STAGE 3: YEAR OVERVIEW, DEADLINES AND MODULES

Autumn Term: Monday 21 Sept 2009 – Friday 11 Dec 2009
Spring Term: Monday 4 Jan 2010 – Friday 19 March 2010
Summer Term: Monday 19 April 2010 – Friday 11 June 2010

Semester 1: Monday 21 Sept 2009 – Friday 22 Jan 2010
Semester 2: Monday 25 Jan 2010 – Friday 11 June 2010

Sy+ Week and date w/c		Laboratory Classes	Deadline for Lab Reports	Exams
10	21 Sept	**Induction week**		
11	28 Sept	**Advanced Organic Chemistry**		
12	5 Oct		**Molecular Modelling**	
13	12 Oct			
14	19 Oct			
15	26 Oct			
16	2 Nov		Lab reports deadline: 12 noon Fri 6 Nov	
17	9 Nov	**Advanced Physical Chemistry**		
18	16 Nov			
19	23 Nov			
20	30 Nov	**Advanced Medicinal Chemistry**		
21	7 Dec			
Vacation				
25	4 Jan		Lab reports deadline 12 noon Mon 4 Jan	
26	11 Jan			Examinations
27	18 Jan			Examinations
28	25 Jan	**Advanced Inorganic Chemistry**		
29	1 Feb			
30	8 Feb			
31	15 Feb			
32	22 Feb			
33	1 Mar		Lab reports deadline 12 noon Fri 5 Mar	
34	8 Mar	**Information Literacy**		
35	15 Mar			
Vacation				
40	19 Apr			
41	26 Apr			
42	3 May			
43	10 May			
44	17 May			Examinations
45	24 May			Examinations
46	31 May			Examinations
47	7 June			Examinations
48	14 June			Orals: Tues 22 June

Weeks are numbered according to the Syllabus Plus (S+) system. These week numbers will also feature on timetables

ADVANCED PRACTICAL CHEMISTRY	**CHY3001** 40 credits [20 ECTS credits] semesters 1 & 2
Module Leader	Dr S Doherty
Staff	Dr C Bleasdale, Dr S Doherty, Dr BR Horrocks, Dr JG Knight and Dr Z MacMillan
Prerequisites	CHY2101, CHY2201, CHY2301
Co-requisites	Stage 3 chemistry modules (= 60 credits at Honours Level)
Aims	To practise and develop skills in practical inorganic, organic, and physical or medicinal chemistry; in searching and reading the chemical literature, including the use of electronic databases and journals; in writing reports.
Timetabled sessions	Information Literacy: Lectures, 4 h Laboratory: Monday 2-5 and Tuesday 9-4, or Thursday 2-5 and Friday 9-4, as allocated, for three 5 week blocks. Seminars 20h
Assessment	Information literacy exercises (10%) In-course assessment of practical components (3 x 30%)

Intended Learning Outcomes
At the end of this course, students should:

- have improved their skills in information literacy
- be aware of further procedures commonly used in practical chemistry, particularly in the research environment
- be competent in assembling and/or using apparatus, and in working with chemical substances, with due regard to safety
- be competent in observation, note taking, and the reporting of results
- be able to manage their time

Module Structure
The practical work is in three 5 week blocks of 10 h per week, dealing principally with Organic Chemistry (weeks 10-15). Physical or Medicinal Chemistry (weeks 17-21), Inorganic (weeks 28-32). These are followed by information literacy.

There are separate component leaders and separate documentation/manuals for each of these components.

For the practical classes students will normally work in pairs but each student will produce individual reports as required.

All assessment requirements of students for each component of the course must be met before the beginning of the following block or examination period.

Attendance and Assessment
Attendance will be monitored daily during the practical blocks and absences of more than 15 days will result in a mark of zero for the practical component.

Organic Chemistry Laboratory Course, JGK
Each student pair is assigned **five** experiments from the following list:

1 Investigations into S_N1 and S_N2 Reactions
2 An investigation into the Stereoselectivity of Wittig Reactions
3 Synthesis of a Queen Honeybee Pheromone
4 Completion of the Synthesis of Queen Substance
5 Use of an Acetal Protecting Group in Synthesis
6 Synthesis of Jacobsen's Catalyst
7 Discovering Selectivity in the Diels-Alder Reaction

Physical Chemistry Laboratory Course, BRH

Each student pair is assigned **four** experiments from the following list:

1 Computational chemistry
2 Scanning tunneling microscopy
3 A conductive polymer: polypyrrole
4 UV/VIS spectroscopy
5 A dye-based photovoltaic cell
6 Fluorescence titration of DNA
7 Enzyme kinetics – urease inhibition
8 Determination of calcium using a potentiometric sensor
9 Infrared spectroscopy of porous silicon
10 Investigation of the visible spectra of metal nanoparticles

Medicinal Chemistry Laboratory Course, ZM

Each student should carry out **five** experiments comprising one from experiments 1 and 2, one from experiments 3, 4, and 7, and one from experiments 5 and 6.

1 A Quinoline Synthesis
2 The Hantzsch Pyridine Synthesis
3 Resolution of *Racemic*-Alanine
4 Synthesis of the Pheromones 4-Methyl-3-heptanol and 4-Methyl-3-heptanone
5 A Study of Cholestan-3,5,6-triol and Some of its Acetates
6 The Baker-Venkataraman Synthesis of Flavones
7 Reduction of Ethyl 3-oxobutanoate using Baker's Yeast

Inorganic Chemistry Laboratory Course, SD

Each student is assigned **five** experiments from the following list:

1 Vanadium Chemistry: Coordination Chemistry and Catalysis
2 Early Transition –Metal Polyoxoanions: Metal Oxide Chemistry in Organic Solvents
3 Ferrocene $(\eta^5\text{-}C_5H_5)_2Fe$, and its Derivatives
4 Phenanthroline Complexes: Stoichiometry of $[Fe(phen)_3]^{2+}$ Resolution and Optical Activity of $[Ni(phen)_3]^{2+}$
5 Use of Liquid Ammonia as a Solvent – Synthesis of a Diphosphine
6 Phosphazenes

Information Literacy, CB

Workshops will introduce, practice and assess information literacy skills including the avoidance of plagiarism, and summarizing the primary scientific literature.

Coursework Type	**Date given**	**Date to hand in**	**Feedback**
Information Literacy	8 March	3 May	within 4 weeks
Practical report	weekly	within 1 week	within 4 weeks
Oral feedback session	after 1st report	n/a	during oral feedback session

CHEMICAL BIOLOGY	**CHY3007** 10 credits [5 ECTS credits] semester 2
Module Leader	Dr EM Tuite
Lecturers	Professor BT Golding, Professor RA Henderson, and Dr EM Tuite
Prerequisites	CHY2101, CHY2201,CHY2301, CHY2103
Aims	The module aims to provide students with an overview of aspects of chemical biology in a manner that is cross-disciplinary and provides a thorough understanding of: catalysis in the context of biological reactions; the roles of cofactors and metal ions in biomolecule structure and function; the biological chemistry of selected proteins; the application of biomimetic chemistry to elucidate the details of the biological reactions; biophysical techniques particularly in the context of nucleic acids
Timetabled sessions	Lectures and seminars 24 h
Assessment	2h exam at end of semester 2 (90%) Coursework (10%)

Intended Learning Outcomes

At the end of this course, students should understand:

- the modes of enzymatic catalysis and the roles of amino acid functional groups, metal ions and coenzymes
- detailed mechanistic pathways for specific coenzymes
- protein structures and the modes of metal ion binding to these macromolecules
- the interactions and functions of metal sites in proteins
- the roles of metal ions in small molecule transport and activation
- the structure, dynamics, and function of nucleic acids.

Lectures

Basic Principles of Chemical Biology, BTG

1 Overview of the role of amino acid side-chains, metal ions and coenzymes in catalysis
2 Characteristics of enzymes: stability, substrate specificity, stereospecificity, catalytic groups, factors affecting catalysis, enzyme kinetics
3 Model systems for enzymes (probing proximity effects, solvation, strain), acid-base and nucleophilic catalysis
4 Overview of selected enzyme mechanisms including those with no cofactor/metal (e.g. glutathione transferases)

Action of Selected Cofactors, BTG

5 Redox cofactors (BTG)
6 Small molecule activation by non-metallic cofactors (BTG)
7 Radical enzymes (BTG)

Metalloproteins Exemplified by Nitrogenase, RAH

8 The functions of metal sites in proteins. Metal centres and metal transport/storage sites. Substrate activation by the entire active site.
9, 10 Nitrogen fixation

Chemical Biology of Dioxygen, RAH

11 How biology uses metal centres in proteins to control the reactivity of dioxygen
12 Metabolism and O_2: removing toxic O_2^- (superoxide dismutase) and O_2^{2-} (peroxidases and catalases)
13 Activation of saturated hydrocarbons by cytochrome P_{450}
14 Methane monooxygenase

Biophysical Chemistry and Nucleic Acids, EMT

15	Weak forces in biochemistry
16	Structure of DNA
17	Biological role of DNA
18	Binding to DNA
19, 20	Recombinant DNA and cloning
21	Sequencing and electrophoresis

Revision Seminars, BTG, RAH and EMT

22	BTG topics
23	RAH topics
24	EMT topics

Assignment, BTG, RAH and EMT
Students will choose a recent publication relevant to chemical biology from a list prepared by BTG, RAH and EMT. They will produce an A4 sized poster summarising the content of this paper. The list will be posted on the Stage 3 noticeboard in the week beginning 8th February. The deadline for submission (either electronically to EMT (as PDF, PPT or doc) or as hardcopy to the School Office is 12 noon on Friday 23rd April 2010.

Coursework

Type	Date set	Deadline
Poster	Week 30 w/c 8th Feb 2010	Week 40 Friday 23rd April 2010, 12 noon

Reading References

An Introduction to Enzyme and Coenzyme Chemistry. T Bugg, Blackwell Science, 2nd edition, 2004 IBSN: 0865427933

The Organic Chemistry of Biological Pathways, JE McMurry and TP Begley, Roberts & Co, Colorado 2005 ISBN: 0974707716

Bio-inorganic Chemistry: Inorganic Elements in the Chemistry of Life. W Kaim and B Schwederski, Wiley, 1994 IBSN: 047194369X

Principles of Bioinorganic Chemistry. SJ Lippard and JM Berg, University Science Books, 1994 IBSN: 0935702733

Nucleic Acids: Structure, Properties and Functions, VA Bloomfield, DM Crothers and I Tinoco, Jr, University Science Books, 2000 ISBN: 0935702490

ADVANCED ORGANIC CHEMISTRY	**CHY3101** 20 credits [10 ECTS credits] semester 1 & 2
Module Leader	Dr MJ Hall
Lecturers	Dr MJ Hall and Professor M North
Prerequisites	CHY2101
Aims	To equip students with the necessary knowledge and understanding for them to study organic chemistry at Stage 4; to further enhance the students' knowledge of the chemistry of aldehydes, ketones, esters, amides and related species; to allow students to design syntheses of compounds containing carbonyl groups; to illustrate the rich and diverse chemistry of the carbonyl group and to show how this can be logically predicted; to introduce the concept of retrosynthetic analysis; to show how the chemistry of the carbonyl unit can be used in total syntheses. To show the importance of carbonyl reactions in enzyme chemistry. To highlight the use of organo-element compounds in the synthesis and reactions of carbonyl compounds.
Timetabled sessions	Lectures 34h
Assessment	3h exam at end of semester 2 (100%)

Intended Learning Outcomes

At the end of this course, students should:

- understand the methods available for the synthesis of compounds containing a C=O bond, including reaction mechanisms and an appreciation of the scope and limitations of each method
- understand the concept of nucleophilic addition to a carbonyl bond and the factors that determine the subsequent chemistry following nucleophilic addition. Students should understand the relevant reaction mechanisms
- understand the ways in which enolates can be prepared including control of regio- and stereochemistry
- understand the ways in which enolates react with electrophiles including reaction mechanisms
- understand the factors that determine the regiochemistry of reactions involving alpha,beta-unsaturated carbonyl compounds
- understand how and why the chemistry of the C=N group is both similar and different to that of the C=O group
- be familiar with the concept of retrosynthetic analysis and be able to apply this technique to compounds containing or derived from carbonyl groups
- appreciate the importance of carbonyl based chemistry in synthesis
- be able to apply knowledge from the course to unseen syntheses; including knowledge of reagents, solvents and mechanisms for transformations and the ability to predict mechanisms and products from reactions

Lectures

Synthesis of the C=O group, MN

1-3 Oxidation of alcohols; chromium (Jones, PCC, PDC), ruthenium (TPAP), Swern, hypervalent iodine and MnO_2.
4 Rearrangments, alkyne hydration and hydroboration
5 Oxidative cleavage of C=C; ozonolysis, OsO_4/$NaIO_4$ and the Wacker oxidation
6-7 Addition of hydrides and carbanions; reaction with carboxylic acids, esters, imines and Weinreb amides
8 Aromatic aldehydes and ketones, dithianes and the Benzoin condensation

Nucleophilic addition to C=O, MJH

1, 2 General mechanisms for nucleophilic attack on C=O and C=N
3 Nucelophilic addition of hydrides; uses and selectivity
4 Nucelophilic attack of organometallics; synthesis of organometallics and selectivity
5 Conjugate additions; hard vs soft nucleophiles and the control of 1,2- versus 1,4-addition to alpha,beta-unsaturated carbonyl compounds
6, 7 Conversion of C=O into C=C using nucleophilic organoelement chemistry; phosphorous ylides (Wittig and Horner-Wadworth-Emmons), silicon stabilised carbanions (Peterson), alpha-sulphonyl carbanions (Julia)
8 Conversion of C=O into epoxide using nucleophilic organoelement chemistry; sulphur ylides

Enolate chemistry, MN

1 Formation of enolates and pKa
2, 3 Enolate alkylation; O vs C alkylation, kinetic vs thermodynamic control, 1,3-dicarbonyls and the use of malonates in synthesis
4 Enamines; formation and reactions
5, 6 The aldol reaction; aldol, dehydration of products, intramolecular aldol and cross aldol
7 Acylation of enolates; Claisen and Dieckmann condensations
8 Tandem processes; Darzens, Baylis Hillman, Robinson etc.

Carbonyl Chemistry in Synthesis, MJH

1 Classical synthesis and synthetic stratergy
2 Retrosynthetic analysis
3 Protecting group chemistry
4-8 Syntheses of specific molecules drawn from the classical and recent literature and covering molecules of theoretical interest, natural products and pharmaceuticals to highlight the application of carbonyl chemistry

Reading References

Organic Chemistry, J Clayden, N Greeves, S Warren and P Wothers, Oxford University Press, 2000 IBSN: 0198503466

Core Carbonyl Chemistry, J Jones, OCP47, Oxford University Press, 1997 IBSN: 0198559593

Oxidation and Reduction in Organic Synthesis, T J Donohoe, OCP6, Oxford University Press, 2000 IBSN: 0198556640

Organic Synthesis: The Roles of Boron and Silicon, S E Thomas, OCP1, Oxford University Press, 1991 IBSN: 0198556624

Organic Synthesis, C Willis and M Wills, OCP31, Oxford University Press, 1995
IBSN: 0198557914

CHEMICAL TOXICOLOGY	**CHY3102** 10 credits [5 ECTS credits] semester 1
Module Leader	Dr C Bleasdale
Lecturers	Dr C Bleasdale and Professor BT Golding
Prerequisites	CHY2101, CHY2103
Aims	To introduce the principles of toxicology and drug and toxin metabolism; to equip students with a knowledge and understanding of the mechanism of toxicity of a range of chemicals encountered in the environment and workplace.
Timetabled sessions	Lectures and seminars 18 h
Assessment	2h exam at end of semester 1 (80%), assignment (20%)

Intended Learning Outcomes

At the end of this course, students should:

- understand of the principles of adsorption, distribution, metabolism and excretion of chemicals
- understand basic pharmacokinetics/toxicokinetics
- know about the role of glutathione
- understand how chemicals interact with DNA and proteins
- be familiar with the mechanisms of carcinogenesis of selected chemicals
- understand radical chemistry and the relevance of radicals in toxicology
- know about oxidative stress
- know about industrial toxicants and environmental disasters
- understand the toxicology of natural marine, food and plant toxins
- know about the toxicology of substances suspected in murder cases and the analytical methods and forensic evidence used to investigate these

Lectures

1, 2 Principles of Toxicology (CB)
3, 4 Drug Metabolism: Principles (BTG)
5, 6 Drug Metabolism: Case Studies (BTG)
7, 8 Oxidative Stress (CB)
9, 10 Carcinogenesis (BTG)
11 Industrial Toxicants (CB
12 Natural Marine Toxins (CB)
13, 14 Food and Plant Toxins (BTG)
15 Molecules of Murder
16 Forensic Toxicology

Seminars

1, 2 Revision and sample exam papers

Assignment

Students are asked to find a recent news item of relevance to toxicity and to prepare a one page poster.

Coursework

Type	Date set	Deadline
Poster	w/c 28 September	Friday 6th Nov 12 noon

Reading References

Principles of Biochemical Toxicology, 2nd edition, JA Timbrell, Taylor and Francis, 1991 IBSN: 0850668328

Fundamental Toxicology for Chemists, JH Duffus and HCJ Worth, The Royal Society of Chemistry, 1996 IBSN: 0854045295

Medicinal Chemistry, Principles and Practice, 2nd edition, FD King ed, The Royal Society of Chemistry, 2002 IBSN: 0854046313

CHEMOTHERAPY	**CHY3103** 10 credits [5 ECTS credits] semester 2
Module Leader	Professor RJ Griffin
Lecturers	Professor RJ Griffin and Dr IR Hardcastle
Prerequisites	CHY2101, CHY2103, CHY3102
Aims	To introduce the basic concepts of the aetiology of cancer and pathogenic disease; to impart an understanding of the host-pathogen relationship, and the concepts of selective toxicity and resistance; to equip students with an understanding of the basic principles of chemotherapy of cancer and infectious disease; to provide an understanding of the molecular mechanisms underpinning the action of anticancer and anti-infective drugs.
Timetabled sessions	Lectures and seminars 22h
Assessment	Exam 2h at the end of semester 2 (100%)

Intended Learning Outcomes

At the end of this course, students should:

- understand the basic principles of chemotherapy
- have a reasonable knowledge of the various classes of antitumour and anti-infective agents
- understand the mechanism of action of chemotherapeutic agents at the molecular level
- be familiar with the chemical structures of the more common pharmacophores of anticancer and anti-infective drugs

Lectures

Cancer Chemotherapy, IRH

1 Introduction to cancer
2. DNA reactive drugs
3 Antimetabolites
4 DNA interactive antitumour agents
5 Inhibitors of DNA processing
6 Antiendocrine drugs
7 Targeted therapies - ADEPT
8 New approaches to cancer chemotherapy
9 New therapies: Targeting the EGF receptor pathway
10 New therapies: Kinase targets in leukemia

Chemotherapy of Infectious Diseases, RJG

1 Introduction and historical overview
2 Principles of antimicrobial chemotherapy
3 Antibacterial agents – Penicillin and related β-lactam
4 Antibacterial agents – Glycopeptides, quinolones, and oxazolidinones
5 Antifungal agents – Polyenes and azoles
6 Antifungal agents – Azoles and other antifungals
7 Metronidazole
8 Malaria and its treatment
9 Antiviral chemotherapy
10 Aciclovir, oseltamiuir and related antiviral agents

Reading references

Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics, L. Pecorino. Oxford University Press, 2nd edition, 2008, ISBN: 0199211485

The Anticancer Drugs, WB Pratt, RW Ruddon, WD Ensminger and J Maybaum, Oxford University, Press, 1994, ISBN: 0195067398

Antimicrobial Chemotherapy, D. Greenwood, R. Finch, P. Davey, and M Wilcox, Oxford University Press, 5th edition, 2007 ISBN: 978-0198570165

The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press, 2003, ISBN: 0126437327

Life Saving Drugs: The Elusive Magic Bullet (RSC Paperbacks), J. Mann. RSC, 2004 ISBN: 0854046348

ADVANCED PHYSICAL CHEMISTRY	**CHY3201** 20 credits [10 ECTS credits] semester 1

Module Leader	Professor A Harriman
Lecturers	Professor A Harriman, Professor A Houlton and Dr PR Briddon
Prerequisites	CHY2201
Aims	To explain the energetics and dynamics of chemical reactions in terms of detailed molecular behaviour; to provide an understanding of chemical nanoscience, and to review selected advanced experimental techniques. To practise and develop skills in molecular modelling.
Timetabled sessions	Lectures 32, Seminars 8h, Practicals 6h
Assessment	Exam 2h at end of semester 1 (70%), Class test (15%), Practical assessment (15%)

Intended Learning Outcomes

At the end of this course, students should have:

- an understanding of reaction dynamics, including transition state theory and fast reactions
- an appreciation of how the rate of reaction depends on the available energy content.
- familiarity with the laws of molecular energy transfer
- an understanding of the theoretical background to and strengths and limitations of some techniques in molecular modelling
- developed skills in performing some simple types of computer modelling of molecules
- an understanding of the emerging field of chemical nanoscience
- an appreciation of the methodology used to fabricate and examine nanoscale materials

Lectures

Energetics and Dynamics, AHa

1 Molecular photophysics
2 Potential energy surfaces
3 Radiative decay
4 Nonradiative processes
5 Energy-gap law
6 Isomerisation
7,8 Energy transfer
9 Spin restriction
10,11 Marcus theory
12 Revision seminar

Molecular Modelling, PRB

1. Introduction to molecular modelling: types, scope, limitations
2. Molecular force fields: theoretical basis, construction, examples, applications, limitations
3. Some quantum concepts: Molecular Orbitals (MOs) and LCAO; self-consistency
4. Semi-empirical methods: PM3, AM1
5. Basis functions: building accurate descriptions of MOs.
6. *Ab initio* quantum chemistry: Hartree Fock and Density functional theories
7. *Ab initio* quantum chemistry in practice: examples.
8. Revision Seminar

Chemical Nanoscience, AHo

1 Introduction to Chemical Nanoscience
2, 3 Nanomaterials – an overview. Dimensionality, fabrication/synthesis, electronic structure, quantum confinment

5, 6 Scanning Probe Microscopies
7 Spectroscopic methods for surfaces analysis
8-10 Nanoparticles, nanowires/tubes and nanoscale films
11 Application of nanomaterials
12 Revision session

Reading References

Physical Chemistry, PW Atkins, Oxford University Press, 1998, 8th Edition ISBN: 0198501013

Principles of Physical Chemistry, H Kuhn, HD Forsterling, John Wiley, 1999
ISBN: 0471965413

Physical Chemistry, Silbey, Alberty, Bawendi, 4th Edition,.John Wiley, 2005
ISBN: 0471658979

Nanoscale Science and Technology, Ed. Kelsall, Hamley, Geoghegan, John Wiley, 2005
ISBN: 0470850868

ADVANCED INORGANIC CHEMISTRY	**CHY3301** 20 credits [10 ECTS credits] semester 2
Module Leader	Professor A Houlton
Lecturers	Dr S Doherty, Professor A Houlton and Dr KJ Izod
Prerequisites	CHY2301
Aims	To introduce the fundamental principles and reactions of organometallic chemistry; to introduce concepts of homogeneous catalysis; to demonstrate the diverse chemistry of the s- and p-elements; to discuss inorganic aspects of biological systems
Timetabled sessions	Lectures and seminars 42h
Assessment	Exam 3h at end of semester 2 (100%)

Intended Learning Outcomes

At the end of this course, students should have:

- an understanding of organometallic synthesis and reaction mechanisms
- familiarity with homogeneous catalysis using organometallic compounds
- an understanding of the properties and reactivity of organometallic compounds
- a sound knowledge of the organometallics of groups 1, 2 and 13
- an understanding of the concepts of electron deficiency and multi-centre bonding and a good knowledge of the chemistry of boranes and related cluster compounds
- familiarity with low oxidation state and multiply-bonded compounds of the p-block elements
- an understanding of some basic principles of bioinorganic chemistry
- an understanding of basic aspects of metalloprotein structure and metal ion binding groups
- an understanding of the structure, function and mechanism of action of myoglobin and haemoglobin
- an understanding of Pt-containing antitumour drugs and their mode of action
- an understanding of aspects of contemporary inorganic chemistry research

Organometallic Chemistry, SD

Lectures

1 Background and introduction
2 The 18-Electron rule
3 Important ligand types; carbonyl (bonding and binary carbonyls)
4 Pi-ligands, hydrides, phosphines
5 The synthesis of organometallic compounds
6, 7 Organometallic reaction mechanisms 1. Reaction at the metal: ligand substitution, oxidative addition and reductive elimination
8, 9 Organometallic reaction mechanisms 2: Reactions involving the ligand: migratory insertion, reductive elimination and nucleophilic additions and abstractions
10, 11 Transition metal carbene complexes: synthesis, structure and reactivity
12, 13 Homogeneous catalysis: an introduction

Comparative Main Group Chemistry, KJI

1 General principles. Complexes of the s-elements: macrocycles and the macrocyclic effect, alkalides and electrides
2-4 Organometallics of the electropositive metals: an introduction to electron-deficient compounds
5-7 More electron-deficient compounds: boranes and carboranes, Zintl ions
8, 9 Low oxidation states of the p-block elements (groups 13 and 14)
10, 11 E=E bonds (groups 14 and 15); synthesis and reactions. Phosphorus (V) ylides and related compounds
12, 13 E=E' bonds – stability, synthesis and reactions

1,2 An introduction to bioinorganic chemistry; the essential metals, metal ion overload-deficiency and treatments.
3,4 An introduction to metalloproteins. Protein structure, metal ion binding groups, protein function and role of metal ions.
5,6 Myoglobin- protein structure and function, haem group, oxidation and spin states of the metal centre before and after oxygen coordination
7,8 Haemoglobin – protein structure and function, comparison with Mb, the cooperative nature of oxygen binding in haemoglobin
9,10 Metallo-enzymes – details of the structure and function of Zn and Fe-containing systems
10,12 Pt-containing anti-tumour drugs. Discovery, metal ion binding in DNA, mode of action, side effects.

Reading References

Organometallic Chemistry, GO Spessard, GL Miessler, Prentice Hall,1997 IBSN: 0136401783

Organotransition Metal Chemistry, AF Hill, Royal Society of Chemistry tutorial text IBSN: 0854046224

Chemistry of the Elements, 2nd edition, NN Greenwood, A Earnshaw, Butterworth-Heinemann, 1997 IBSN: 0750633654

Bio-inorganic Chemistry: Inorganic Elements in the Chemistry of Life, W Kaim and B Schwederski, Wiley, 1994 IBSN: 047194369X

Principles of Bioinorganic Chemistry, SJ Lippard and JM Berg, University Science Books, 1994 IBSN: 0935702725

Supplementary Reading
Advanced Inorganic Chemistry, FA Cotton, C Murillo, E Wilkinson, M Bochmann and R Grimes, John Wiley, 1999, 6th edition IBSN: 0471199575

Main Group Chemistry, AG Massey, John Wiley, 2000, 2nd edition IBSN: 0471490393

PROBLEM SOLVING A	**CHY3401** 10 credits [5 ECTS credits] semesters 1
Module Leader	Professor RA Henderson
Lecturers	Dr AC Benniston, Professor RA Henderson, Dr AR Pike and Dr E M Tuite
Prerequisites	CHY2101, CHY2201, CHY2301
Aims	To reinforce chemical principles learnt in stage 2 chemistry; to show how to apply fundamental chemical principles to solving multi-disciplinary and inter-disciplinary problems in contemporary chemistry; to provide experience in problem solving in a wide range of applied situations.
Timetabled sessions	Lectures 1h per week and Seminars 2h per week for 10 weeks 2x 2h Mock Examination Sessions
Assessment	Assessment (20%) 'Open book' exam 3h at the end of semester 1 (80%)

Intended Learning Outcomes

At the end of the course students should be able to:

- identify the fundamental chemical basis of a problem
- apply chemical principles to a wide range of contemporary problems
- apply general chemical knowledge to the solution of a problem in a specialist area
- practice the application of rational chemical arguments to solve problems in areas of contemporary chemistry

Teaching
Each week a lecture will highlight an aspect of problem solving. The problems will contain an element of medicinal or biological chemistry. Problem sheets will be distributed and the students will go through these, with staff during the workshop sessions later the same week.

The problem solving sessions will be based on chemical principles learnt in Stage 1 and 2 modules, together with a little new material introduced in the lectures associated with this Problem Solving course.

Examination
The examination will be of the 'open book' type. The examination is worth 80% of the module mark.

Students are permitted to take any written material (text books, lecture notes, catalogues etc) into the examination.

At the end of the course students must submit their portfolio to be marked. This mark is worth 20% of the module mark. The date the portfolio must be submitted will be announced at the beginning of the course.

Coursework

Type	**Date set**	**Deadline**	**Feedback**
Question sheet	Weekly in workshop	Completed in workshop	Model answers at end of each Workshop

PROBLEM SOLVING B	**CHY3402** 10 credits [5 ECTS credits] semester 2
Module Leader	Professor RA Henderson
Lecturers	Dr AC Benniston, Professor RA Henderson, Dr AR Pike and Dr E M Tuite
Prerequisites	CHY2101, CHY2201, CHY2301
Aims	To reinforce chemical principles learnt in Stage 2 chemistry; to show how to apply fundamental chemical principles to solving multi-disciplinary and inter-disciplinary problems; to provide experience in problem solving in a wide range of applied situations; to provide experience in problem solving in a wide range of applied situations.
Timetabled sessions	Lectures 1h per week and Seminars 2h per week for 10 weeks 2x 2h Mock Examination Sessions
Assessment	Assessment (20%) 'Open book' exam 3h at the end of semester 2 (80%)

Intended Learning Outcomes

At the end of the course students should be able to:

- identify the fundamental chemical basis of a problem
- apply chemical principles to a wide range of contemporary problems
- practice the application of rational chemical arguments to solve problems in the areas of contemporary chemistry
- apply general chemical knowledge to the solution of a problem in a specialist area

Teaching
Each week a lecture will highlight an aspect of problem solving. Problem sheets will be distributed and the students will go through these, in smaller groups, with staff during the workshop sessions later the same week.

The problem solving sessions will be based on chemical principles learnt in Stage 1 and 2 modules, together with a little new material introduced in the lectures associated with this Problem Solving course.

Examination
The examination will be of the 'open book' type. The examination is worth 80% of the module mark.

Students are permitted to take any written material (text books, lecture notes, catalogues etc) into the examination.

At the end of the course students must submit their portfolio to be marked. This mark is worth 20% of the module mark. The date the portfolio must be submitted will be announced at the beginning of the course.

Coursework

Type	**Date set**	**Deadline**	**Feedback**
Question sheet	Weekly in workshop	Completed in workshop	Model answers at end of each Workshop