

## **School of Chemistry**

**Head of School** Professor N V Richardson

### **Degree Programmes**

M.Phil: Chemistry

### **Programme Requirements**

#### **Chemistry**

M.Phil.: CH5442 and 60 credits chosen, with the approval of the Director of Teaching from the following: CH4461, CH4511, CH4512, CH4611, CH4612, CH4613, CH4711, CH4712, CH4713, CH5411, CH5511, CH5512, CH5513, CH5514, CH5515, CH5611, CH5612, CH5613, CH5614, CH5615, CH5711, CH5712, CH5713, CH5714, CH5715.

## **Modules**

### **CH4461 Integrating Chemistry**

Credits: 10.0 Semester: 1

Description: This is a general chemistry module aimed at developing and consolidating fundamental aspects of basic understanding. Students will be encouraged to gain a deeper understanding of elementary core material by a combination of discussion, general reading, essay work and problem solving at a more advanced level than previously required. Students will be expected to read externally on related topics. In addition, each student will be required to submit an essay which will be on a topic relevant to the broader issues of chemical study and knowledge. The problems will be aimed at Level 4000 standard.

Class Hour: To be arranged.

Teaching: Two classes each week for 9 weeks.

Assessment: Continuous Assessment = 40%, One Hour Examination = 60%

### **CH4511 Inorganic Reaction Mechanisms and Bioinorganic Chemistry**

Credits: 10.0 Semester: 1

Description: This course aims to develop the students' understanding of the mechanisms that lie behind the reactions of inorganic compounds and to explore the role played by inorganic systems in biology and their growing importance in medicine. There will also be discussion of the mechanisms of action of some inorganic systems in biology which will link the two parts of the module together.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

### **CH4512 Chemistry in the Natural Environment**

Credits: 10.0 Semester: 2

Description: This module is concerned with the role of chemical processes in the Earth's crust responsible for the development of natural resources, such as minerals and petroleum, and the role of chemistry in their exploitation. The effect of natural and anthropogenic processes on the natural environment will also be discussed, particularly with reference to water chemistry, together with chemical routes to safeguard water quality.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

## Chemistry – 5000 Level Modules

### CH4611 Target Synthesis and Medicinal Chemistry

Credits: 10.0 Semester: 1

Description: The module will cover aspects of organic chemistry that are important for the synthesis of biologically active compounds such as pharmaceuticals and agrochemicals. Firstly, fundamental aspects of heterocyclic chemistry will be discussed, with a review of the structure, reactivity and synthesis of heterocyclic systems, which is important as the majority of pharmaceuticals and agrochemicals are heterocyclic compounds. The module will then go on to discuss the process of industrial chemical synthesis. This will include the design of synthetic routes, choice of reagents and conditions, as they apply to the development of processes for the synthesis of commercially important molecules.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

### CH4612 Blockbuster Pharmaceuticals

Credits: 10.0 Semester: 1

Anti-requisite: CH5615

Description: The module will discuss case studies from the most successful pharmaceutical products. How the compounds came to be discovered, what diseases they are targeting, how they work and how they are made and delivered to the market. Compounds that will feature are aspirin, penicillin, AZT, 5-flourouracil, Zantac, viagra,  $\beta$ -blockers, prozac etc.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

### CH4613 Natural Products and Society

Credits: 10.0 Semester: 2

Description: Natural products are low molecular weight compounds produced by plants, fungi and bacteria. They have had a dramatic impact in shaping our society. The course will discuss the impact of natural products in medicine, the food industry and in society more generally. Particular case studies will be covered eg. The discovery and impact of penicillin from a fungal mould, morphine as the most widely prescribed pain killer, taxol from the yew tree as a new generation anticancer compound. The role of natural flavours and fragrances in the food and cosmetics industries will be highlighted as well as the impact of plant alkaloids in medicine.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

### CH4711 Physical Chemistry of Solutions

Credits: 10.0 Semester: 1

Description: This course discusses the physical chemistry of and in solutions. In the first part the thermodynamics of ideal and non-ideal solutions are covered, together with micellar solutions and the chemistry of colloidal suspensions. In the second part solution electrochemistry is covered.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

**CH4712 Energy Conversion and Storage**

Credits: 10.0 Semester: 1

Description: In our efforts to mitigate global warming it is essential to develop new and improved methods of generation and storage of energy. Foremost among these methods are the electrochemical technologies of batteries and fuel cells. In this course we will discuss the technical details and applications of such devices. Particular emphasis will be placed on the underlying electrochemistry and materials chemistry.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

**CH4713 Interactions of Light with Matter**

Credits: 10.0 Semester: 2

Description: This course describes the fascinating properties of matter relevant to their interaction with electromagnetic radiation. Absorption, transmission, reflection and diffraction of light across the electromagnetic spectrum is covered. The properties of matter, particularly in the gas and solid phases, which are important for the emission, modification and transport of light are discussed at the atomic and molecular level.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

**CH5411 Industrial Chemistry**

Credits: 10.0 Semester: 2

Description: This module, to be given by visiting Industrial Chemists, will cover recent advances in the chemical, petrochemical and oil industries.

Class Hour: To be arranged.

Teaching: 2 – 5 lectures and 3 – 4 seminars over 5 – 7 weeks.

Assessment: Continuous Assessment = 100%

**CH5442 Chemistry Research Project for First Year MPhil**

Credits: 60.0 Semester: Whole Year

Programme(s): Compulsory module for MPhil in Chemistry

Description: The research project for MPhil only aims to develop the students' skills in the following areas: experimental design and problem-solving; abstraction, evaluation and interpretation of data in the chemical literature; practical skills and teamwork; communication of results orally and in a dissertation. The project will be selected and supervised by a member of the academic staff. It will contain a significant literature survey.

Class Hour: To be arranged.

Teaching: 540 hours spread over both semesters and summer vacation.

Assessment: Continuous Assessment = 100%

**CH5511 Applications of Transition Metal Compounds**

Credits: 10.0 Semester: 1

Description: This course discusses the Chemistry of metals with particular relevance to their uses in [1] organic transformations and [2] inorganic pharmaceuticals.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

## Chemistry – 5000 Level Modules

### CH5512 Homogeneous and Heterogeneous Catalysis

Credits: 10.0 Semester: 2

Description: The role of catalysis in providing clean and energy efficient routes to a variety of chemicals will be discussed. Examples will be taken from systems where the catalyst is insoluble (heterogeneous) or soluble (homogeneous). Mechanistic details will be emphasised.

Class Hour: To be arranged.

Teaching: 2-3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### CH5513 Supramolecular and Macrocyclic Chemistry

Credits: 10.0 Semester: 2

Description: This course offers a systematic introductory treatment of molecular recognition, emphasizing fundamental concepts of intermolecular interactions and molecular recognition in solution. The nature, strength and directionality of orbital, hydrogen-bonding and hydrophobic interactions will be explored. Spectroscopic and other techniques for studying these interactions will be outlined with examples. Recognition of cations and anions using macrocycle, cryptand and spherand hosts will be discussed, as will the interaction of neutral molecules with cyclodextrins, calixarenes, cyclophanes and clefts with applications in catalysis and enzyme mimics. Recent developments in other applications such as molecular electronics and solar energy conversion will be described.

Class Hour: To be arranged.

Teaching: 2-3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### CH5514 Advanced Coordination Chemistry

Credits: 10.0 Semester: 2

Description: This is a Masters level course in advanced co-ordination chemistry covering the heavier d-block and f-block metals and also the theory behind bonding, magnetism and electronic spectroscopy in d-block metal complexes. At the end of the course students should be in a position to understand fully the nature of bonding in d- and f-block metal systems, to understand the electronic spectra of d-block complexes and to rationalise trends in chemical properties both down and across the periodic table.

Class Hour: To be arranged.

Teaching: 2-3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### CH5515 Characterisation of Solids

Credits: 10.0 Semester: 2

Description: This course aims to describe the most important experimental techniques available for the characterisation of solids, viz. X-ray crystallography, solid-state NMR and transmission electron microscopy. The fundamentals of each technique, together with examples of their applications to inorganic chemistry will be covered.

Class Hour: To be arranged.

Teaching: 2–3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### CH5611 Asymmetric Synthesis and Retrosynthesis

Credits: 10.0 Semester: 1

Description: This course discusses the methods available for the synthesis of chiral compounds. After a detailed introduction to the specialised terminology and analytical methods used, the main methods using chiral auxiliaries, chiral reagents and chiral catalysts will be described. This will then be combined with a consideration of synthetic strategy and total syntheses of several complex chiral compounds will be discussed.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

**CH5612 Natural Products, Biosynthesis and Enzyme Co-factors**

Credits: 10.0 Semester: 2

Description: The course will investigate the biosynthesis of the main natural products groups (polyketides, terpenes, alkaloids). Unifying features of their structures and biosynthesis will be described and methods for studying the biosynthesis of natural products will be taught (isotope tracer methods). The common enzyme co-factors (PLP, TPP, NADH, co-enzyme B12) will be highlighted and their mechanistic role in mediating enzymatic transformations will be explored.

Class Hour: To be arranged.

Teaching: 2–3 weekly lectures over 5–7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

**CH5613 Reactive Intermediates**

Credits: 10.0 Semester: 2

Description: Aspects of the organic chemistry of the most important reactive intermediates *viz.*: carbocations, carbanions, free radicals, carbenes, nitrenes and arynes will be covered. Means of generating each type of reactive intermediate will be introduced. The key reactions of each intermediate will be reviewed and their characteristic reactions highlighted. An understanding of the use of each species in organic synthesis and of their significance in mechanistic analysis will be developed.

Class Hour: To be arranged.

Teaching: 2–3 weekly lectures over 5–7 weeks

Assessment: One-and-a-half Hour Examination = 100%

**CH5614 Drug Discovery, Protein Crystallography and Combinatorial Chemistry**

Credits: 10.0 Semester: 2

Description: This course will examine new methodologies for drug discovery. An overview of the processes of target discovery, lead discovery and lead optimisation will be given. The use of structural biology (protein crystallography, NMR), computational chemistry and combinatorial chemistry in 'rational drug design' will be described. The course will look at the technologies behind combinatorial library design, synthesis and high throughput screening. Broad and focused libraries will be discussed. Several examples will be explored, such as the development of drugs against AIDS and influenza.

Class Hour: To be arranged.

Teaching: 2–3 weekly lectures over 5–7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

**CH5615 Advanced Pharmaceutical Chemistry**

Credits: 10.0 Semester: 1

Anti-requisite: CH4612

Description: The module will discuss case studies from the most successful pharmaceutical products. How the compounds came to be discovered, what diseases they are targeting, how they work and how they are made and delivered to the market. Compounds that will feature are aspirin, penicillin, AZT, 5-fluorouracil, Zantac, viagra,  $\beta$ -blockers, prozac etc.

Class Hour: To be arranged.

Teaching: Two - three lectures over 5–7 weeks, two tutorials, plus extra directed reading.

Assessment: One-and-a-half Hour Examination = 100%

## **Chemistry – 5000 Level Modules**

### **CH5711 Advanced Spectroscopic Methods**

Credits: 10.0 Semester: 1

Description: This module describes the importance of more advanced spectroscopic methods for the elucidation of structure and properties of increasingly complex molecules and materials. Particular attention will be paid to those techniques which exploit synchrotron radiation.

Class Hour: To be arranged.

Teaching: 2 – 3 lectures per week over 5 – 7 weeks and 2-3 tutorials.

Assessment: One-and-a-half Hour Examination = 100%

### **CH5712 Functional Materials / Electrons in Solids**

Credits: 10.0 Semester: 2

Description: The course introduces the physical concepts of dielectrics, semiconductors, and metals. Electronic properties of interfaces and thin films which are fundamental to devices such as microprocessors, lasers in CD players, or solar cells will be discussed.

Class Hour: To be arranged.

Teaching: 2-3 lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### **CH5713 Surface Chemistry**

Credits: 10.0 Semester: 2

Description: The course describes the Chemistry of solid surfaces with particular reference to the structure of metal, oxide and semiconductor surfaces. The techniques available to characterise the uppermost atomic layers of a solid are presented and the novel reactivity of surfaces is linked to applications in sensors, electronic devices, heterogeneous catalysis as well as the processes of corrosion, friction and wear.

Class Hour: To be arranged.

Teaching: 2 –3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### **CH5714 Statistical Mechanics and Quantum Mechanics**

Credits: 10.0 Semester: 2

Prerequisites: CH3711, CH3712

Description: This course builds on 'Statistical Mechanics. Part I', given in CH3712, 'Quantum Theory of Atoms, Molecules and Solids. Part I' given in CH 2102 and 'Quantum Theory of Atoms, Molecules and Solids. Part II' given in CH3711. While the course is mathematically based, the emphasis throughout is on the physical and chemical implications of the mathematical results and how this provides a coherent, quantitative framework for understanding the basis of thermodynamics and the electronic structure of atoms, molecules and solids.

Class Hour: To be arranged.

Teaching: 2 –3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%

### **CH5715 Excited States in Molecules**

Credits: 10.0 Semester: 2

Description: This course discusses the special properties of excited states in molecules. The creation, characterisation and the relevance of excited states in analysis and detection, in the operation of lasers and in their ability to carry out state selective chemistry is described.

Class Hour: To be arranged.

Teaching: 2 –3 weekly lectures over 5-7 weeks.

Assessment: One-and-a-half Hour Examination = 100%