STAGE 1: 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

S+ Week and date w/c		**Laboratory Classes**	**Deadline for Lab Reports**	**Exams etc**
10	21 Sept	**Induction Week**		
11	28 Sept	**CHY1102** Introductory Practical		
12	5 Oct			
13	12 Oct			
14	19 Oct			
15	26 Oct			
16	2 Nov		**CHY1102** 12 noon Fri 6 Nov	Assessments (some modules)
17	9 Nov	**CHY1101** Organic Practical		
18	16 Nov			
19	23 Nov			
20	30 Nov			
21	7 Dec			
Vacation				
25	4 Jan		**CHY1101** 12 noon Mon 4 Jan	
26	11 Jan			Examinations
27	18 Jan			Examinations
28	25 Jan	**CHY1201** Physical Practical		
29	1 Feb			
30	8 Feb			
31	15 Feb			
32	22 Feb			
33	1 Mar		**CHY1201** 12 noon Fri 5 Mar	Assessments (some modules)
34	8 Mar	**CHY1301**		
35	15 Mar			
Vacation				
40	19 Apr	Inorganic Practical		
41	26 Apr			
42	3 May			
43	10 May		**CHY1301** 12 noon Fri 14 May	
44	17 May			Examinations
45	24 May			Examinations
46	31 May			Examinations
47	7 June			Examinations

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

BASIC ORGANIC CHEMISTRY	**CHY1101** 20 credits [10 ECTS credits] semester 1 & 2
Module Leader	Dr JG Knight
Lecturers	Dr JG Knight, Professor M North
Prerequisites	A level Chemistry
Aims	To introduce the basic principles of organic chemistry; the use of curly arrows; the chemistry of the common functional groups, and to describe the important reactions of these groups; to introduce basic concepts of reaction mechanisms in organic chemistry; to introduce basic aspects of spectroscopy; to introduce some essential techniques of experimental organic chemistry.
Timetabled sessions	Lectures and assessment 42h, Tutorials 8h Practicals 2 x 3h per week for 5 weeks
Assessment	1½ h exam at the end of semester 1 (30%) 1½ h exam at the end of semester 2 (30%) In course assessment (2 x 7.5%) In course assessment for practical work (25%)

Intended Learning Outcomes

At the end of this course, students should:

- understand the basic principles of organic chemistry
- appreciate functional group chemistry including the chemistry of alkenes, alkynes, haloalkanes, alcohols and amines
- be familiar with the chemistry of carbonyls and carboxylic acids
- be familiar with basic spectroscopic identification of organic compounds

Lectures

Basic Principles of Organic Chemistry, JGK

1 Drawing and naming molecules
2 Orbitals and hybridisation
3, 4 Curly arrows for writing reaction mechanisms
5 Delocalization and conjugation
6 Acids, bases and pKa
7 Equilibria, rates and mechanisms
8, 9 Stereochemistry and isomerism
10 Conformation and cyclic compounds

Carbonyls and Carboxylic Acids, JGK

1 Overview of carbonyl functional groups. Structure and electronic configuration of carbonyl compounds. Relative energies and shapes of the molecular orbitals σ, $\sigma*$, π, and $\pi*$. Understanding reactions in terms of simple orbital interactions
2, 3 Nucleophilic addition to the carbonyl group
4, 5 Nucleophilic substitution at the carbonyl group
6 Acid catalysed ester formation/hydrolysis and base mediated ester hydrolysis. Hydrolysis of amides and nitriles
7 Addition of Grignard reagents to carboxylic acid derivatives. Summary of nucleophilic substitution at the C=O group
8, 9 Nucleophilic substitution at C=O with loss of carbonyl oxygen
10 Formation and reactions of enols and enolates

Introduction to Functional Group Chemistry, MN

1, 2	Review of Key Concepts from Semester 1
3, 4	Nucleophilic Substitution: S_N1 and S_N2
5, 6	Elimination Reactions: E1 and E2
7, 8	Addition to Alkenes
9	Reduction
10	Oxidation
11	Revision class

Basic Principles of Organic Spectroscopy, MN

1	Mass spectrometry and elemental analysis
2	Infra-Red spectroscopy
3	^{13}C NMR spectroscopy
4, 5	^{1}H NMR spectroscopy
6	Identifying compounds from their spectra
7	Revision class

Laboratory Course

Course Organiser: Dr J G Knight

1	Introduction to the Laboratory and Safety Awareness
2	Separation of an organic compound by liquid-liquid extraction
3	Purification of an organic compound by recrystallisation
4	Analysis of products by melting point and TLC
5	Purification of a mixture by column chromatography
6	Hydrolysis of an ester and purification by recrystallisation
7	Preparation of Pear Ester and purification by Distillation
8	Reduction of a ketone and purification by column chromatography

Coursework

Type	Date set	Deadline	Feedback
Practical	weekly	following session	following week
Written problem sheets (5)	2nd lecture slot in weeks 11, 13, 15, 17 & 19	2nd lecture slot of weeks 13, 15, 17, 19, and 21	immediately after hand-in, in writing, by peer-assessment

Reading Reference

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

FUNDAMENTALS OF BIOLOGICAL & MEDICINAL CHEMISTRY	**CHY1102** 10 credits [5 ECTS credits] semester 1
Module Leader	Dr EM Tuite
Lecturers	Dr IR Hardcastle, Dr C Bleasdale
Prerequisites	A level Chemistry
Aims	To provide students with the fundamental knowledge needed to study biological and medicinal chemistry; to introduce the main classes of biological macromolecule; to introduce concepts of biological stability and dynamics; to introduce concepts of medicinal chemistry and toxicology; to provide practical experience in basic experimental procedures; to develop information literacy skills in the context of biological and medicinal chemistry
Timetabled sessions	Lectures 18h, workshops 4h, practicals 15h, Maths support 12h
Assessment	90 min exam at the end of semester 1 (50%) In course assessment of workshops (25%) In course assessment of practical work (25%)

Intended Learning Outcomes

At the end of this course, students should:

- know the different forces involved in holding biomolecules together
- be familiar with the structures of proteins, nucleic acids, lipids, and carbohydrates
- know the structures of the naturally occurring amino acids and understand primary, secondary, tertiary and quaternary structures of proteins, DNA and RNA
- understand replication, transcription and translation
- understand how some enzymes work
- appreciate the fundamental behaviour and importance of enzymes
- understand the basis of medicinal chemistry and toxicology
- know how to perform simple physical measurements, understand the relevance of errors and reproducibility, and appreciate scientific method

Lectures

IRH

1 Amino acids
2 Peptides
3 Proteins
4 Nucleotides and nucleosides
5 DNA – replication
6 RNA – transcription and translation
7 Genes and Disease
8 Summary and Revision

CB

1, 2 Introduction, the cell and its constituents
3, 4 Absorption, distribution, metabolism and excretion (ADME)
5 Introduction to toxicology
6, 7 Medicinal chemistry, drug-receptor interactions, enzymes
8 Revisiting the cell. Revision

Practical Chemistry Support Tutorials

EMT

1–6 Significant figures, uncertainities, data analysis, graphing
7–12 Maths for chemistry, including integration

Laboratory Course

EMT

1 Scientific Method and Safety
2 Reproducibility in Weighing
3 Acid/Base Titrations
4 Redox Titrations
5 pK_a values

Coursework

Type	Date set	Deadline	Feedback
Lab Reports	Weeks 11–15	Weeks 11–15 at start and end of labs	Annotated reports returned prior to next lab class. General feedback at start of next lab class
Assignments	1. CB – Week 1 2. CB – Week 7 3. IRH – Week 6 4. IRH – Week 11	Week 3 Week 9	Week 3 workshop Week 9 workshop Within 2 weeks Within 2 weeks

Assignments
The four assignments will be linked to workshops and will be handed out at relevant lectures/workshops. Since feedback and answers for the assignments will be provided in workshops, these assignments will be exempt from the late submission of assessed work policy.

Formative assessment will be linked to the Practical Chemistry Support classes.

Reading References

Primary Text
Biochemistry, D.Voet and J Voet, John Wiley, 2004, 3rd Edition IBSN: 0471392235

Supplementary Reading
Biochemistry, CK Mathews, KE van Holde, and KG Ahern, Benjamin/Cummings, 2000, 3rd Edition IBSN: 0201702355

Foundations of Chemical Biology, CM Dobson, JA Gerrard, AJ Pratt, Oxford Chemistry Primer 98, 2001 IBSN: 0199248990

Principles of Biochemical Toxicology, JA Timbrell, Taylor & Francis, 1999, 3rd Edition
IBSN: 0748407367

ELEMENTS OF PHYSICAL CHEMISTRY	**CHY1201** 20 credits [10 ECTS credits] semester 2

Module Leader	Dr BR Horrocks
Lecturers	Dr JP Hagon, Dr LJ Higham and Professor KM Thomas
Prerequisites	A-Level Chemistry and normally A Level Mathematics or (SFY0001 + SFY0003)
Aims	To provide an essential understanding of basic thermodynamic principles, chemical kinetics and spectroscopy and, in conjunction with the stage 1 physical chemistry laboratory class, an introduction to some experimental techniques which can be employed in physical chemistry
Timetabled sessions	Lectures and classes 33h, Calculation classes 9h Practicals 2 x 3h per week for 5 weeks
Assessment	3h exam at the end of semester 2 (50%) Coursework associated with calculation classes (25%) In course assessment for practical work (25%)

Intended Learning Outcomes

At the end of this course, students should:

- have a basic level of knowledge of fundamental physical chemistry: spectroscopy, thermodynamics, kinetics
- be familiar with simple calculus notation
- be familiar with empirical chemical kinetics, simple dynamical theories of kinetics; collisions, Eyring
- be familiar with the laws of thermodynamics and their application to chemical energetics; state functions, equilibria, cells
- understand the basic principles of spectroscopy and quantization of energy
- be familiar with the common spectroscopies employed in chemistry, eg, IR, UV, NMR

Lectures

Chemical Energetics, KMT

1 Work, heat and internal energy
2 Reaction enthalpies and thermochemistry
3 Temperature dependence of internal energy and enthalpy
4 Entropy and spontaneous change
5 Gibbs Free Energy and reaction feasibility
6 Chemical equilibria and chemical potential
7 Entropy of mixing – pefect gases, ideal solutions
8 Ions in solution – conventions for electrochemical cells
9 Electrochemical cells – standard reduction potentials
10 Molecular speeds and molecular collisions
11 Heat capacity data – classical equipartition

Kinetics, JH

1 Empirical chemical kinetics: relationship with equilibrium
2 Rate laws: first-order, second-order, and pseudo first-order reactions
3 Experimental techniques
4 Determination of the rate law I: isolation method
5 Determination of the rate law II: integrated rate laws, half lives
6 Temperature dependence: Arrhenius law
7 Collision theory and activated complexes
8 Accounting for the rate laws: mechanisms and steady-state approximation
9 Example mechanisms: Lindemann mechanism
10 Revision seminar I
11 Revision seminar II

Spectroscopy, LJH

1	General introduction to spectroscopy
2, 3	Vibrational spectroscopy
4, 5	Electronic spectra
6	Summary, mock assessment and feedback
7–10	Magnetic resonance spectroscopies
11	Electron spin resonance

Laboratory Course
Course organiser Dr BR Horrocks

1	Electrochemical cells: ΔG of a reaction and Nernst equation
2	Measurement of pH and pK_a by titration
3	Measurement of solubility using conductance
4	Kinetics using spectrophotometry
5	Infrared spectroscopy – interpretation
6	Ultraviolet/visible spectroscopy
7	Calorimetry: heats of reaction and dissolution
8	Reaction kinetics using conductance
9	Ideal gas law and absolute zero
10	Investigation of the kinetics of the BZ reaction
11	Infrared spectroscopy – physical basis
12	UV/VIS and fluorescence spectroscopy – physical basis

Note. The stage 1 laboratory is being updated and further experiments employing the new equipment (flash photolysis, fluorescence lifetime and stopped flow kinetics may be offered).

Assignments
The assignments associated with the calculation classes consist of calculations based on the lecture material.

Coursework

Type	**Date set**	**Deadline**	**Feedback**
6 assignments in total	weekly	following week	Within 4 weeks
Practical report x9	weekly	within 1 week	within 4 weeks
Oral Feedback session	after 1st report	n/a	during viva

** Resits will normally be by examination only; coursework marks are carried**

Reading References

The Elements of Physical Chemistry, PW Atkins, Oxford University Press, 4th edition, 2005 IBSN: 0199271836

Fundamentals of Molecular Spectroscopy, CN Banwell and EM McCash, McGraw Hill, 1994, 4th Edition IBSN: 0077079760

FUNDAMENTALS OF CHEMISTRY	**CHY1202** 10 credits [5 ECTS credits] semester 1
Module Leader	Professor A Harriman
Lecturers	Professor A Harriman and Dr JP Hagon
Prerequisites	A level Chemistry
Aims	To provide a review of the foundations of chemistry, including principles of chemical change and chemical equilibria
Timetabled sessions	Lectures and seminars 12h, calculation classes 20h
Assessment	$1^1/_2$ exam at the end of semester 1 (50%) In-course assessment for calculation classes (50%)

Intended Learning Outcomes

At the end of this course, students should:

- manipulate units and understand their significance in formulae
- understand the concepts of chemical change and elementary thermodynamics
- understand dissolution processes; the nature and characteristics of the equilibrium state; equilibrium constants, acids/bases, buffer solutions, solubility products, hydrolysis, etc
- appreciate the concept of reaction rate, and understand the concept of experimental rate law
- undertake chemical calculations
- appreciate the basic mathematical operations needed for physical chemistry

Lectures

Chemical Principles and Chemical Equilibria, JPH

1 States of matter, units and dimensions
2 Molar mass and reaction stoichiometry, chemical analysis
3 Energy and specific heat, enthalpy and reaction enthalpies
4 Perfect gases and gas mixtures, gas laws and stoichiometry
5 Molecular kinetic theory of gases, solutes, solvents and concentrations
6 Dissolution processes and nature of salts in water, colligative properties
7 Equilibrium and composition, equilibrium constants
8 Response of equilibria to change, strong and weak acids and bases
9 pH and buffers, titrations and solubility equilibria
10 Hydrolysis and hydration
11 Rates of chemical change
12 Revision session

Calculation classes, AHa

Calculation classes will be held each week, starting in the second week of the module and running until the final week. The basic mathematical operations needed for physical chemistry will be covered. These classes will provide worked examples of calculations associated with all parts of the taught material. A set of related questions will be distributed at the end of each class. These must be answered by the student and handed-in for marking within a specified period.

Coursework

Type	**Date set**	**Deadline**	**Feedback**
Calculation class*	weeks 12, 13, 14, 15 and 17, 18, 19, 20	before 4pm Friday of these weeks	marked work is returned Monday of the following week

* Since feedback and answers for the calculation classes will be provided during the following week, these assessments will be exempt from the late submission of assessed work policy.

Reading References

Chemistry, CE Housecroft and EC Constable, Prentice Hall, 2nd Edition, 2002 IBSN: 0130869244

Chemistry and Chemical Reactivity, JC Kotz and P Treichel, Saunders College Publishing, 4th Edition, 1999 IBSN: 0030237629

STRUCTURAL AND INORGANIC CHEMISTRY	**CHY1301** 20 credits [10 ECTS credits] semester 1 & 2

Module Leader	Professor RA Henderson
Lecturers	Dr AC Benniston, Dr S Doherty, Dr AR Pike
Prerequisites	A level Chemistry
Aims	To introduce basic concepts of bonding, structure, and reactivity used in inorganic chemistry as a foundation for other courses in the subject and to teach common factual knowledge about inorganic systems in the context of the Periodic Table; to teach elementary practical techniques in inorganic chemistry.
Timetabled sessions	Lectures and assessments 43h, Tutorials 8h Practicals 2 x 3h per week for 5 weeks
Assessment	1½ h exam at the end of semester 1 (30%) 1½ h exam at the end of semester 2 (30%) Mid-semester assessments (2 x 7.5%) In course assessment for practical work (25%)

Intended Learning Outcomes

At the end of this course, students should:

- an understanding of the basic principles of inorganic chemistry
- an appreciation of periodic trends in structure and reactivity of inorganic compounds
- familiarity with the structures of inorganic solids
- an understanding of atomic and molecular orbitals

Lectures

Basic Principles of Inorganic Chemistry, RAH

1 Introduction to the periodic table; the elements and their positions; trivial names of certain groups of elements

2 Quantum mechanical basis of periodicity; electron configuration of the elements; prediction of simple stoichiometric compounds

3 Ionization potentials; systematic trends and discontinuities along periods and down groups

4, 5 The jargon of inorganic chemistry; oxidation state, coordination number, overall charge, donor atom, ligand (monodentate, polydentate, macrocyclic, ambidentate), chelate ring

6 Stability constants and formation constants; effects of statistics, charge, bulk, spin state; Chelate effect and macrocyclic effect

7 Acid-base chemistry; Hard Soft Acid Base Theory; stabilization of oxidation states, preferences with ambidentate ligands; proton transfer to and from ligands

8 Redox chemistry; half-cell reactions, common oxidants and reductants; use of Latimer diagrams

9, 10 Inorganic substitution mechanisms; associative and dissociative mechanisms; trends across periodic table and down groups

Structural Inorganic Chemistry, SD

1 Introduction to structure in chemistry
2 Valence Shell Electron Pair Repulsion Theory
3 Symmetry in chemistry
4 Symmetry in the solid state
5 Other structural models including close-packing
6 Inorganic solid structures and bonding within them
7 Solid-state structures of the elements
8 Structures of AX and AX_2 compounds
9 Factors determining solid-state structures
10 Energetics of ionic solids I
11 Energetics of ionic solids II

Atomic and Molecular Orbitals, ARP

1, 2	Waves, wave equations, wavefunctions
3	Atomic orbital contour plots, planar nodes, orthogonality
4	Spherical nodes, radial plots, radial distribution
5	Energy levels, degeneracy; Pauli, Aufbau
6	Shielding, penetration, Slater's Rules, valence shell versus core
7	LCAO MO theory for H_2
8	MO scheme for first period diatomic species without *sp* mixing
9	Bond order, magnetic properties; effect of *sp* mixing
10	Electron deficient and heteronuclear diatomics
11	MO scheme for CO_2
12	Revision drylab on MOs

First-Row Transition Metal Chemistry, ACB

1	Introduction to transition metals; orbitals; orbital energies etc. Definition of formal oxidation state
2	Trends along the period and resulting variations in range and stability of oxidation states
3, 4	Bonding ideas: ionic crystal field and covalent molecular orbital treatments; occupation of energy levels in transition-metal complexes; magnetic effects; thermodynamic effects
5	Macrocyclic Chemistry
6	Crystal field stabilization energies, Jahn-Teller distortion chelate effect
7	Molecular orbital theory for an octahedral complex.
8, 10	Factual survey of the chemistry of the elements Sc-Cu, illustrating ideas from previous lectures

Laboratory Course
Course organiser: Professor RA Henderson

1	Preparation of bis-2,4-pentanedionato oxovanadium (IV) and its adducts with nitrogen bases. Infra-red spectroscopy
2	Preparation of an oxalato complex of iron (III). Redox titrations for analysis
3	Preparation and characterisation of tin (IV) iodide
4	Preparation of a nickel ammine complex and gravimetric determination of nickel
5	Infra-red spectroscopy and linkage isomerisation
6	Computer based problem tutorial on Atomic Orbitals

Coursework

Type	Date set	Deadline	Feedback
Practical report	weekly during lab course	weekly	marked books returned within 3 days
Oral Feedback Session	after first experiment (within 2 weeks)		
Mid semester assessments	week 16 and week 33	immediately	returned within 2 weeks with written comments. Oral feedback in lecture

Reading References

Inorganic Chemistry, C E Housecroft and A G Sharpe, Pearson Higher Education, 2000, 4th edition IBSN: 0582310806

Chemical Bonding, M J Winter, Oxford University Press, 1994 IBSN: 0198556942

Solid State Chemistry, An Introduction, L Smart and E Moore, Stanley Thornes Ltd, 1995, 2nd edition IBSN: 0748740686

d-Block Chemistry, M J Winter, Oxford University Press, 1994. IBSN:0198556969

DATA HANDLING IN CHEMISTRY	**CHY1401** 20 credits [10 ECTS credits] semester 2

Module Leader	Professor RA Henderson
Staff	TBC, Dr JP Goss
Prerequisites	A level Chemistry or SFY001 + SFY0003
Aims	To emphasise the application of mathematical and computing methods to the study of chemical problems. To introduce and develop an understanding of how to use basic software programmes to aid the analysis and presentation of scientific data. To develop the student's ability to solve scientific problems using fundamental chemical principles.
Timetabled sessions	30h lectures/workshops, 30h of computer work
Assessment	2h exam at the end of semester 2 (60%) In-course assessment of computer assignments (20%) Problem solving assignment (20%)

Intended Learning Outcomes

At the end of this course, students should:

- to practise using mathematics to solve chemical problems
- to practise solving chemical problems of an unfamiliar nature using basic chemical principles
- understand how contemporary commercial software can be used to analyse and present data

Teaching

Statistics and Errors, TBC

Students are introduced to the ideas of errors, precision and statistical analysis through a combination of lectures and worked examples.

- Averaging procedures and simple statistics
- Errors and their propagation

Calculus, TBC

Students are introduced to calculus and its use in chemistry.

- Differentiation
- Integration

Chemical Problem Solving, RAH

Each week, for 6 weeks, a lecture will be presented which illustrates how various mathematical methods can be used to solve multi-stage chemical problems. The student will gain familiarity with the solving of chemical problems in workshops. Topics to be covered are as follows.

- Elemental analysis and interpretation of spectroscopy
- The gas laws
- Chemical equilibria, determining pK_a's of acids, buffer solutions etc
- Chemical kinetics

Computer-Assisted Teaching, JPG

A combination of lectures and computer-labs will be used to guide the student in the application of a range of methods in solving chemical problems, and provide practice and guidance for application of these methods.

An emphasis will be placed on the use of software packages, particularly in the use of spreadsheets:

- Spreadsheet structure, key functions and data entry

- Using spreadsheets, particular for numerical solution of mathematical problems, including iterative methods and numerical integration
- Curve fitting and plotting.
- Statistical analysis of numerical data sets, with reference to error analysis.

The computer-assisted teaching is assessed via problem sets to be submitted electronically on the above themes with particular reference to the rules stipulated for presentation of data in graphs for laboratory reports.

Coursework Feedback

Type	Date set	Deadline	Feedback
Computer Assignment	TBA	TBA	
Problem Solving Assignment	Week 34	Midday Monday Week 39	Written feedback within 2 weeks. Oral feedback in lecture

Reading References

Beginning Mathematics for Chemistry, SK Scott, Oxford University Press, 2004 IBSN: 0198559303

Spreadsheet Tools for Engineers, BS Gottfried, McGraw Hill, 1999 IBSN: 0070246540

Quantities, Units, and Symbols in Physical Chemistry, I Mills, T Cvitas, K Homann, N Kallay, and K Kuchitsu, eds, IUPAC, 1993, 2nd edition IBSN: 0632035722