Chemistry & Pharmacy Modules for Visiting Students 2024/25

Chemistry:

Level 4 modules are introductory 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. 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 advanced and provide a more-specialised study of inorganic, physical and organic chemistry.

Pharmacy:

Pharmacy is a science-based healthcare profession that involves the preparation, supply and monitoring of medicines for the treatment and prevention of disease.

Level 4 modules introduce the scientific basis of pharmacy. This includes cell biology, physiology and pharmaceutical and biological chemistry (including the importance of natural products as medicines). Other modules consider important pharmaceutical dosage forms, formulation and manufacturing processes, physico-chemical aspects of drug stability and pharmacopoeial and regulatory requirements.

Level 5 modules places more emphasis on the role of hospital, community and industrial pharmacists. It also includes the study of pharmacy law and ethics and good dispensing practice. The science is integrated with the practice and case studies are used to illustrate how chemistry, pharmacology and pharmaceutics affect clinical practice.

Level 6 modules focus on body systems and disease stats. Examples include the role of the liver in health and disease and cancer, its causes, the science behind its treatment and clinical management of cancer patients.

Updated April 2024/PJW

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

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

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Pre-requisites:

- **Level 4:** prior study of introductory (freshman) level chemistry is required. For pharmacy modules, some knowledge of biology is also useful.
- **Level 5:** some study of chemistry at intermediate university- level is required. There are no formal pre-requisites for Level 4 modules.
- **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 ____
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 2024), 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.

5. Due to timetabling constraints, we recommend that you only select one CH module. If you are a pharmacy/chemistry major and wish to study more than one CH module, we recommend that you select modules from the same level eg all level 4. We also advise that they are from the same degree programme ie chemistry or pharmacy. If you are unsure about this, please e-mail studyabroad@kingston.ac.uk. These measures should help to reduce any timetable clashes.

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

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

MODULE CODE	TITLE	SUITABILITY KEY		
	LEVEL 4 – INTRODUCTORY			
CH4001	Foundation Organic and Physical Chemistry	1	2	
CH4002	Foundation Inorganic and Environmental Chemistry	1	2	3
CH4003	Introduction to Spectroscopy and Experimental Techniques	1	2	3
CH4004	Academic Skills for Molecular Sciences	1	2	3
CH4005	Foundation Chemistry for Pharmaceutical Science	1	2	3
CH4006	Biosciences	1	2	3
	LEVEL 5 – INTERMEDIATE			
CH5001	Inorganic Chemistry	1	2	3
CH5002	Organic and Medicinal Chemistry	1	2	
CH5003	Physical Chemistry	1	2	3
CH5004	Analytical and Experimental Chemistry	1		
CH5005	Pharmacology and Pharmaceutics	1	2	
CH5006	Analytical Science	1	2	3
CH5007	Practical and Research Skills in Pharmaceutical Science	1	2	3
CH5008	Crime Scene, Evidence and Law	1	2	
	LEVEL 6 – ADVANCED			
CH6001	Organic and Natural Product Chemistry	1	2	3
CH6007	Advanced Analytical Science	1	2	3
CH6008	Drug Development	1	2	
CH6009	Topics in Pharmaceutical Science	1	2	
CH6010	Forensic Chemistry and Trace Analysis	1	2	
CH6016	Advanced Materials and Industrial Chemistry	1	2	
CH6023	Physical Chemistry 2	1	2	
CH6033	Inorganic Chemistry 2	1		3

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

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Module Code	**CH4001**
Module Title	**Foundation Organic and Physical Chemistry**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4
Prerequisites	introductory university-level chemistry useful
Suitability	• Study Abroad/International Exchange students for Study Options 1 or 2 • Not open to Erasmus students (as Level 4) • Can't be taken with **CH4005** as similar content in this module.
Content	This module introduces the structure and isomerism observed in organic molecules, and then describes the preparation and chemical reactions (including the mechanisms involved) of the hydrocarbons and monofunctional organic molecules. The main principles of molecular systems, chemical reactivity and kinetics, including those of gas–phase reactions, are described before presenting the essential principles of chemical thermodynamics and molecular quantum mechanics. **Overall Topics:** • Causes and effects of the major types of isomerism observed in organic compounds (geometric, optical and conformational); definition of E/Z, R/S • Effect of ring size on the stability of cyclic compounds; introduction to conformational analysis in cyclic systems • Structure, hybridisation state of carbon atoms and bonding in alkanes, alkenes, alkynes and aromatic hydrocarbons • Typical reaction mechanisms including free-radical halogenation, electrophilic addition and polymerisation of alkenes, the Diels-Alder reaction and the first electrophilic substitution of aromatic compounds • Structure, bonding and main reactions of haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives and amines • Schrodinger equation, boundary conditions and quantization of energy; observables and quantum mechanical operators, Eigen values and Eigen vectors, particle on a ring, particle in a box wave functions; electronic structure of simple systems. • Macroscopic and microscopic properties of gases and their molecules; kinetic energy terms and the Boltzmann distribution; ideal and real gas behaviour

- Bulk and particulate theories of gas- and solution-phase reaction kinetics of first and second-order reactions and the associated mathematical models; appropriate problem-solving and dimensional analysis
- Heat and work, internal energy, enthalpy, entropy, free energy and equilibrium in general chemical reactions; the thermodynamic laws

➢ **Autumn Semester:**

❖ ***Organic: Structure and Bonding of Organic Modules***

- fundamentals of structure, bonding and mechanism
- Isomerism

❖ ***Organic: Chemistry of the Hydrocarbons***

- Organic Reaction Types, Mechanisms and Electronic Effects (Chemical reactivity)
- Alkanes
- Alkenes
- Alkynes and Alkadienes
- Aromatic compounds
- Haloalkanes & reaction mechanisms

❖ ***Physical: Thermodynamics, Kinetics and Gases***

- Matter and energy: introduction to Physical Chemistry
- Thermodynamics: internal energy, Enthalpy, Entropy
- Properties of Gases
- Internal energy
- Enthalpy
- Physical Change
- Entropy
- Gibbs Free energy
- Chemical equilibrium
- Empirical kinetics
- Integrated rate laws

➢ **Spring Semester:**

❖ ***Organic: Chemistry of Monofunctional Compounds***

- Alcohols
- Reactions of Alcohols
- Ethers and epoxides
- Aldehydes and ketones
- Carboxylic acids

	• Acid Chlorides • Esters, anhydrides & amides • Amines ❖ ***Thermodynamics, Kinetics and Gases*** • Kinetics: The Arrhenius equation • Kinetics: Collision and transition state theories • Gases: Real Gases • Kinetic theory of gases • Gas Mixtures ❖ ***Quantum Mechanics*** • Context of Quantum Mechanics • Matter Waves • Postulates of Quantum Mechanics
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1**: • 3-hour Exam (60%) • In-class practical work (8 x 2.5%) • Assignment: physical chemistry (30%)
	Study Option **2**: • In-class practical work • Assignment: physical chemistry
Last updated	12/04/24 PJW

Return to top

Module Code	**CH4002**
Module Title	**Foundation Inorganic and Environmental Chemistry**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Prerequisites	introductory university level chemistry useful
Suitability	• Study Abroad/International Exchange students for Study Options 1 or 2 or 3 • Not open to Erasmus students (as Level 4)
Course	This module introduces various bonding models including the structure and bonding of inorganic solids. Trends in the periodic table are illustrated by coverage of the chemistry of Group 1, 13 and 17 elements. The module also introduces students to atmospheric and aquatic pollution and goes on to cover the impact of pollutants on the environment. ➢ **Topics (Overall):** • Introduction to atomic structure. H atom spectrum. Rydberg formula, Bohr atom, dual wave/particle nature of light and electrons. • Electronic structure, quantum numbers, orbitals, radial distribution functions, bond order and molecular orbital description of bonding in homo- and heteronuclear diatomic molecules. • Revision of the fundamental periodic properties of atoms: size, ionization potential, electronegativities. • Valence bond theory, shapes of molecules, VSEPR theory. • Structures of the solid elements, including hexagonal and cubic close-packed structures. Ionic solids. Calculation of lattice energies. Born-Haber cycles • Chemistry of Hydrogen, Group 1, 13, 17 and 18 elements. • Introduction to coordination chemistry- naming compounds and identifying isomers. • Structure and chemical composition of the atmosphere, hydrosphere and lithosphere. • Chemical properties of water bodies and soils. • Origins, chemistry, decomposition and effects of different classes of organic pollutants (organochlorine compounds, dioxins, PCBs, dibenzofurans). • Sources, chemistry and effects of heavy metals and their compounds (lead, mercury, arsenic and cadmium). • Principal atmospheric pollutants, environmental consequences and methods of control. • Origins and the impact of acid rain, photochemical smog, enhanced greenhouse effect and stratospheric ozone destruction and global warming. ➢ **Autumn Semester: Atmospheric Environmental Chemistry; Structure and Bonding** ❖ ***Atmospheric Environmental Chemistry*** • The Atmosphere

	• Global Warming and Smog • Ozone Depletion and Acid rain ❖ ***Structure and Bonding*** • Atomic Structure • Atomic Orbitals • Electronic Structure • Trends in atomic properties • Oxidation and Reduction • Hydrogen • Chemistry of Group 1 Elements ➢ **Spring Semester: Environmental Chemistry of the Hydrosphere; Structure and Bonding** ❖ ***Structure and Bonding*** • VSEPR Theory • Valence Bond theory • Molecular Orbital Theory • Solid State Chemistry • Ionic Solids and Born Haber Cycles ❖ **Environmental Chemistry of the Hydrosphere and Lithosphere** • Introduction to environmental chemistry & hydrosphere part 1 • Hydrosphere part 2: Chemistry and water • Hydrosphere part 3 - Water stratification • the Lithosphere • Lithosphere: Soil Chemistry • Water Pollution • Organic Pollutants • Inorganic Pollutants
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1**: • 3-hour exam (60%) • Lab report (20%) • 8 in-class lab exercises - 8 x 2.5 % (20%)
	Study Option **2**: • Portfolio of in-class lab exercises

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

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

	Study Option **3**: • Lab report • Portfolio of in-class lab exercises
	Last updated: 12/04/24 PJW

Return to top

Module Code	**CH4003**
Module Title	**Introduction to Spectroscopy and Experimental Techniques**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4
Prerequisites	Successful completion of introductory university level chemistry
Suitability	• Study Abroad/International Exchange students for Study Options 1 or 2 or 3 • Not open to Erasmus students (as Level 4)
Content	This module provides an introduction to basic laboratory techniques and procedures such as weighing and volumetry, proceeding to descriptions of laboratory manipulations, elemental analysis and general practical knowledge. There is included an introduction to spectroscopic techniques in terms of simple theory, as well as a practical introduction to the identification of simple organic compounds. These compounds will sometimes be synthesised in the course of the practical element of the module, which will also serve to demonstrate laboratory techniques of preparation and purification of these materials. ➢ **Autumn Semester:** • General Principles of Spectroscopy • Instrumental Techniques • Infrared Spectroscopy • Instrumental Techniques • Volatility/crystallisation • Instrumental Analysis • Spin-spin Coupling in ^{1}H NMR Spectroscopy • Introductory ^{13}C NMR Spectroscopy

	➢ **Spring Semester:** • Theory and Application of Proton NMR Spectroscopy • Chromatography • Carbon—13 NMR • Microwave and other techniques • Mass Spectrometry • Consolidation and Combined Structure Problems
Teaching	Lectures, workshops, pre-lab seminars and practical sessions
Assessment	Study Option **1**: • Assignment 1: Oxalate analysis (10%) • Assignment 2: Phenacetin synthesis writeup (10%) • Assignment 3: Techniques and apparatus quiz (10%) • Assessment Portfolio (20%) • Exam (50%)
	Study Option **2**: • Portfolio
	Study Option **3**: • Assignment 2: Phenacetin synthesis writeup • Assignment 3: Techniques and apparatus quiz
Last updated	12/04/24 PJW

Return to top

Module Code	**CH4004**
Module Title	**Academic Skills for Molecular Sciences**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4
Prerequisites	• introductory university level chemistry useful • For Study Option 3, basic algebra and calculation skills are required.
Suitability	• Study Abroad/International Exchange students for Study Options 1, 2 or 3

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

	• Not open to Erasmus students (as Level 4)
Content	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. ➢ **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, exam and revision technique. • Maths – numeracy, algebra, logarithms and exponentials, introduction to calculus. Statistical analysis of variables, probabilities and their application in biochemical sciences, including the correct use of graphs, tables. Units and dimensional analysis. • IT – Production of scientific documents and presentations using office and specialist scientific software. Information retrieval and online literature sources. Use of scientific software for structure drawing and database queries. • Personal & Career development – production of CVs, letters and PDPs. ➢ **Autumn Semester:** • Introduction to algebra • Graduate attributes • Algebraic rules and principles • Algebraic symbols in science • Scientific units • Statistics: normal distribution • Mean, variance and standard deviation • Dealing with outliers • Significance testing • Computing workshops ➢ **Spring Semester:** • Real and imaginary numbers • Dealing with complex materials • Simultaneous equations • Quadratic equations • Logarithms and exponentials • Problem solving • Graphical analysis • Graphical and straight-line analysis

	• Data analysis • Calculus – differentiation • Calculus – integration • Computing Excel workshops
Teaching	Lectures and workshops
Assessment	Study Option **1**: • LRC workbook (5%) • Summative note-taking assignment 10%) • 2 x in-class tests (20%) • Group assignment (10%) • Critical Thinking Exercises (15%)
	Study Option **2**: • tutor assignment (20%) • academic skills assignment (30%) • in-class test (50%)
	Study Option **3**: • 2 in-class tests (60%) • tutor assignment (10%) • academic skills assignment (10%) • IT assignment (20%)
Last updated	12/04/24 PJW

Return to top

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Module Code	**CH4005**
Module Title	**Foundation Chemistry for Pharmaceutical Science**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4
Prerequisites	Successful completion of introductory chemistry at university level useful
Suitability	• For pharmaceutical science and biochemistry majors • Study Abroad/International Exchange students for Study Option 1 or 2 or 3 • Not open to Erasmus students (as Level 4) • Can't be taken with **CH4001** as similar content
Content	This module revises some introductory content before expanding on this content to give foundation knowledge of the core chemistry concepts required for progress within the field of pharmaceutical science and biochemistry ➢ **Autumn Semester:** ❖ ***Organic: Structure and Bonding of Organic Modules*** • fundamentals of structure, bonding and mechanism • Isomerism ❖ ***Organic: Chemistry of the Hydrocarbons*** • Organic Reaction Types, Mechanisms and Electronic Effects (Chemical reactivity) • Alkanes • Alkenes • Alkynes and Alkadienes • Aromatic compounds • Haloalkanes & reaction mechanisms ❖ ***Atomic structure and fundamentals of inorganic chemistry*** • Introduction to atomic structure: Structure of the atom, Bohr atom, dual wave/particle nature of light and electrons. H emission spectrum Rydberg formula. • Atomic orbitals: quantum numbers, radial distribution functions. • Electronic configuration • Trends in fundamental atomic properties: Revision of the fundamental periodic properties of atoms: size, ionization potential, electronegativities • Lewis structures and bonding

	• Covalent bonding: Valence Bond theory and hybridisation σ- and π- bonds. • Molecular orbital theory and ionic bonding • Molecular geometries: Valence Shell Electron Pair Repulsion model. • Intermolecular forces: Van der Waals forces: dispersion forces, dipole-dipole attraction and Hydrogen bonding. Dipole –ion interactions. • pH and pK ➢ **Spring Semester:** ❖ ***Chemistry of Monofunctional Compounds*** • Introduction to alcohols: synthesis of alcohols • Elimination and substitution reactions of alcohols: oxidation of alcohols • Formation and reactions of ethers and epoxides • Introduction to carbonyl compounds: synthesis of aldehydes and ketones; nucleophilic addition reactions of aldehydes and ketones. • Further nucleophilic addition reactions of aldehydes and ketones: reactions with ammonia and its derivatives; redox reactions of aldehydes and ketones • Introduction to carboxylic acids: synthesis of carboxylic acids; strength of carboxylic acids; chemical reactions of carboxylic acids. • Conversion of carboxylic acids to acyl derivatives: introduction to acid chlorides, acid anhydrides, esters and amides. • Interconversion of acyl derivatives: structural degradation of polypeptides. • Introduction to amines: synthesis of amines • Basicity of amines: chemical reactions of amines ❖ ***Introduction to kinetics and thermodynamics*** • Kinetics • Energetics • The First Law of Thermodynamics • The Second Law • The Third and Zeroth Laws
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1:** • 3-hour exam (50%) • Practical Portfolio (20%) • Assignment Portfolio:

	○ Organic chemistry assignment (15%) ○ Physical chemistry assignment (15%)
	Study Option **2**: • Practicals • Organic chemistry assignment
	Study Option **3**: • Physical chemistry assignment • Practicals
Last updated	12/04/24

Return to top

Module Code	**CH4006**
Module Title	**Biosciences**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	4
Prerequisites	Successful completion of introductory biology/chemistry at university level
Suitability	• For medicinal chemistry and pharmacology majors • Study Abroad/International Exchange students for Study Options 1 or 2 or 3 • Not open to Erasmus students (as Level 4)
Content	This module introduces the fundamental principles of the biochemical processes that occur within the cell, introducing students to prokaryotic and eukaryotic cell structure, basic tissue types, microbial entities and organisms that include; viruses, bacteria and fungi. It is designed to introduce cell biology and microbiology, particularly with reference to human physiology and the pathological microorganisms affecting it. It progresses from the subcellular through to the cellular and then to tissues and a few selected organ systems examining the mechanisms that maintain homeostatic balance.

➢ **Topics (whole year):**

- Chemical metabolites and macromolecules as components of cells.
- Role of enzymes in cellular pathways and how and why these pathways are controlled
- Cellular respiration and energy metabolism in the prokaryotes and eukaryotes including; Anabolism and catabolism of metabolites and macromolecules, including common sugars, lipids and nitrogenous substances such as amino acids.
- The cell concept and main components of animal and plant cells, including; the cell membrane, cytoplasm and cytoplasmic organelles and the nucleus.
- Characteristics of chromosomes, genes, DNA, RNA and the processes involved in transcription and translation, together with the factors controlling them in prokaryotes and eukaryotes including; the genetics and metabolism of bacteria, energy transfer into ATP, inducible genes, plasmids and transposons.
- Definition and components of principal tissues: epithelium, connective tissues, muscle tissues and nervous tissues and their subtypes, outlining processes such as; cell signaling, cell growth and cell differentiation.
- Describing the variety of microbes. The structure and physiology of; bacteria, fungi, viruses and selected protozoa.
- Manipulation, identification (staining selective and differential media), laboratory growth, and estimation (bio-burden) of microbes. Safe laboratory handling of microorganisms, particularly bacteria.
- Symbiotic and probiotic bacteria. Biochemical mechanisms of disease. Common pathological micro-organisms in disease.
- Modes of infection/transmission and antibiotic targets. Antimicrobial resistance and overuse of antibiotics. Vaccines.
- The homeostatic mechanisms that are enabled by the characteristics and biochemical processes that occur within the major tissue types and organ systems in the body.

➢ **Autumn Semester: Basic Microbiology, Cell Biology & Clinical Sciences**

❖ ***Basic microbiology***

- Introduction to microbiology
- Safety, handling and containment of bacteria
- Eukaryotes & prokaryotes
- microrganisms/bacterial cell structure
- Bacterial nutrition, laboratory media & growth
- Genetics and metabolism
- Classification & identification of bacteria

❖ ***Cell Biology***

- Structure of nucleus & DNA

	• DNA replication: mitosis/meiosis • Chromosomes • Cell cycle • Gene transcription • Protein synthesis ❖ ***Clinical Sciences*** • Infectious disease life-cycle and transmission modes • Introduction to antibiotic mechanisms • Viruses • Fungi and Parasites ➢ **Spring Semester: Cell Biology, Metabolism & Systems Physiology** ❖ ***Cell Biology*** • Basic cell structure • Enzymes • Cell signalling • Fatty Acid Metabolism • Cell Membrane • Biochemical mechanisms of disease: purines/pyrimidines ❖ ***Metabolism*** • Carbohydrate metabolism • Amino Acid metabolism ❖ ***Systems Physiology*** • Body systems: Central Nervous system • Parkinson's disease • Phenylketonuria • Body systems: Respiratory system • Body Systems: Cardiovascular System
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1**: • Exam 1: 40 MCQs (40%) – Autumn content • quiz of 20 MCQs based upon the microbiology practical (10%)

	• Urinalysis practical report - 22 questions (theory and data-based) - Spring (10%) • Exam 2: 40 multiple-choice questions (MCQ) – Spring content (40%)
	Study Option **2**: • Exam 1: 40 MCQs (80%) • Microbiology practical quiz (20%)
	Study Option **3**: • Bespoke assessment
Last updated	12/04/24 PJW

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Module Code	**CH5001**
Module Title	**Inorganic Chemistry**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	5
Prerequisites	• Prior study of introductory level inorganic chemistry such as CH4002 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	This module builds upon the theory and principles developed in CH4002 (or equivalent) and applies them second and third row transition metal, the lanthanides and Group 14. It introduces solid state chemistry with a consideration of defects and conductivity. The module also introduces bonding and reactivity of inorganic complexes and organometallics. ➢ **Topics (Whole year):** • Solid state. 2D projections. Electronic structure of solids, band theory, conductors, semi-conductors and insulators. Intrinsic and extrinsic defect structures. • Oxidation state chemistry: reduction half equations, redox couples and equations, Latimer diagrams, oxidation state diagrams, Ellingham diagrams • Trends in oxidation state chemistry of 3d elements. Detailed chemistry of selected 3d elements • Trends in properties of Group 15 elements • Chemistry of 4d and 5d series. Comparison with 3d series, oxidation state chemistry, metal-metal and metal-ligand bonding. • Chemistry of Group 6 metal halides and polyoxometallates. • Group 14 chemistry: Structure and bonding of allotropes, oxides, halides, multiple bonding and oxidation state chemistry. Silicone polymers, silicates and aluminosilicates. • Lanthanide chemistry. Occurrence and recovery, electronic structure, oxidation state chemistry and co-ordination chemistry. • Introduction to symmetry and point groups. Applications of symmetry to inorganic chemistry problems • Crystal Field theory: high and low spin complexes, spectrochemical series, magnetic properties, electronic transitions (colour), Jahn-Teller distortion and square planar complexes. • Co-ordination compounds. Advanced aspects of the structure of chelate compounds, ring conformations. • Stability and substitution chemistry of transition complexes: equilibrium constants, the chelate effect, labile and inert complexes- inner sphere mechanism- stereoselectivity

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

- Carbonyl complexes and organometallics: Synthesis, structure and reactions of simple carbonyl compounds of the d-block. Derivatives of carbonyls, organometallics.
- M.O. description of the bonding in carbonyls and other co-ordination compounds. The 18-electron rule.
- Introduction to of common organometallic reaction steps - oxidative addition, reductive elimination, hydride elimination; insertion reactions; transmetallation and complexes.
- Introduction to homogeneous catalysis and associated catalytic cycles

➢ **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	Lectures, workshops and practical sessions
Assessment	Study Option **1**: • 3-hour exam (50%)

	• Portfolio of lab reports (30%) • assignment (20%)
	Study Option **2:** • assignment and workshop tests (60%) • lab reports (40%)
	Study Option **3**: • assignment and workshop tests (60%) • lab reports (40%)
Last updated	12/04/24 PJW

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	Completion of introductory study of organic chemistry such as CH4001 or CH4005 or similar
Suitability	Study Options 1 or 2
Content	This module seeks to develop and expand student knowledge of both Organic Chemistry and Medicinal Chemistry subject areas and introduces important principles, reactions and mechanisms in organic chemical reactivity as well as basic mechanisms of drug action. It develops students' understanding of the methodology of organic synthesis following concepts introduced at level 4 and includes important organic chemistry topics such as carbanion reactivity of carbonyl compounds, the reactions of aromatic and heteroaromatic compounds, stereochemistry, asymmetric synthesis and retrosynthesis. It also introduces the specific reasons why a small amount of a drug molecule can exert a complex biological response. It uses examples from a range of medicinal areas in order to illustrate these key processes as well as giving an introduction on the ideas of drug design and the role this plays in the modern pharmaceutical industry.

This module also gives students experience of using spectroscopic techniques for chemical structure elucidation. Lectures and workshops are designed to develop the students problem solving and team working skills.

- **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 syste. 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, Conjugate addition • Combinations of reactions: Selective reductions, Robinson Annelation • Retrosynthesis ❖ ***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	Lectures, workshops and group work
Assessment	Study Option **1:** • 3-hour exam (60%) • Lab (10%)

	• Group poster and presentation (20%)
	Study Option **2:** • 90-minute test (6 out of 9 questions) (100%)
Last updated	12/04/24 PJW

Return to top

Module Code	**CH5003**
Module Title	**Physical Chemistry**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	5
Prerequisites	Completion of CH4001 or similar
Suitability	Study Options 1 or 2 or 3
Content	This module discusses the electrochemistry of ionic solutions including both strong and weak electrolytes; cell electrochemistry and the associated applications to chemical thermodynamics; phase equilibria and colligative properties; transition state theory of chemical reactions; complex reaction mechanisms and their kinetic analysis; an introduction to statistical thermodynamics and partition function; 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. ➢ **Topics (Whole year):** • Phase equilibrium; the phase rule; phase diagrams. One- component systems. Derivation and applications of the Clapeyron and Clausius-Clapeyron equations. Two-component systems. Ideal liquid mixtures. Raoult and Henry laws. Non-ideal mixtures. Eutectics, compound formation and solid solutions. • Colligative properties and viscosity. • Electrolyte solutions. Conductance measurements and their applications. Weak and strong electrolytes. Kohlrausch and Onsager equations. Non-ideality - Debye-Hückel limiting law. Acids, bases and salts.

- Cell electrochemistry. Thermodynamics and the Nernst equation. Applications of cell emf measurements.
- Transition state theory
- Complex mechanisms: steady-state approximation, chain reactions, enzyme reactions, isotope effects.
- Introduction to statistical thermodynamics and partition function.
- Quantum mechanics and solution of the Schrödinger 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 Schrödinger 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.

➢ **Autumn Semester**

❖ ***Phase Equilibria and Colligative properties***

- One-component Systems and Phase diagrams
- From one component to two: chemical potential and colligative properties
- Binary systems
- Osmosis - the fourth colligative property
- Viscosity and viscometry

❖ ***Introduction to Electrolytes and Electrolyte Solutions***

- Brønsted – Lowry theory
- Salt hydrolysis and buffer solutions
- Electrolyte (ie ionic) solutions
- Ion migration
- Ostwald's dilution law and mobility
- Debye – Hückel theory
- Cell electrochemistry
- Cell thermodynamics / Nernst equation
- Quantifying phase changes: the Clapeyron and Clausius-Clapeyron equations

➢ **Spring Semester**

❖ ***Kinetics***

	• Kinetics of Composite Reactions: opposing and consecutive reactions) • Kinetics of Composite Reactions: the steady state approximation) • Kinetics of Composite Reactions: radical chain reactions • linear and branched radical chain reactions) • Radical polymerisation • Theory of Reaction Rates • Transition State Theory • Reactions in solution • Enzyme kinetics • Experimental kinetics • Fast Reaction methods ❖ ***Spectroscopy:*** • Statistical Thermodynamics • Rotational Spectroscopy: Rigid Rotors • Rotational Spectroscopy: Non-rigid Rotors • Rotational Spectroscopy: polyatomics • Vibrational Spectroscopy: harmonic oscillators • Vibrational Spectroscopy: anharmonic oscillators • Vibrational-Rotational Spectroscopy • Rotational Raman Spectroscopy • Vibrational Raman Spectroscopy • Derivation of energy levels from the Schrodinger equation
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1:** • Exam (60%) • Portfolio of assignments (3): one-component systems, electrolytes, kinetics (30%) • Portfolio of Lab reports (10%)
	Study Option **2**: • Lab notebook (10%) • Assignments (30%) • Exam (60%)

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

	Study Option **3:** • Lab notebook (20%) • Practical report (20%) • 2 assignments (each 30%)
Last updated	12/04/24 PJW

Return to top

Module Code	**CH5004**
Module Title	**Analytical and Experimental Chemistry**
Credits	Full Year: 8 (US) 15 (ECTS)
Level	5
Prerequisites	Completion of CH4003 or similar
Suitability	Study Option **1** only.
Content	This module takes forward the themes of analysis and practical procedures (with an emphasis on analytical and organic chemistry) that were introduced in introductory level study. 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. The modes of obtaining and evaluating findings, by use of electronic databases (e.g. Reaxys®) in addition to conventional printed literature sources. The ability to write coherent, evidence-based, yet succinct reports is a component. ➢ **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	Lectures, tutorials and practical sessions
Assessment	Study Option **1**: • Exam (40%) • Laboratory pro-forma completion (4X5%) and sample and report submission (2X10%) • Quantitative Analysis of HPLC Data (10%) • Group PowerPoint Media Presentation on Pedagogical Skills Development (10%)
Last updated	12/04/24

Return to top

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Module Code	**CH5005**
Module Title	**Pharmacology and Pharmaceutics**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	5
Prerequisites	Completion of CH4005 and CH4006 or similar
Suitability	Study Options 1 or 2
Content	The module will incorporate elements of pharmacology, toxicology, immunology and pharmaceutics (including formulation science). In particular students will receive a thorough grounding in the processes of absorption, distribution, metabolism and excretion which underlies many of the toxicological and pharmacological effects of biological agents. In addition, how drug formulation affects the bioavailability of a drug and how the physiology of the human system affects these processes will also be discussed. The module also provides an introduction to the area of immunology. This is important as much of the recent developments in drug development and consequently employment opportunities for our graduates involve antibodies as therapeutic agents. The module then will encompass all of the major factors involved in the effective and safe delivery of therapeutic agents to human populations. ➢ **Autumn Semester: Pharmacology, Immunology & Toxiocology** ❖ ***Immunology*** • Introduction to Immunology • Soluble Mediators • Innate response and antibacterial mechanisms • Adaptive Immunity • MHC • Antibodies: Structure and Function • T cells • Primary and secondary immune responses ❖ ***Introduction to Toxicology*** • general environmental toxins • specific household toxins

- specific drugs as toxins
- toxins in our food and drink
- heavy metal toxins
- pesticides as toxins
- toxicity testing
- teratogenicity, mutagenicity and carcinogenicity

❖ ***Introduction to Pharmacology***

- Introduction to how drugs function – the general principles and molecular aspects, including drug targeting of receptors, ion channels, enzymes, carrier molecules, active and passive cellular transport systems.
- Basic absorption, distribution and excretion of drugs, including movement across body membranes, partitioning into body fat and other tissues, binding of drugs to plasma proteins.
- How drugs act on a specific body system, e.g. the autonomic nervous system, including brief physiological information on the body system being affected.
- Characteristics of the innate and adaptive immune system, including the antigen-antibody reaction, immunoglobulins and cell-mediated immunity.
- Introduction to the different types of toxin, including carcinogens, mutagens, natural toxins, food additives, and what effect they have on the body.
- Introduction to safety and health issues, including CoSHH rules and Maximum and Minimum Exposure Limits.

➢ **Spring Semester: Introduction to Pharmaceutics & Drug Delivery**

❖ ***Introduction to Pharmaceutics***

- Preformulation: Characterization of the solid state: structure, crystalline state, amorphous state, polymorphism. Powders: particle size, eutectic mixtures; control and determination; influence on drug delivery rates. Solution properties: solubility and factors affecting solubility, additives (salting agents, cosolvents, surfactants). Excipients.
- Properties of solutions: viscosity, diffusion, osmotic pressure. Concept of isotonicity and its relevance to injection formulations. Adjustment of solution pH by excipients; the laws of diffusion; influence of pH on transport across membranes and distribution between phases.
- Disperse systems: Colloids, gels, surface-active agents, coarse disperse systems. Surface tension, its measurement and adjustment by excipients.

❖ ***Drug Delivery***

	This refers to approaches, formulations, technologies, and systems for transporting a pharmaceutical compound in the body as needed to safely achieve its desired therapeutic effect. It may involve scientific site-targeting within the body, or it might involve facilitating systemic pharmacokinetics; in any case, it is typically concerned with both quantity and duration of drug presence. Drug delivery is often approached via a drug's chemical formulation, but it may also involve medical devices or drug-device combination products. Drug delivery is a concept heavily integrated with dosage form and route of administration, the latter sometimes even being considered part of the definition. Drug delivery technologies modify drug release profile, absorption, distribution and elimination for the benefit of improving product efficacy and safety, as well as patient convenience and compliance. Drug release is from: diffusion, degradation, swelling, and affinity-based mechanisms. Most common routes of administration include the preferred non-invasive peroral (through the mouth), topical (skin), transmucosal (nasal, buccal/sublingual, vaginal, ocular and rectal) and inhalation routes.
Teaching	Lectures, workshops and practical sessions
Assessment	Study Option **1**: • ABO Blood Group Practical – Autumn (10%) • Pharmaceutics Practical – Spring (10%) • 2 x MCQ tests (10% each) • Exam – MCQ, short and long answer (60%)
	Study Option **2**: • Bespoke assessment, including test and practical.
Last updated	12/04/24 PJW

Return to top

Module Code	**CH5006**
Module Title	**Analytical Science**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Level	5
Prerequisites	Prior study of introductory university-level chemistry
Suitability	• Study Options 1 or 2 • For Pharmaceutical Science, Forensic Science and Biochemistry majors
Content	The module introduces students to the applications of analytical science within analytical biochemistry, clinical chemistry, forensic analysis and the pharmaceutical sciences. It allows students to build their knowledge, practical skills and interpretation skills whilst implementing the analytical process model using scenario-based learning. ➢ **Topics (whole year)** • Introduction to analytical methodology, the analytical process model and sample preparation in analytical science. • Theory of chromatography: Partition coefficients, retention time, capacity factor, selectivity factor, column efficiency and resolution. • Optimisation of column performance, quantitative analysis. • Gas Chromatography (GLC): sample injection, ovens, detectors, GC Columns and stationary phases. • High Performance Liquid Chromatography (HPLC): pumps, columns, detectors. • Partition Chromatography, normal and reverse phase. Ion-Pair chromatography and chiral stationary phases. • Absorption Chromatography (LSC) & Thin Layer Chromatography (TLC). • Introduction to hyphenated Techniques (GCMS, LCMS). • Introduction to electromagnetic radiation and its interaction with matter, including absorption, emission and fluorescence. • Principles and practice of atomic and molecular spectrometry including UV Visible and IR. • Principle and practice of electrophoresis, including gel electrophoresis, iso-electric focusing, immune-electrophoresis and capillary electrophoresis. • Mass Spectrometry • Interpretation of spectra • Applications of all techniques above to analytical biochemistry, clinical chemistry, forensic science and the pharmaceutical sciences. • The relevance of statistics, quality control and quality assurance systems in analytical science • Develop practical analytical skills, and problem solving skills to relate the laboratory work to theoretical aspects of the module. ➢ **Autumn Semester:** • Analytical Tools • Analytical Terminology

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

	• Analytical Problem solving • Introduction to the Electro Magnetic Spectrum • Infra-Red Spectroscopy • Nuclear Magnetic Spectroscopy • Chromatography • High Performance Liquid Chromatography ➢ **Spring Semester:** • Gas Chromatography • Thin Layer Chromatograph • Atomic Spectroscopy • Electrophoresis • UV-Vis Spectroscopy • Mass Spectrometry
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1**: • HPLC assignment (15%) • Practical Test – 60 mins, 20 questions (35%) • Exam (50%)
	Study Option **2:** • Bespoke assessment
	Study Option **3:** • Practical Test – 60 mins, 20 questions
Last updated	12/04/24

Return to top

Module Code	**CH5007**

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Module Title	**Practical and Research Skills in Pharmaceutical Science**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	5
Prerequisites	Prior study of introductory level chemistry/pharmacology
Suitability	Study Options 1 or 2 or 3
Content	This module allows students to learn new laboratory techniques aims to improve their practical skills and data interpretation through a range of experiments that encompass organic synthesis, drug regulation and pharmacology / immunology. It will also provide students with skills and methodologies needed to understand how to partake in a research programme, such as literature searching, data analysis and producing a short critical analysis or a research article. This module aims to provide students with the necessary skills needed to conduct an independent research project at advanced level. Students will be given the opportunity to develop other transferable skills that are important to improving their employability, such as planning and presentation skills. ➢ **Topics:** • Practical techniques for synthetic chemistry. • Use of NMR, infra red and ultra violet spectroscopy and mass spectrometry in structural elucidation • Standard laboratory techniques to determine some the physico-chemical properties (TLC and melting point anlysis) of synthesised compounds • Identifying appropriate literature sources: Chemical Abstracts, Beilstein, Gmelin, scifinder, web of science and inter-library methods, use of information technology and the internet • Methods in planning and execution of research-based projects. Selection of a research paper to prepare an abstract summary. • Application of computers and databases for information retrieval and literature searching. Preparing and planning experimental work • Reporting experimental work in an academic/professional style. • Careers in the pharmaceutical industry. ➢ **Autumn semester:** • practicals, COSHH, risk assessment, spectroscopy, careers.
Teaching	Lectures, workshops and practical sessions

Kingston University London

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Assessment	Study Option **1**: • Oral presentation (30%) • Open-book practical MCQ test (30%) • Coursework portfolio including literature review & COSHH assignment (40%)
	Study Option **2**: • Oral presentation • Coursework portfolio
	Study Option **3**: • Spectra proforma • Open-book practical MCQ test • Coursework portfolio including literature review
Last updated	12/04/24 PJW

Return to top

Module Code	**CH5008**
Module Title	**Crime Scene, Evidence and Law**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	5
Prerequisites	Successful completion of introductory university level forensic science
Suitability	Study Options 1 or 2
Content	In this module, students will be introduced to the duties of all those involved in crime scene processing. They will gain experience of observation and recording at the crime scene, evidence collection, preservation, documentation and chain of custody. The module will cover the role of an expert witness and provide students with knowledge of the UK Criminal Justice system. A detailed familiarity of the core roles and responsibilities within the professional field of forensic science will enhance the student's awareness of future employment opportunities. The group practicals in the crime scene house and the professional conduct and presentation demanded by the mock trials develop key areas of employability. Questions of safety and quality assurance in crime scene processing are also addressed. Students will use the 'Case

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

	Assessment and Interpretation' (CAI) model in relation to the prosecution and defence scenarios and this skill will be assessed during a mock trial. The module will also introduce students to those statistical models used by forensic scientists in the court of law. ➢ **Topics (whole year):** • Role of the forensic personnel at a crime scene and a range of forensic specialists and expert witnesses. • The observation, collection, recording and preservation of evidence from a range of crime scenes. • The UK Criminal Justice System, particularly relating to physical evidence and expert witnesses • The interpretation of evidence using CAI model and relevant statistics • Expert witness report and testimony – The successful completion of a case from assessment and interpretation of evidence, the preparation of a witness statement and oral testimony in court. ➢ **Autumn Semester:** • The forensic process • Crime scene processing: The various roles at the scene, FOA, CSM, SOCO, Specialist services • Various reports produced in Forensics. • Law in Forensic Science • Case assessment, Interpretation and Evaluation of Evidence ➢ **Spring Semester:** • Presenting in Court • Streamlined Forensic Report Writing (SFR) • Types of Evidence: Impression Evidence. • Types of Evidence from a Crime Scene: Glass Evidence • Types of Evidence from a Crime Scene: Body Fluids and Blood Evidence • Case Assessment, Interpretation and Evaluation of Evidence
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1**: • 2 x in-class test (MCQ, short answer questions) (20%) • Group case study presentation (40%) • Individual mock trial (40%)
	Study Option **2**:

	• 1 group presentation (50%) • 1 in-class test (MCQ, short and long answer questions) (50%)
Last updated	12/04/24

Return to top

Module Code	**CH6001**
Module Title	**Organic and Natural Product Chemistry**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of CH5002 Organic and Medicinal Chemistry or similar
Suitability	Study Options 1 or 2 or 3
Course Content:	This module builds upon and develops further topics introduced in the intermediate-level 5 module CH5002, for example, stereoselective synthesis and retrosynthetic analysis. In addition, new topics are introduced such as pharmacognosy, combinatorial chemistry, photochemistry, free radical chemistry and pericyclic reactions. The lectures and associated workshops encourage the development of problem solving and team working skills, in order to prepare students for their future careers. These skills will be practised during laboratory-based exercises, where students will participate in group "mini-projects" which will be assessed using a range of methodologies that include oral presentations, report writing and poster presentations. ➢ **Topics (whole year):** • The role of pharmacognosy in the treatment of various diseases. • Drugs derived from natural sources such as taxol, enediynes, vincristine/vinblastine, cardiac glycosides, antimalarials, anti-inflammatories etc. • Semi-synthetic strategies e.g. 10-deacetylbaccatin III; combinatorial chemistry; and polymer supported peptide synthesis-orthogonal protecting groups. • Stereoselectivity in syntheses: stereoselective double bond formation and diastereoselective nucleophilic additions. • Examples of chiral catalysts and reagents. • Pericyclic reactions (cycloaddition, electrocyclic reactions, sigmatropic rearrangements): Frontier Orbital descriptions of these; thermal and photochemical initiation; stereochemical outcomes.

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

	• Introduction to photochemistry, illustrated isomerism and pericyclic reactions; light storage and photosynthesis examples. • Retrosynthetic analysis using relevant and topical examples: synthons and starting substrates; disconnections and functional group interconversions; 1,1- to • 1, 6-difunctional compounds; C-3 to C-6 carbocycles; advanced strategy in more complex examples. • Radicals: applications in synthesis and in metabolic processes such as aging and anticancer chain (DNA) cutters. • Biosynthesis of precursors terpenes, steroids and fats as well as key natural products such as arachidonic acid/prostaglandins. The use of labelling experiments such 13C in the elucidation of biosynthetic processes and advanced NMR techniques to elucidate the structure of an unknown natural product (group work) • Laboratory practical experiments and a mini-project to supplement the taught material ➢ **Autumn Semester: Organic Synthesis** • Principles and applications of radical chemistry • Photochemistry • Cycloaddition Reactions and Retrosynthetic Analysis • Stereoselectivity and Regioselectivity • Biosynthesis of Natural Products ➢ **Spring Semester: Natural Products Chemistry** • Drugs from Natural Sources and Opiates • Drugs containing the tropine ring • Alkaloids from Ephedra • Biosynthesis of Taxanes – and Other Terpenoids • Taxol • Cholesterol • Cardiac Glycosides • Enediyne Antitumour Drugs • Artemisinin – A Natural Antimalarial
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1**: • Practical 1 report (10%) • Natural products project critical review and presentation (25%) • Practical proformas (10%) • 3-hour exam (50%)

	Study Option **2:** • Mock exam (100%)
	Study Option **3:** • Natural products project critical review and presentation • Practical proforma
Last updated	12/04/24

Return to top

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	Successful completion of intermediate-level study of spectroscopy such as Analytical and Experimental Chemistry CH5004 and Analytic Science CH5006 or similar.
Suitability	Study Options 1 or 2 or 3
Content	This module takes forward the themes of spectroscopy that were introduced at intermediate level (CH5004, CH5006) and develops a more rigorous theoretical footing and advanced applications. In parallel to this, analytical themes are introduced covering electroanalysis, thermal analysis, spectroscopic analysis, radiochemical analysis, and chromatography. ➢ **Topics (whole year):** • Analytical quality systems • Data analysis and measurement uncertainty • Nuclear Magnetic resonance: pulse NMR, 1D and 2D NMR, MRI, Electron spin resonance, analysis of complex mixtures. • Advanced topics in separation science including optimisation of HPLC, fast chromatography, Ion Chromatography hyphenated techniques, capillary electrophoresis • Electroanalytical techniques and applications including potentiometric analysis, ion selective electrodes (ISE), voltammetric techniques, pulse techniques, trace analysis • Radiochemical techniques and applications including alpha, beta and gamma spectroscopy and radioimmunoassay (RIA)

	• Thermal methods techniques and applications; Thermogravimetry (TG) Differential thermal analysis (DTA), Differential sanning calorimetry (DSC) • A comparative review of the various techniques of atomic emission/absorption spectroscopy with regard to cost, performance, applicability and potential for future development leading to an appreciation of the present status of the techniques•Atomic Ion Mass Spectrometry: ICP-MS and Glow Discharge, interface, detector, interferences, isotope dilution analysis and applications • Molecular Mass Spectrometry: ion sources, instrumentation-single and double focussing spectrometers, high resolution mass spectrometry, ion trap and time of flight mass analysers (TOF), quadrupole and tandem mass spectrometers, Fourier-Transform Mass Spectrometry (FTMS), GC-MS, LC-MS • Molecular Fluorescence and Phosphorescence: principles, quantitative analysis by fluorometry, instrumentation and applications, atomic fluorescence, a review of the present status of atomic fluorescence methods, mercury analysers • X-ray techniques: instrumentation, optics, detection and measurement, X-ray fluorescence spectrometry, qualitative and quantitative analysis, electron probe microanalysis and electron microscopes, applications, X-ray diffraction, interpretation of powder diffraction data, applications • Specialised Spectroscopies: e.g. Circular Dichroism, Atomic Force Microscopy, Mössbauer Spectroscopy: principles and applications ➢ **Autumn Semester:** • ICP-AES/ ICP-MS • Raman • Chromatography • Fluorescence/Phosphorescence • Ultra High Performance Liquid Chromatography • Ion sources/Interfaces • Mass spectrometry-analysers • Radiochemistry **Spring Semester:** • Radiochemistry • Electroanalysis • Thermal Analysis • NMR for the analysis of complex mixtures • Future trends in Analytical Science • Further atomic spectroscopy content and Future trends in Analytical Science
Teaching	Lectures, workshops and practical laboratory sessions

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Assessment	Study Option **1**: • Portfolio 1 comprising: 2 online tests, GC-MS,ICP/AAS practicals 10% each (20%) • Portfolio 2: Submission of the practical report NMR/GC-MS/ICP-AAS practicals (20%) • 3-hour exam (60%)
	Study Option **2**: • Portfolio 1 • Portfolio 2
	Study Option **3**: • Portfolio 2 (100%)
Last updated	12/04/24

Return to top

Module Code	**CH6008**
Module Title	**Drug Development**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of pharmaceutical science modules CH5004 or CH5006 or similar
Suitability	Study Options 1 or 2
Course Content	The module deals with the pharmacology involved in the treatment of various disease types and details the synthetic chemistry behind the development of drug molecules and evaluates the structure activity effects from pharmacodynamic and pharmacokinetic perspectives. The module also outlines the process for intellectual property protection and exploitation, toxicological events that might affect the body and the body's immunological response to toxic insult or disease. ➢ **Autumn Semester:** ❖ ***Medicinal Chemistry***

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

	• Overview of the drug discovery process using the 'bench to market' model • Design, discovery and synthesis of lead compounds, encompassing: natural sources, • Combinatorial chemistry, high-throughput screening, rational drug design, computer aided drug design, genomics and proteomics. • Principles of drug development, research strategy, structure of the pharmaceutical industry. • Pharmacokinetics, pharmacodynamics, distribution, elimination of drugs and factors affecting these processes. • Structural modification to improve the pharmacokinetic profile and efficacy of a drug. • Prodrugs: structural modification to improve bioavailability or remove other undesirable properties of a drug. • Patents, intellectual property rights. • In vitro and in vivo tests for evaluation of efficacy, pharmacokinetics and toxicity of drugs • Nucleic acid and compounds targeting DNA and RNA • Anti-bacterial agents and their mode of action • Phytochemistry and Medicines from Nature • Cholinergics, anticholinergics and anticholinesterases • Adrenergic nervous system • The analgesics (non-opioid), their function, uses and mode of action • QSAR and Hansch analysis and applications in the rational design of drugs • The synthesis of medicines, combinatorial synthesis , newer reagents in synthesis, semi-synthesis, solid support synthesis and the role of high-throughput screening in drug discovery • Illustration of the importance of zinc metalloenzymes as targets for pharmaceutical inhibitors. Development of - Angiotensin Converting Enzyme inhibitors for the treatment of hypertension; carbonic anhydrase inhibitors for treatment of glaucoma) • Metalloenzymes and the metabolism of pharmaceuticals in vivo – Cytochrome P-450 • Metals in medicine – inorganic drugs (e.g. cis-platin as an anti-cancer agent, development of second and third generation platinum complexes) ➢ **Spring Semester:** ❖ ***Cardiovascular Pharmacology*** • Function of the normal heart. Mechanical contractility, electrical excitation and E-C coupling. • Symptoms and pathophysiology of congestive heart failure (CHF). Cardiac haemodynamics, pre-load and after-load. Interpretation of the Frank Starling curve and it's relation to the length-tension curve for single cardiac cells. Epidemiology of CHF. • Rationale for drug therapy in CHF. Drugs currently used in the treatment of CHF and their efficacy. Putative new treatments for CHF and their potential to reverse underlying pathology. • Description of coronary artery disease and associated ischaemic heart disease, myocardial infarction and sudden death. Angina pectoris and other indications of disease.

	• Pharmacological treatment of angina pectoris and ischaemic heart disease. • Pathophysiological characterisation of the various arrhythmic diseases and the different drug classes used to treat specific arrhythmic events. ❖ ***Toxico-immunology*** • Importance of T cells, MHC introduction to HIV • The adaptive response 2: Specifically targeting and killing the toxic foreign body by cytotoxic T cells • Activating and switching off T cells: a new direction in the pharmaceutics industry • Tolerance of T cells and lymphoproliferative disorders • Organ transplant: Current toxic immunosuppressive agents and novel induction of immunological tolerance • Allergy: Pathogenesis and treatments by toxic immunosuppressants, pharmacology and novel immunotherapies • Pathogenesis of the immune system that creates tumours: The current toxic immunosuppression and novel immunotherapies used as treatments • Vaccination and its role in the pharmaceutical industry. ❖ ***Neuropharmacology*** • Brain physiology and brief survey of brain anatomy. • Role of the synapse and neurotransmitters in CNS function. • Pathophysiology, epidemiology and symptoms of Alzheimer's Disease (AD). Criteria for diagnosis of AD. Purpose of drug treatment in AD. Mechanism of action of the current therapies for AD. Implications of recent developments in the treatment of AD. • Parkinson's Disease (PD). Description of symptoms and possible pathogenetic causes of PD. Areas of the brain affected by PD. Neurotransmitters and PD. • Pharmacological treatment of PD. Side-effects of PD medication and optimisation of the efficacy of the drug regimen. • Epidemiology and symptomology of schizophrenia.
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1:** • 3-hour exam (60%) • Literature review (10%) • Practical report (10%) • Essay (10%) • Practical (10%)
	Study Option **2**: • assignment/practical assessment.

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

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Last updated	12/04/24

Return to top

Module Code	**CH6009**
Module Title	**Topics in Pharmaceutical Science**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of intermediate university level pharmacology
Suitability	Study Options 1 or 2
Content	This module introduces various aspects of chemical and pharmaceutical industry pertinent to their future career and aims to cover a wide range of topics covering Drug Delivery, Polymers and Biomaterials, Green Chemistry, patents, intellectual property, health and safety, and legislation. Many of the descriptive parts of the module are reinforced by workshops and group debate to develop their communication, teamwork and independent learning skills. There are also lectures, workshops and practical sessions to demonstrate and reinforce the concept learnt. ➢ **Topics:** • Identifying the ideal characteristics for a range of novel pharmaceutical designs such as stability of drugs. • The discipline of particulate science and effects on granulation. Methods of crystal engineering, and effects on macromolecules' stability. • Overview of polymerisation reactions; biochemical routes to natural and synthetic polymers. Outline principles of the environmental degradation of polymers. • Synthetic polymers for biomedical applications: e.g. ophthalmic, prosthetics and dentistry as well as drug delivery. Hydrogels, e.g. for tissue culture media or soft contact lenses. • The structure of the chemical and pharmaceutical industry. marketing of chemicals, patents and licences, health and safety, quality assurance and control. • The principles of sustainable development and 'Green Science', recent developments involving cleaner and safe technologies, Environmental factors and atom utilisation, role of catalysts in waste minimisation.

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

	Industrial (Indicative) • Brief history of the chemical and pharmaceutical industry, roles and rationalisation on the multinational companies. • Patents and licenses, patent medicine and law on pharmaceutics with reference to case studies. • Aspects of marketing and economics in chemical industry. • The development of pharmaceuticals, the roles of authorities such as MHRA, FDA, Medicine Act in legislation, clinical trials. • Ethics in pharmaceutical and chemical industry • Health and safety, quality assurance and control **Polymers (Indicative)** • Making polymers: Introduction to polymerisation - step, chain and ring-opening polymerisation. • Stereoregular polymers; living anionic or free-radical polymers; preparing and crosslinking thermoset resins; biochemical routes to natural and synthetic polymers. • Molecular mass: definitions of number-average, viscosity-average and weight-average molar masses. Determination of number-average and viscosity-average molar masses. • Blends and composites of polymers. Polymers and composites in nature: examples based on proteins or cellulose, such as plant structures, spider silk, bones and teeth. • Synthetic polymers for biomedical applications: e.g. opthalmics, prosthetics and dentistry. • Hydrogels, e.g. for tissue culture media or soft contact lenses. • Glassy and crystalline polymers. Effects of molecular mass and crystallinity on polymer properties and applications. • One or more specialised topics, selected from the following, will be discussed: • Additives for polymers, e.g. fire retardants, plasticisers, anti-oxidants. • Conducting polymers and ferroelectrics. Luminescent plastics for displays and TV screens. • Polymer chemical sensors or biosensors. • Natural and synthetic textile fibres. ➢ **Autumn Semester:** Chemical and Pharmaceutical Industry, Polymers
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1:** • 3-hour exam (50%) • practical proformas: polymer practical and pharmaceutics (35%) • Coursework (15%)
	Study Option **2**:

	• Practical portfolio: Tablet characterisation experiment (100%)
Last updated	12/04/24

Return to top

Module Code	**CH6010**
Module Title	**Forensic Chemistry and Trace Analysis**
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of intermediate university-level forensic chemistry
Suitability	Study Options 1 or 2
Content	This module introduces students to the analytical and forensic techniques encountered in trace and contact evidence analysis. The module focuses on four areas of forensic casework; drugs of abuse, fibre analysis, fire investigation and ballistics. ➢ **Autumn Topics:** ❖ ***Quality*** High quality analysis underpins Forensic Science and hence the Criminal Justice System. This part of the course will explore the regulatory environment in the UK and how it has evolved and may develop into the future. The role of the Forensic Science Regulator, UKAS, ENFSI and the growing use of databases and their impacts on quality will be discussed. Additionally the use of statistics and probability will be explored through evaluation of case studies. ❖ ***Introduction to Fire and Explosions*** These lectures will cover the investigation of fires and scenes of explosions which often require a different approach from the forensic investigator as will be discussed. ❖ ***Introduction to Forensic Toxicology and Drugs of Abuse*** These series of lectures will build on prior knowledge of Forensic Toxicology and Illicit Drug Confirmation. Students will learn the casework practices used for in investigations such as drug overdoses, poisons and suspicious deaths, drug facilitated sexual assault and drink and drug driving. Students will also gain advance skills in alcohol technical defence, back and forward calculations and the interpretation of case law in relation to a range criminal offences. This will

	be complimented by developing knowledge of the analytical procedures such as drug confirmations, new psychoactive substances, method development and validation. ➢ **Spring Topics:** ❖ ***More on Forensic Toxicology and Drugs of Abuse*** ❖ ***Introduction to Fibre Analysis*** Textile fibre transfer has the potential to feature in all manner of investigations and is principally used to link a suspect to a victim or crime scene. ❖ ***Firearms & Ballistics***
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1**: • 3-hour exam (50%) • Practical portfolio: short reports on five practicals (25%) • Case study (25%)
	Study Option **2**: • bespoke assessment
Last updated	12/04/24

Return to top

Module Code	**CH6033**
Module Title	**Inorganic Chemistry 2**
Credits	4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of intermediate level chemistry such as Inorganic Chemistry CH5001 and Organic Chemistry (CH5002) or similar.
Suitability	this module runs in the Spring semester only so is suitable for Study Options 1 or 3

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Chemistry & Pharmacy Modules for Visiting Students 2024/25

Course Content	This module introduces bio-inorganic chemistry and supramolecular chemistry, as well as further developing 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 and 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	Lectures, workshops and practical laboratory sessions
Assessment	• Inorganic chemistry assignment (30%) • Laboratory practical report (20%) • 2-hour exam (50%)
Last updated	12/04/24

Return to top

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

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

Chemistry & Pharmacy Modules for Visiting Students 2024/25

Prerequisites	Substantial prior study of chemistry at intermediate level.
Suitability	Study Options 1 or 2
Content	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. Materials conveyed in lectures will be further reinforced via workshops and laboratory practical classes. Areas covered in the module will be evaluated via summative assessments and final exam, and group presentations, that will test critical thinking, communication skills, team work and handling Q&A. Overall, this module will provide a grounding in commercially and industrially relevant topics in chemistry as well as providing key employability skills. ➢ **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*** • Introduction to green chemistry • Catalysis • Solvents and click chemistry ➢ **Spring Semester – Intellectual Property, Industrial policy & safety, Polymer Chemistry, Green Chemistry, Conducting polymers** ❖ ***Green Chemistry*** • Renewable resources & biodegradation (& transaminase paper for discussion) ❖ ***Intellectual Property, Industrial policy & safety*** • Patents

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

	• Intellectual property relating to chemicals & pharmaceuticals • Health & safety in chemical industry ❖ ***Polymer Chemistry*** ❖ Introduction to polymers ❖ Environmental impact of polymers
Teaching	Lectures, workshops and practical laboratory sessions
Assessment	Study Option **1:** • 2-hour exam (50%) • Group presentation (20%) • Practical portfolio (30%)
	Study Option **2**: • Practical portfolio • Group presentation
Last updated	12/04/24

Return to top

Module Code	**CH6023**
Module Title	**Physical Chemistry 2**
Credits	4 (US) 7.5 (ECTS)
Level	6
Prerequisites	Successful completion of intermediate level chemistry such as Physical Chemistry 1 CH5003 or similar.
Suitability	this module runs in the Autumn semester only so is suitable for Study Options 1 or 2

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Chemistry & Pharmacy Modules for Visiting Students 2024/25

Course Content	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. **Content:** • 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	Lectures, workshops and practical laboratory sessions
Assessment	• Lay summary (30%) • Critique (5%) • Critique (15%) • Practical investigation report (1,500 words) (50%)
Last updated	12/04/24

Return to top