alignment of nuclear magnetic fields.
- The principles of mass spectrometry.

- Identification of simple compounds using spectroscopic information.
- Laboratory report writing.

Teaching: weekly 2-hour lectures/workshops and weekly 1-2 hour practical sessions

Assessment:

- Study Option **1**:

- 3 practical assignments:
  - Oxalate Analysis,
  - Phenacetin Synthesis Writeup,
  - Techniques and Apparatus MCQ 20 questions (90 mins) (10% each)
- Portfolio of laboratory samples (typically 7, in class) and a set of Q&A sheets (typically 8) (30%)
- 2-hour end of year exam (40%)

- Study Option **2**:

- A version of Study Option 1 assessment

Note: methods of assessment and weighting are indicative only and may be subject to change

Last updated: 21/04/26 21/04/26

Return to top

Module Code: CH5002

Module Title: Organic and Medicinal Chemistry

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 5

Prerequisites: introductory study of university level chemistry

Suitability: Study Options 1 & 2

Content:
This module builds upon and develops further, topics introduced in introductory (level 4) modules CH4005 and CH4001, for example, stereochemistry, carbonyl and aromatic chemistry. In addition, new topics are introduced such as medicinal chemistry and heterocyclic reactions in which students combine the concepts of carbonyl and aromatic reactions

- **Topics (whole year):**

  - Overview of carbonyl chemistry: tautomerism; formation and stability of enolates; aldol, Claisen and related reactions; alpha alkylations.
  - Difunctional aliphatic compounds: ethyl acetoacetate and diethyl malonate and their uses in the synthesis of ketones and acids.
  - Enamines and other enolate equivalents in synthesis.
  - Unsaturated carbonyl compounds: conjugate and Michael additions
  - Electrophilic substitution of benzene; second and third substitutions of benzene derivatives; activating and directing effects of substituents.
  - Diazonium salts and their synthetic applications.
  - Nucleophilic aromatic substitution; formation and reactivity of benzynes.
  - Polycyclic aromatic compounds: naphthalene, anthracene and phenanthrene.
  - Heteroaromatic compounds: structure, aromaticity, synthesis and reactivity of pyridine, pyrrole, furan and thiophene, pyridine derivatives, indole, quinoline; the synthesis and properties of selected azoles, diazines and purines.
  - Stereochemistry: enantiomers, diastereomers and atropoisomers; Fischer projections; resolution of asymmetric compounds; asymmetric synthesis.
  - Selectivity in synthesis: chemo selective reagents, protecting groups and application in the synthesis of pharmaceutical agents.
  - Introduction to retrosynthetic analysis.
  - Conformational analysis, stability and reactivity of simple cycloalkanes.
  - Introduction to biochemical compounds: carbohydrates, fatty acids, nucleic acids and proteins.
  - An introduction of drug action in terms of receptor theory; drug receptor binding interactions: Chirality, 3D and the drug effect; agonist and antagonist.
  - Bonding in medicinal systems; SAR and drug design
  - Mode of action of a range of antibiotics: beta lactams, sulfonamides, clavulanic acid and strategies to treat penicillin resistant bacteria.
  - The nervous system. Neurotransmitter mimics and their pharmaceutical use.
  - Alkaloids-examples of drugs

- **Autumn Semester:**

- ***Carbonyl Chemistry***

  - Electrophilic & nucleophilic reactions of carbonyl compounds
  - Chirality
  - Amino acids and peptides
  - Enamines and their nucleophilic reactions, Kinetic and thermodynamic control of reactions
  - Combinations of reactions: Selective reductions, Robinson Annelation
  - Retrosynthesis

Kingston University London

Chemistry Modules for Visiting Students 2026/27

❖ ***Medicinal Chemistry***

- Introduction to Proteins and Enzymes
- Drug receptor theory and binding interactions
- Carbohydrates and Fatty acids
- Nucleic Acids & the nervous system
- Medicinal Chemistry of Antibiotics
- Structure-Activity Relationships & drug discovery
- In Vitro Profiling and Drug Discovery
- Alkaloids

❖ ***Aromatic Chemistry***

- Aromaticity
- Electrophilic aromatic substitution reactions
- Alkyl benzenes & diazonium salts
- Aromatic nucleophilic substitution
- Friedel-Crafts reactions
- Aromatic heterocyclic chemistry
- Aromatic Heterocycles 2: Pyridine chemistry
- Aromatic heterocycles 3: Furan & Pyrrole

➢ ***Spring Semester: Heterocyclic Chemistry***

- Polycyclic Aromatic Compounds
- 5-Membered Ring Heterocycles
- 6-Membered Ring Heterocycles, Pyridines
- Heterocycles with 2 Heteroatoms in the Ring
- Carbohydrates

Teaching: weekly 2-3 lectures, 1-hour workshops (and two 3-hour practicals in autumn semester)

Assessment:

➢ Study Option **1**:

- 2-hour exam (50%)
- Group Poster Project (30%)
- 2 lab experiments; each at 5% (10%)
- computational practical assignment(10%)

➢ Study Option **2:**

- 90-minute test (6 out of 9 questions) (100%)

Note: methods of assessment and weighting are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

Please note that if you wish to take more than one CH* module from the Chemistry modules listed here, then it must be from the same level to ensure that there are no timetable clashes

Chemistry Modules for Visiting Students 2026/27

Module Code: CH5004

Module Title: Future Trends in Synthetic and Analytical Chemistry

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 5

Prerequisites: introductory study of university level chemistry

Suitability: Study Options 1 or 2

Content:

This module takes forward the themes of analysis and practical procedures (with an emphasis on analytical and experimental organic chemistry) that were introduced at level 4. It incorporates both a more rigorous approach to laboratory work, coupled with developing the research skills required to devise experiments and then objectively assess results, followed by preparing high-quality reports and presentations.

The analytical methodologies and experimental techniques are those used routinely in academia, industry, and other laboratory research – spectroscopy; organic syntheses; molecular modelling; inorganic and physical chemistries; and the uses of applied separation technologies in common use. This module aligns with the United Nations Sustainable Development Goals (UN SDGs), particularly those related Responsible Consumption and Production (SDG 12) and also Industry, Innovation and Infrastructure (SDG 9).

The Future Skills Explore learning outcomes are delivered in this module.

➢ **Overall Topics:**
- Overview of analytical methodology, process models, and sample preparation.
- Chromatography: partition coefficients, retention time, capacity factor, selectivity factor, column efficiency and resolution.
- Analytical and process validation – accuracy, precision (immediate & intermediate), linearity, specificity (peak resolution, impurities), ruggedness, limits of detection & quantitation, internal standards.
- High performance liquid chromatography: pumps, columns, mobile phase selection, solvent gradient / isocratic, detectors.
- Gas-liquid chromatography: sample injection, ovens (temperature ranges & rates of increase), detectors, stationary phases (columns), and carrier gases.
- Partition chromatography, normal and reverse phase. Ion-pair chromatography. Chiral stationary phases.
- Introduction to hyphenated techniques (GC-MS, HPLC-MS, tandem MS-MS).
- Principles and practice of electrophoresis (including gel, electric focusing, immuno, and capillary).
- Introduction to electromagnetic radiation and its interaction with matter, including absorption, emission and fluorescence.
- Principles and practice of atomic spectroscopy: atomic absorption/emission spectra.
- Molecular spectroscopies, including spectral interpretation: nuclear magnetic resonance (proton &

carbon), infra-red (mid-range & near), and ultra violet light.
- Fundamentals of mass spectrometry (EI, CI, FAB, tandem).
- Synthesis, preparation, and characterisation of the structure of a range of compounds using a broad range of techniques.
- Preparing and planning experimental procedures.
- The relevance of statistics, quality control and quality assurance systems in analytical science.
- Develop problem solving skills to relate laboratory work to the theoretical topics.
- Application of computers to information retrieval and literature searches, using both the internet and non-web-based databases.
- Reporting experimental work in an academic/professional style, using both websites and more traditional printed literature sources such as books, journals, professional society magazines, conference summaries, and/or official reports.

Teaching: weekly 2-hour lectures and 3-hour practical sessions

Assessment:

➢ Study Option **1**:

- Explore Experience: reflection on academic and practical graduate attributes (Max word count 500) (40%)
- Problem solving and chemical analysis assignment with MCQs and 500 words (20%)
- In-Lab assessments (samples submissions, spectra, calculations. (8X5%) equivalent 1500-word count max (40%)

➢ Study Option **2**:

- Part of Study Option 1 assessment (100%)

Note: methods of assessment and weighting are indicative only and may be subject to change.

Last updated: 21/04/26 PJW

Return to top

Module Code: CH5012

Module Title: Aspects of Physical Chemistry

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 5

Prerequisites: introductory study of university level chemistry

Suitability: Study Options 1 or 2 or 3

Content:

This module comprises four main strands, namely electrochemistry, phase equilibria, kinetics and spectroscopy. The module investigates the electrochemistry of ionic solutions including both strong and weak electrolytes; cell electrochemistry and the associated applications to chemical thermodynamics; how to interpret phase diagrams; colligative properties; transition state theory of chemical reactions; complex reaction mechanisms and their kinetic analysis; an introduction to statistical thermodynamics and partition functions, and the quantum mechanics and theory underlying both rotational (microwave) and vibrational (Infra-red and Raman) spectroscopies, including rigid rotor and centrifugal distortion models and both simple harmonic and anharmonic vibration models and their interactions.

Note that topics may occasionally change semesters.

- **Autumn Semester: *Phase Equilibria and Colligative Properties*; *Electrolytes and Electrolyte Solutions***

- ***Phase Equilibria and Colligative Properties***

  - The behaviour of one- component systems and their response to varying pressure or temperature. Applications of the Clapeyron and Clausius-Clapeyron equations.
  - The behaviour of ideal and non-ideal two-component systems. Colligative properties and viscosity.

- ***Electrolytes and Electrolyte Solutions***

  - The behaviour of electrolyte solutions. Conductance measurements and their applications. Weak and strong electrolytes. Kohlrausch and Onsager equations. Non-ideality and the Debye-Hückel limiting law. Acids, bases and salts.
  - Cell electrochemistry. Thermodynamics and the Nernst equation. Applications of cell emf measurements.

- **Spring Semester: *Spectroscopy; Kinetics***

- ***Spectroscopy***
  - Introduction to statistical thermodynamics and partition function.
  - Quantum mechanics and solution of the Schroedinger equation for rotating systems. Rotational analysis of the rigid rotor and centrifugally-distorted rotor. Microwave rotational spectroscopy and associated selection rules.
  - Quantum mechanics and solution of the Schroedinger equation for vibrating systems. Vibrational analysis of both simple harmonic oscillator and anharmonic oscillator models. Infra-red vibrational spectroscopy and associated selection rules.
  - Vibrational-rotational interactions. Analysis of rotational behaviour from high-resolution infra-red spectroscopy.
  - The Raman effect. Rotational and vibrational Raman spectroscopies. Mutual exclusion principle. Identification of symmetry types. Advanced Raman techniques.

- ***Kinetics***
  - Transition state theory.
  - Complex mechanisms: steady-state approximation, chain reactions, enzyme reactions, isotope effects.

Chemistry Modules for Visiting Students 2026/27

Teaching: weekly 2-hour lectures, 1-hour workshops (and several 3-hour lab sessions but not every week)

Assessment

➢ Study Option **1**:

- 2-hour exam (40%)
- Assignment 1800 words (30%)
- Automated online assessments of laboratory data and samples – typically 12 x 2.5 %. (equiv. 250 words each) (30%)

➢ Study Options **2/3**:

- Part of Study Option 1 assessment (100%)

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Module Code: CH5013

Module Title: Inorganic Chemistry: Trends, Coordination and Structures

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 5

Prerequisites:
- introductory university-level inorganic chemistry such as CH4011 or equivalent.
- In addition, for study option 3, prior study of co-ordination and redox chemistry.

Suitability: Study Options 1 or 2 or 3

Content:

The module builds upon the theory and principles developed at introductory level and applies these to second and third row transition metals, the lanthanides and Groups 14 and 15. It introduces solid state chemistry with a consideration of defects and conductivity. The module also introduces bonding and reactivity of inorganic complexes and organometallics. The fundamental knowledge on Main Group and Transition Metal chemistry acquired in this module allows students to understand concepts of modern industrial processes and material design.

This module will meet some of the United Nations Sustainable Development Goals (UN SDGs), for instance Responsible Consumption and Production (SDG 12) and also Industry, Innovation and Infrastructure (SDG

9).

- **Topics:**
- **Autumn Semester:** ***Redox Chemistry and Co-ordination Chemistry***

❖ ***Redox Chemistry***

- Reduction half-equations, standard potentials, redox couples, Latimer diagrams
- Construction and interpretation of Oxidation State diagrams (Frost diagrams), disproportionation and comproportionation
- Extraction of elements by reduction, thermodynamics, use of Ellingham diagrams
- Electronic structure of 3d elements, relative energies of 3d and 4s, ground state configurations of 3d atoms and ions.
- Transition metal trends
- The pnictogens
- Revision of close packed solids
- 2D projections of unit cells and Miller indices
- The Bragg equation and X-ray diffraction

❖ ***Coordination Chemistry***

- Revision – geometry of coordination compounds, Isomerism, Stereoisomerism (geometric and optical), and structural isomerism.
- Crystal Field Theory
- Electronic spectra: types of transitions
- Magnetism, colour, Jahn Teller distortion, square planar complexes
- Ligand Field Splitting and Ligand Field Stabilisation Energy, High-spin vs. low spin complexes
- Stability constants of complexes and chelate effect
- Preparation of complexes (labile and inert complexes)
- Uses of complexes: analytical chemistry, biological chemistry and industrial catalysis

- **Spring Semester:** ***Organometallic Chemistry, the Chemistry of f-block Elements & the Composition of Solids and the elements themselves***

❖ ***Organometallic Chemistry***

- Introduction to metal carbonyls, preparation and simple properties. The 18 electron rule
- Revision of bonding in heteronuclear diatomic molecules. Bonding in metal carbonyls and its consequences e.g. infrared spectra and bond lengths
- Reactions of metal carbonyls. Carbonyl derivatives e.g. halides and hydrides
- Organometallic compounds of transition elements 1: ionic, sigma and pi-bonded compounds; alkene complexes and electron counting
- Organometallic compounds of transition elements 2: protonation, oxidative addition, insertion
- Organometallic compounds of transition elements 3: homogeneous catalysis e.g. hydrogenation and hydroformylation.
- Structure of some important chelate complexes: crown ethers and cryptates, alkali metal anions and bioinorganic aspects of chelate complexes
- Introduction to reaction mechanisms of co-ordination compounds: substitution reactions of octahedral and square planar complexes. The trans- effect

❖ ***Solid State Chemistry***

- Electronic structure of solids: Band theory, band structure of conductors, insulators and intrinsic & extrinsic semi-conductors.
- Defects in solids: Thermodynamic tendency for defects, Schottky and Frenkel Defects, extrinsic point defects.
- Main Group Chemistry
- Oxidation state chemistry of 4d and 5d elements: Stability of higher and +2 oxidation states, reducing ability of metals. Oxidation state diagrams.
- Aspects of inorganic and co-ordination chemistry of 4d and 5d metals. atomic radii, metal–ligand bonding compared to 3d metals, magnetic properties and stereochemistry
- Aspects of inorganic and co-ordination chemistry of group 6 (Cr, Mo, W): properties of halides, metal-metal bonding, oxidation states.
- Group 14 chemistry: structure, bonding and properties of allotropes, diamond, graphite, silicon and germanium semi-metals and tin and lead metals.
- Group 14 chemistry: oxides and halides, structure, multiple bonding, reactivity of M-X, stability of +2 vs +4 oxidation state.
- Group 14 chemistry: silicone polymers, silicate structures, aluminosilicates-zeolites.
- Introduction to symmetry and point groups
- Lanthanide chemistry: f orbitals, electronic structure, ionic and atomic radii, ionisation energies, reduction potentials and oxidation states. Occurrence and recovery; co-ordination chemistry and applications.

Teaching: weekly 2-hour lectures, 1-hour workshops (and seven 3-hour lab sessions per semester)

Assessment

➢ Study Option **1**:

- 3-hour exam (50%)
- Coursework – calculation-based (1000 words nominal) (20%)
- Portfolio of practical samples, and short reports (15*2%)

➢ Study Option **2**:

- Coursework – calculation-based (1000 words nominal)
- Portfolio of practical samples, and short reports

➢ Study Option **3**:

- Portfolio: practical performa & lab report

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Chemistry Modules for Visiting Students 2026/27

Module Code: CH6007

Module Title: Advanced Analytical Science

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 6

Prerequisites:
- Intermediate university-level study of spectroscopy such as CH5012 or similar

Suitability: Study Options 1 or 2

Content:
Building upon the fundamental knowledge that was introduced at intermediate level (Level 5), this module applies knowledge of spectroscopy and develops a more rigorous theoretical footing. Students will explore industry relevant advanced analytical techniques, and their relevance will be studied using real world examples including (but not limited to) environmental, fragrance, Forensic, Chemical and Pharmaceutical applications.

Students will be trained in current analytical practices used in industry, which includes concepts of quality, chemometric and how to suitably select sustainable analytical approaches.

Topics:

➢ **Autumn Semester:**

❖ ***Data Analysis and Atomic Spectroscopy (AAS and ICP)***
- Concepts of chemometrics -multivariate statistics: Analysis of Variance and Principal Component Analysis
- Revision of calculations for quantitative analysis
- ICP-AES/ ICP-MS

❖ ***Raman/ Fluorescence***
- Raman and NMR: spectroscopic analysis of organic compounds

❖ ***Chromatography***
- Ultra High Performance Liquid Chromatography
- Chiral chromatography/ Ion sources/Interfaces

❖ ***Mass spectrometry***

➢ **Spring Semester:**

- ***Electroanalysis:*** electroanalytical techniques and applications including potentiometric analysis, ion selective electrodes (ISE), voltametric techniques, sensors, biosensors and trace analysis
- ***Thermal analysis*** **-** techniques and applications; Thermogravimetry (TG) Differential thermal analysis (DTA), Differential sanning calorimetry (DSC)
- ***Advanced Nuclear Magnetic resonance NMR):*** pulse NMR, and 2D NMR for the analysis of complex

mixtures
- Future trends in Analytical Science
- Further atomic spectroscopy content

Teaching: weekly 2-hour lectures, 1-hour workshops (and ten 3-hour lab sessions in the autumn, two 3-hour in the spring semester)

Assessment:

➢ Study Option **1:**

- 3-hour exam (50%)
- Practical report – questions on data analysis, calibrations, quantifications interpretation of spectra and chromatograms (1,200 words) (20%)
- Portfolio of 3 online tests (one for each practical, 3*10%) (30%)

➢ Study Option **2:**

- Practical report – questions on data analysis, calibrations, quantifications interpretation of spectra and chromatograms (1,200 words)
- Online test for practical session

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Module Code: CH6015

Module Title: Natural Product Chemistry and Sustainable Synthesis

Credits:
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 6

Prerequisites:
- Intermediate university-level study of organic chemistry such as CH5012 or similar

Suitability:
- Study Option 1 only
- Note that this module runs in the Autumn semester only

Content:

Natural products have played a significant role in drug discovery, from commonly used drugs such as aspirin to potent pain relievers such as morphine and complex chemotherapy drugs like Taxol. Understanding the role of natural products in drug discovery as well as looking at ways in which we can synthesise them is an important

part of medicinal and organic chemistry. This module follows on from intermediate-level (level 5) organic chemistry topics and will take you on a journey of discovery through the biosynthesis and synthesis as well as isolation from natural sources of some exciting naturally derived compounds.

The module aligns with several UN Sustainable Development Goals (SDGs), including SDG 3: Good Health and Well-being, SDG 9: Industry, Innovation, and Infrastructure, SDG 12: Responsible Consumption and Production and SDG 15: Life on Land. These goals collectively support the broader aim of sustainable development and improving global health.

The Future Skills Apply learning outcomes are delivered in this module.

- **Topics:**

  - The role of pharmacognosy in the treatment of various diseases,
  - Synthesis of important organic and natural products using techniques such as semi-synthetic strategies e.g 10-deacetylbaccatin III; the use of protecting groups in natural product synthesis, stereoselectivity in syntheses, stereoselective double bond formation and diastereoselective nucleophilic additions.
  - The biosynthesis of important natural such as the precursors for terpenes, steroids and fats as well as key natural products such as arachidonic acid/prostaglandins and the use of labelling experiments such as ^{13}C in the elucidation of biosynthetic processes
  - Retrosynthesis will be considered including a study of the terminology for API synthetic targets and important industrial intermediates in terms of one and more than one bond disconnections.
  - Pericyclic reactions in the formation of five and six membered rings, in particular in the formation of larger bioactive molecules, will be considered.
  - The importance of radical chemistry in organic and polymer chemistry, including the electronic structure and stability of radicals and charged radicals in terms of MO theory and applied to cyclization reactions, including tandem examples, and regioselectivity in chain reactions, including organic and polymer reactions will be included.
  - The role of reactive intermediates (carbocations, carbanions, radicals, charged radicals, carbenes, and nitrenes) in mechanisms, including of anti-cancer drugs (e.g. mitomycin C), polymerisations, and visible light mediated photochemical reactions using relevant and topical examples will be studied.

Teaching: weekly 2-hour lectures and 1-hour workshops; practical sessions

Assessment

- 2-hour exam (40%)
- Future Skills Experience (40%)
- Coursework portfolio (20%)

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Chemistry Modules for Visiting Students 2026/27

Module Code: CH6016

Module Title: Advanced Materials and Industrial Chemistry

Credits:
- Full Year: 8 (US) 15 (ECTS)
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 6

Prerequisites:
- Good background in intermediate university-level study of chemistry

Suitability:
- Study Options 1 and 2

This module addresses some of the most current and industrially relevant areas of applied chemistry. Key topics include polymer chemistry, Nano materials synthesis and applications, heterogeneous catalysis, green chemistry, sustainable practices in chemistry, intellectual property and health and safety.

➢ **Autumn Semester: Nanochemistry, Catalysis, Green Chemistry**

❖ ***Nanochemistry***
- History, evolution & significance of nanochemistry
- Synthesis & characterisation of nanoparticles
- Key applications of nanomaterials

❖ ***Catalysis***
- Catalysis: key mechanisms & industrial processes
- Zeolites & titanosilicates
- Magnetic catalysts

❖ ***Green Chemistry***
- The 12 Principles of Green Chemistry,
- atom economies, waste factors, homogeneous and heterogeneous catalysis
- the use of water, supercritical carbon dioxide and ionic liquids as solvents
- the use of renewable raw materials and the biodegradation of chemical products.

➢ **Spring Semester:** ***Intellectual Property, Industrial policy & safety, Polymer Chemistry, Conducting Polymers***

❖ ***Intellectual Property, Industrial policy & safety***
- Patents
- Intellectual property relating to chemicals & pharmaceuticals
- Health & safety in chemical industry

Kingston University London

Chemistry Modules for Visiting Students 2026/27

Polymer Chemistry

- Overview of different polymerisation reactions; preparation and crosslinking phenomena; biochemical routes to natural and synthetic polymers.
- One or more specialized topics selected from topics including: Conducting polymers and ferroelectrics, additives for polymers natural and synthetic textile fibres.
- Key aspects of the environmental impact of polymers, nanomaterials and catalysts.

❖ ***Conducting polymers (CPs)***

- CPs have received much attention in both fundamental and practical studies because they have electrical and electrochemical properties similar to those of both traditional semiconductors and metals. CPs possess excellent characteristics such as mild synthesis and processing conditions, chemical and structural diversity, tunable conductivity, and structural flexibility.
- Advances in nanotechnology have allowed the fabrication of versatile CP nanomaterials with improved performance for various applications including electronics, optoelectronics, sensors, and energy devices.

Teaching: weekly 2-hour lectures and 1-hour workshops; four 3-hour practical sessions (Autumn); three 3-hour practical sessions (Spring)

Assessment:

Study Option **1:**

- 2.5-hour exam (50%)
- 6 x 5% of portfolio of polymer and industrial practical e.g. sample, data analysis (30%)
- Group presentation (20%)

Study Option **2:**

- portfolio of polymer and industrial practical e.g. sample, data analysis
- Group presentation

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Module Code: CH6023

Module Title: Physical Chemistry 2

Credits:

- Single Semester: 4 (US) 7.5 (ECTS)

Level: 6

Prerequisites:

- Good background in intermediate university-level study of physical chemistry such as CH5012 or similar

Chemistry Modules for Visiting Students 2026/27

Suitability:

- Study Options 1 and 2
- Note that this module runs entirely in the **autumn** semester

This moule takes forward the themes of atomic and molecular electronic structure, photochemistry and spectroscopy that were introduced in the previous modules and develops a more rigorous theoretical footing. In addition important concepts of surface chemistry are developed through the study of various surface phenomena such as adsorption and micellization.

The module also has a focus on scientific communication.

➢ **Topics:**

- Production and critical analysis of sources of scientific information for non-expert audiences.
- Electronic spectroscopy, photoelectron spectroscopy & electronic structure of atoms & molecules; MO theory; LCAO MO approach to diatomics and polyatomics; Huckel theory; HF SCF MO theory; semi empirical MO theory
- Application of group theory to MO theory and spectroscopy; point group character tables, symmetry adapted LCAOs, normal modes of vibration and symmetry selection rules
- Fundamentals of photochemistry, fluorescence, phosphorescence and photochemical kinetics. Operation and chemical applications of lasers.
- Nuclear Magnetic resonance: pulse NMR, 1D and 2D NMR, Electron spin resonance.
- Surface chemistry of liquids; surface & interfacial energy, surface tension & pressure, Laplace & Gibb's equation. Surface activity, micellisation, wetting. Adsorption isotherms.
- Surface chemistry of solids: Adsorption on solids, adsorption isotherms, surface area and porosity determination.

Teaching: weekly 2-hour lectures, 1-hour workshop and 3-hour practical laboratory sessions

Assessment:

- 1,500-word practical investigation report (50%)
- 1,500-word science communication report (50%)

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top

Module Code: CH6033

Chemistry Modules for Visiting Students 2026/27

Module Title: Inorganic Chemistry 2

Credits:
- Single Semester: 4 (US) 7.5 (ECTS)

Level: 6

Prerequisites:
Successful completion of intermediate level inorganic chemistry such as CH5013 and organic chemistry such as CH5002 or similar

Suitability:
- Study Options 1 and 3
- Note that this module runs entirely in the **spring** semester

This module introduces bio-inorganic chemistry and supramolecular chemistry, as well as further developing a student's understanding of organometallic and main group chemistry, including spectroscopic characterisation.

➢ **Topics:**

- Metal–ligand binding and non-covalent interactions in supramolecular chemistry; analytical methods in supramolecular chemistry
- Metal ions in biology, diseases and toxicity. Pharmaceutical agents; cis-platin.
- Transport and storage of iron in vivo – transferrin, ferritin and enterobactin.
- Oxygen transport and storage – myoglobin and haemoglobin. Model compounds for haemoglobin.
- Iron in bacteria; Structure and function of siderophores. Ferrioxamines and enterobactin. Mechanism of uptake and release of iron by siderophores.
- Cytochrome P-450. Role in vivo. Mechanism. Metabolism of pharmaceuticals by Cyt P-450
- Transition metal alkene complexes; bonding and reactivity. Carbene and carbyne complexes.
- Synthesis and properties of nanoparticles and their application in medical imaging/solar technologies
- p-block periodic trends – group 13, 14 and 15 typical and sub-valent compounds and their properties
- Homogeneous catalysis; dehydrogenation, cross coupling and mechanistic investigation

Teaching: weekly 2-hour lectures, 1-hour workshop and five 3-hour practical laboratory sessions

Assessment:

- Inorganic chemistry assignment (30%)
- Laboratory practical report (20%)
- 2-hour exam (50%)

Note: methods of assessment are indicative only and may be subject to change

Last updated: 21/04/26 PJW

Return to top