

Chemistry M. Chem. Programme Specification

The Programme Specification applies to the year 2009/10 and is the result of a major course restructuring.

1. Awarding Institution	University of Oxford
2. Teaching institution	University of Oxford
3. Programme accredited by	Royal Society of Chemistry
4. Final award	M. Chem.
5. Programme	Chemistry
6. UCAS code	F100
7. Benchmark statement	Chemistry, QAA 2007
8. Date of programme specification	January 2009
9. Educational aims of the programme <ul style="list-style-type: none">• To deliver a course of the highest academic quality that will provide a flexible and intellectually challenging learning experience, instil and encourage student enthusiasm, and continue to attract the very best students from the UK and elsewhere.• To provide students with a broad, balanced and in depth knowledge of Chemistry based on firm foundations and leading to a critical awareness of the most recent developments in the subject.• To give the students a core of theoretical and practical knowledge and the ability to apply it to further studies in Chemistry or multidisciplinary areas involving Chemistry or employment in Chemistry based industry. In particular the ability to plan and execute experiments and calculations independently and to assess critically the significance of the outcome.• To develop in students a range of generic skills of value in chemical or non-chemical employment.	
10. Programme outcomes <p>A. Students will develop a knowledge and understanding of:</p> <ul style="list-style-type: none">• Fundamentals of Chemical terminology, nomenclature and Units• Mathematical techniques necessary to assimilate the theoretical aspects of Chemistry• Quantum mechanics and the electronic structures of atoms and molecules• Thermodynamics and its applications in Chemistry.• Reaction mechanisms and kinetics in the gas phase, in solution and at interfaces• The principles of spectroscopic methods and crystallography and their applications in structure determination• The periodic table and periodicity in physical and chemical properties• The structures and reactions of the elements and their compounds.• The fundamentals of organometallic chemistry and its applications to synthesis and catalysis.• Solid state chemistry• The characteristic reactions of functional groups on organic compounds• The structural, stereochemical and reactivity features of aliphatic, aromatic and heterocyclic compounds.• Major synthetic pathways in organic chemistry and their applications in the preparations of key compounds. Solid phase synthesis.• Chemical Biology, including the structures, roles, reactivities and biosyntheses of naturally	

occurring compounds such as amino acids and peptides, nucleic acids/oligonucleotides (and information transfer in Biology), sugars/carbohydrates and fatty acids/polyketides.

- Enzyme catalysis
- Introductory Medicinal Chemistry.

Through the third year options the students will gain knowledge of :

- Multidisciplinary topics at the interfaces between Chemistry with Physics, Materials and Biology. Several of these reflect current research areas within the Chemistry Department.

Related teaching/learning strategies

The course involves the use of lectures, classes, tutorials and practicals.

- Lectures convey the majority of the material contained in the syllabus. Attendance at selected Departmental seminars in the third and fourth years provides access to material at the frontiers of the subject.
- Tutorials are an essential feature of the Oxford course and provide an interactive small group environment to discuss, reinforce and extend the lecture material. Regular written work is required and the tutor gives the student feedback on progress. Tutorials also require the student to construct logical oral arguments, developing their generic skills.
- Classes augment the material presented in lectures and give an opportunity to practice problem solving.
- Practical classes provide the student with the opportunity to develop experimental skills and to gain hands on experience of techniques and methods covered in lectures.

Assessment

Formative Assessment

A crucial feature of the Oxford course is the continuous formative assessment provided for tutorials, both of the written work and of the oral contributions. In addition regular informal College examinations are set and marked at the beginning of each term by tutors, allowing the student to get feedback on examination technique, and giving a good indication of where they stand and what they still need to do. Similar formative assessment is also a key feature of the marking off of practicals in the teaching laboratories. This assessment regime provides regular feedback on student progress, identifying strengths and weaknesses and enabling remedial action to be taken. Further constructive feedback occurs via termly written reports from every tutor for each student; these are discussed individually at the end of each term.

Summative Assessment

Written examinations

The fundamental material of the first year is assessed by means of four qualifying Preliminary examinations. Papers in Inorganic Chemistry, Physical Chemistry and Mathematics are each of two and a half hours; the paper in Organic and Biological Chemistry is of three hours.

Part IA examinations at the end of the second year comprise three 2½ hour papers, which cover the breadth of the core material in the first two years and count 15% to the final overall mark.

Part IB examinations in the third year comprise six 2½ hour general papers, which provide cumulative assessment of the core material of years two and three, and one 3 hour option paper, in which the student selects four questions from a wide choice of topics. Part IB comprises 50% of the final mark.

Other assessment methods

Practicals will be assessed according to a detailed scheme, and will count 10% of the overall mark.

The Part II research project is assessed via a written thesis and a viva voce examination and comprises 25% of the final classification.

B. Skills and other attributes

I. Intellectual skills

Students taking the Oxford Chemistry course will gain the following skills:

- The ability to collate, assimilate and rationalise a wide range of chemical facts, concepts and principles.
- The ability to analyse and solve a wide range of known and unknown problems.
- An awareness and understanding of issues where chemistry impinges on other disciplines.
- The ability to reason logically and creatively.
- The ability to conduct an experimental investigation precisely and safely.
- The ability to interpret complex experimental information and infer appropriate conclusions.
- The ability to apply IT methods for data retrieval and archiving and to use a wide variety of standard Chemistry orientated software packages such as those for structure drawing, spectral simulation etc.
- The ability to read and interpret the primary literature.
- The ability to communicate effectively, both in writing and orally.

Teaching/learning methods and strategies

The first four of these skills are acquired largely via lectures, classes and tutorials, and the work set for these. The remainder are achieved via the undergraduate practicals, including compulsory IT practicals, and the fourth (research) year, all of which are closely supervised.

Assessment

The first four skills are assessed summatively via written examinations and formatively through tutorial discussions and written work. Tutorials also provide a forum for practising oral presentation and verbal argument skills. Practical are assessed through a detailed marking scheme, in which there is also substantial opportunity for formative assessment, both while the experiment is under way and when it is marked off. The major summative assessment of the remainder of the skills is via the thesis and oral examination of the Part II year.

II. Transferable skills

Students of the Oxford Chemistry Course will acquire the following transferable skills:

- Problem solving in a variety of contexts, both familiar and unfamiliar, including the demonstration of both self-direction and originality.
- Numeracy and mathematical skills including the appropriate use of units and the assessment and propagation of errors.
- Numerical, computational and IT information retrieval capabilities.
- Ability to work in a team and interact positively with other people, including those in other disciplines.
- The ability to exercise initiative and personal responsibility.
- Time management and project organisation and decision making abilities
- The ability to study for further professional qualifications
- An ability to communicate effectively via both written and verbal reports and presentations
- Foreign language ability (optional)

Teaching/learning methods and strategies

The first three of these skills are acquired primarily via lectures, classes and tutorials, including supplementary on-line teaching material. The remainder are gained principally via undergraduate practicals and the Part II research year. The optional foreign language component is a Supplementary subject, available in the second year and each subsequent year, and taught in the University Language Centre by a combination of classes and lectures.

Assessment

Problem solving and numerical skills are assessed via the unseen written examinations at the end of each of the first three years of the course. Practical skills are assessed in the teaching laboratories. Other skills are assessed formatively in tutorials, and by means of reports, and summatively by a written thesis and a viva in the case of the 4th research year.

III. Chemistry related practical skills

The Oxford Chemistry course will provide the students with the following Chemistry-related practical skills:

- Ability to handle potentially hazardous materials with due reference to COSHH protocols and regulations and risk assessment procedures
- Ability to carry out independently chemical synthetic procedures based on the original literature and to isolate and purify the products
- Experience of the planning and management of research projects at all stages from conception to completion and the correct documentation of results and observations.
- Ability to evaluate critically experimental procedures and results, theoretical descriptions and the primary literature.
- Ability to select procedures and design experiments.
- Ability to operate modern instrumentation, interpret the data and understand the principles involved.
- Ability to give presentations on research projects and respond to questions on the content and context.

Teaching/learning methods and strategies

These skills are almost exclusively acquired via the undergraduate practicals and the fourth year research project.

Assessment

These are assessed via marking and discussion of individual experiments in undergraduate practicals by a demonstrator and a member of the faculty. Assessment requires certification of results and inspection of the experimental setup. Further assessment of the skills gained will be made in the fourth year through the examination of the thesis, reports and a viva.

11. Programme Structures and Features

This is a four-year course accredited by the RSC leading to the M.Chem degree with classified Honours. The first year provides a broad foundation in core chemistry, together with the necessary background of mathematics, physics, and chemical biology. The second year provides the main toolkit of chemistry and gives students the opportunity to follow a non-compulsory Supplementary Subject or to perform supplementary practical. The third year provides a range of advanced options, including some such as materials and biological chemistry which emphasize the interfaces of chemistry with other disciplines. More details of the course content, including individual lecture synopses, examination information and past examination papers can be found in the department's Undergraduate Course Handbook and its website at www.chem.ox.ac.uk/teaching/.

The fourth year is devoted to carrying out and writing up a project of original research, under the supervision of a member of the chemistry department or in a related area. There are opportunities for part of this work to be carried out in an overseas laboratory (for example at Princeton University).

Learning

Year 1

Subjects

Inorganic Chemistry

Organic chemistry with biological chemistry

Physical chemistry with physics

Mathematics

Practical classes in inorganic, organic and physical chemistry and in IT skills

Assessment

The Preliminary Examination is set in June and consists of four written papers, three (in Inorganic Chemistry, Physical Chemistry, and Mathematics) of two and a half hours, one (in Organic Chemistry with Biological Chemistry) of three hours. The pass mark on each paper is 40%. A Distinction may be awarded to students obtaining excellent marks overall.

All students must pass all four Preliminary Examinations before proceeding to Part I. A resit examination is available in September for students failing one or more papers the previous June.

Practical work is assessed following the completion of each experiment, by a write-up submitted for marking in the appropriate laboratory. Students sitting the Preliminary Examination must have completed the required minimum first-year practical assignments.

Students' work is monitored continuously in college tutorials, problems classes and collections (College examinations).

Industrial sponsorship provides for the award of AstraZeneca Scholarships to students obtaining the best marks in the Preliminary Examination. GlaxoSmithKline provide a bursary for an enthusiastic organic chemist.

Year 2

Subjects

Inorganic Chemistry

Organic Chemistry

Physical Chemistry

Practical work in each of the above areas

Supplementary subjects (optional). Those currently available are:

Quantum Chemistry

Aromatic and Heterocyclic Pharmaceutical Chemistry

Practical chemistry

History and Philosophy of Science

Chemical Pharmacology

Modern Languages

Assessment

Each Supplementary Subject is examined by a written paper set in HT, with the exception of the Modern Languages which is taught and examined in TT and Practical chemistry, which is assessed in the same way as the practical course. A Distinction may be awarded to students obtaining excellent marks.

At the end of the second year students will sit the Part IA examination in June, consisting of three written papers of 2½ hours each, in core aspects of inorganic, organic and physical chemistry. This examination will also require knowledge of material studied in the first year.

As in the first year, practical work is assessed by write-ups marked in the laboratories, and students are monitored weekly in tutorials and classes, and termly in collections.

A book prize is provided by OUP for the candidate who has improved the most between the first and second year.

Year 3

Subjects

Inorganic Chemistry

Organic Chemistry

Physical Chemistry

At least twelve options are offered, out of which students will choose four. The options are intended to cut across the traditional branches and cognate disciplines, and to include biological chemistry, organometallic chemistry, and solid-state and materials chemistry.

Supplementary subjects, as for year 2 are also available for third year students. The requirement for

supplementary practical chemistry may be completed over two years.

Assessment

Assessment of tutorials and classes continues. Part IB consists of six general papers of 2½ hours each examining core material (including that studied in years 1 and 2). There will be a single three hour examination on the options, in which the student will be expected to answer questions on four options.

All students sitting Part IB are required to have completed specified practical work in the laboratories over three years. IT practical is also required. Satisfactory completion of a minimum requirement of laboratory work is an absolute requirement for passing Part IB.

Based on the aggregate marks from Part I (with Part IA counting one fifth, Part IB two thirds and the practical two fifteenths) the examiners will assess whether candidates are worthy of honours. Candidates who appear in a borderline position may be called for a viva voce examination, which will be conducted by the External Examiners and the Chairman of Examiners. It is made clear to such candidates that their performance in the viva cannot worsen their position. The vast majority of candidates will be adjudged worthy of Honours at this stage. Only those adjudged worthy of Honours may proceed to Part II.

The Part IB examiners also recommend the award of university prizes to candidates showing the best overall performance.

Year 4

Subjects

An original research project in chemistry or a closely related field, carried out in the university or possibly overseas.

Supplementary subjects as for year 2 are also available to fourth year students with the exception of Supplementary practical, which must have been completed before the deadline in the third year.

Assessment

Candidates write a thesis giving an account of their fourth year project. Theses are submitted in June and after they have been marked the examiners conduct a viva voce examination of every student to ask questions about the work written up. The viva counts approximately 10% of the marks awarded at Part II.

Final classification of the M.Chem. degree is based on the aggregated marks from Parts IA, IB and II, and the practical course, counting respectively 15%, 50%, 25% and 10% of the total. A bonus (equivalent to 1% of the total marks obtainable) is normally added for a Distinction in a Supplementary Subject.

The examiners also recommend the award of thesis prizes in each of the three laboratories.

12. Support for students and their learning

All students reading for the M.Chem. degree are members of a college, where they have one or more tutors responsible for their academic welfare. Through tutorials and classes tutors provide a substantial part of the teaching and formative assessment. Most college tutors also hold an academic position in the Chemistry department and can provide advice on all aspects of the course, including the choice of options. Colleges also provide welfare support and peer support for their students and may liaise with the University Counselling Service if necessary. Colleges house most undergraduates throughout the course and provide a wide range of social and sporting facilities.

In addition to providing general support, college tutors are responsible for organising most of the tutorial and class teaching that complements and exercises the material covered in lectures during the first three years of the course. Classes in mathematics (for first year students) and in some supplementary subjects and options (for subsequent years) are organised on a departmental basis by co-ordinators who ensure that college tutors are informed each term about their students' progress through an on-line reporting system.

At the end of each term the Senior Tutor or Head of every college receives reports from all students' tutors (including those external to the college). Arrangements are made so that all students receive feedback on their progress and have an opportunity to discuss it with their tutor and/or the Senior Tutor and Head of the college.

The Undergraduate Course Handbook issued each year by the Chemistry department contains full

information on the course. Further details, and updated information on lectures, options and examinations are provided by the department's website at www.chem.ox.ac.uk/teaching/.

Lending library facilities are available to all students in colleges and through the Radcliffe Science Library. These libraries contain multiple copies of core texts as well as some more specialized material. All students are able to use the reference material in the Radcliffe Science Library where they may consult specialized books and a very wide range of current journals, many of which are also available electronically.

Students have access to computers in their colleges and in the department's IT Centre, which is under the direction of an IT Teaching Officer who trains and advises students on the use of web-based teaching materials. Colleges have IT support officers who maintain student computer rooms and provide advice. Most college rooms have network connections for students who have their own computers; there is also a university-wide wireless network. In addition, the University Computing Service has facilities for students and provides an extensive range of training courses in programming and advanced applications of IT.

The Chemistry department runs teaching laboratories in inorganic, organic, and physical chemistry. Each laboratory has a coordinator who reports to senior academics and works with technicians to develop the course and to maintain the equipment and facilities required for undergraduate practicals. Practical classes are supervised jointly by junior demonstrators (usually graduate students) and a senior demonstrator who is a member of the academic teaching staff and who marks the students' write-ups.

The university's Language Centre runs a wide variety of courses at different levels which are available to all students for their personal development; in addition they also provide the Supplementary Subject in Modern Languages, a provision that is shared jointly with Physics.

13. Criteria for Admission

Introduction

The University and its colleges seek to admit students of high academic merit and potential. All colleges select students for admission without regard to gender, marital status, race, ethnicity, colour, religion or social background. Decisions on admission are based solely on the individual merits of the candidate and the application of selection criteria appropriate to the course of study. Entry is competitive and the attainment of minimum standards is no guarantee of a place.

Criteria for admission

(i) Academic ability

- Reasoning ability; aptitude for analysing and solving problems using logical and critical approaches
- Mathematical ability.
- Capacity to absorb new ideas and to apply familiar ideas to unfamiliar situations
- Spirit of enquiry: desire to understand the reasons for observations; enthusiasm and curiosity in science
- An understanding of the chemical concepts covered in courses taken so far.

(ii) Motivation and perseverance

- An enthusiasm for chemistry and the motivation to pursue an academically demanding four-year course

(iii) Independent working and communication

- Ability to work independently; willingness and ability to express ideas clearly and effectively orally, in writing and numerically; ability to listen

(iv) Educational achievement

- GCE: Good grades at GCSE are expected, especially in science and mathematics. Three A-levels (or equivalent) are required, which must include Chemistry and preferably Mathematics. The standard condition is AAA. An A grade is expected in Chemistry and also in Mathematics, if taken. Mathematics at AS or higher is an absolute requirement.
- SCE: AAAAB or AAAAA in Scottish Highers, usually supplemented by two or more Advanced Highers. Offers made to candidates on the basis of the Advanced Higher subjects are likely to be set at AA for two subjects, and AAB for three subjects. Including Chemistry, and preferably

Mathematics.

- International Baccalaureate: 39 to 41, including grade 7 in Chemistry and 6/7 in Mathematics, preferably at higher level.
- Applications are welcomed from those studying for qualifications other than those listed above.

The selectors assess each candidate against the above criteria on the basis of the following information, and also take into account the educational background of students and their experience.

- UCAS application, including references and personal statement
- Examination results
- Interview
- Candidates (or their referees) have the opportunity to present any special factors that may have adversely affected their attainment so far.

14. Methods for evaluating and improving the quality and standards of teaching and learning

Responsibility for the course is vested in the Director of Studies and the Chemistry Academic Board (CAB), which meets at least six times a year. CAB reports to the Chemistry Management Board and the Chemistry Faculty (essentially all academic staff involved in teaching whether in the department or in colleges) and to the Academic Committee of the Mathematics and Physical and Life Sciences Division. The Director of Studies and the CAB ensure that guidelines from the university's Education Committee are followed in the course and in the examination procedures. In addition to receiving feedback as detailed below, they keep a watching brief on all aspects of the course from admissions through to final examinations.

New lecturers are provided with departmental mentors, who observe their teaching and give appropriate advice.

Students are encouraged to provide feedback, in colleges to the Senior Tutor or Head of College concerning the tuition they receive there, and in the department by responding to questionnaires on each course of lectures and the practical courses. Questionnaire returns are forwarded to the lecturers concerned, who are expected to take appropriate action. Returns are also seen by the Chairman of Chemistry, the Director of Studies, and the Head of the appropriate section, who draws attention to any concerns that require action.

The Chemists' Joint Consultative Committee (CJCC) meets five times a year and provides a forum for undergraduate and graduate students to talk to senior academics about more general concerns with the course, including practicals, and for the department to consult with the undergraduates about possible changes. CJCC reports are received by the Faculty and discussed by CAB.

Following the examinations in June/July each year the examiners provide reports, which are considered in the first instance by CAB and the Director of Studies and action is taken if the CAB deem it appropriate. These reports are made available to students and discussed at the CJCC, usually at the end of Michaelmas term. Concerns with individual papers are also discussed in the appropriate section. CAB looks in detail at the reports from the Chairmen and the External Examiners.

15. Regulation of assessment

Parts IA, IB and II of the final examination are conducted by 12 examiners acting under an experienced Chairman, normally the Director of Studies, who is responsible for ensuring that the examination is conducted in accordance with the regulations and with the examination conventions; both of these are reviewed annually by the Director of Studies and the CAB. Nine Internal Examiners (three each in inorganic, organic and physical chemistry) are nominated by the department, and there are in addition three External Examiners. The Chairman is able if necessary to appoint one or more assessors to help with specialist topics. Each set of 12 examiners examines the same cohort of students through Part IA, IB and II.

At Part I the Internal Examiners are responsible for setting and marking the written papers. The External Examiners provide comments on the draft papers, and scrutinise a proportion of the scripts

after marking. External Examiners also conduct the *viva voce* examination of any candidates in a borderline Honours/Pass/Fail position in the examination, and then take part in the plenary meeting of examiners, which makes the decisions required at each stage.

At Part II each candidate's thesis is marked independently by two examiners, with externals playing a full part. External Examiners also participate in the *viva voce* examinations. The final decision on classification of candidates is made by all examiners including the externals following the procedure in the Examination Conventions.

External Examiners are appointed in order:

1. To verify that standards are appropriate to the award, in part by comparison with the standards of comparable institutions, and to ensure that the assessment procedures and the regulations governing them are fair and otherwise appropriate.
2. To ensure that the conduct of the examination and the determination of awards has been fairly conducted, and that individual student performance has been judged in accordance with the regulations and conventions of the Examining Board. This will entail signing the Class List as an endorsement that the processes of examination and classification have been fairly conducted.

External Examiners are expected to report to the Vice-Chancellor in each year in which they act. Their reports are expected to cover all the following points:

- the standards demonstrated by the students
- the extent to which standards are appropriate for the award
- the design, structure and marking of assessments
- the procedures for assessment and examinations
- whether or not External Examiners have had sufficient access to, and the power to call upon, any material necessary to make the required judgments
- students' performance in relation to their peers in comparable courses
- the coherence of the policies and procedures relating to External Examiners and their consonance with the explicit roles required of them
- the basis and rationale for any comparisons made
- the strengths and weaknesses of the students as a cohort
- the quality of teaching and learning which may be indicated by student performance

The report is addressed to the Vice-Chancellor, and is considered in the first instance by CAB, then by the Divisional Board and by the University's Education Committee. Where an External Examiner's report contains particular suggestions or criticisms, CAB ensures that full consideration is given to these, to institute further discussion or action, and to inform the MPLS within a reasonable time of any action taken, whose responsibility it is to inform the External Examiner in turn.

16. Indicators of quality and standards

Each year 180–200 students are admitted to the M.Chem. course, with minimum A-level results of three A grades. External Examiners have repeatedly praised the quality of examination candidates and the standard to which they have been taught.

As a result of External Examiners' recommendations the proportion of Firsts awarded in the final examination has increased in recent years. The percentages in 2006, 2007 and 2008 were:

	2006	2007	2008
I	37%	42%	44%
II.1	50%	44%	46%
II.2	11%	13%	9%
III	1%	1%	1%
Fail	1%	0%	0%

Information provided by the University Careers Service shows that in recent years some 35–45% of graduates from the course undertake further study (the majority in doctoral courses) and very few are "still seeking employment" at the time of enquiry. Graduates enter a wide variety of employment including industry, financial services and other professions.

The M.Chem. degree is accredited by the Royal Society of Chemistry, the most recent reaccreditation was in 2008.

In the last HEFCE Teaching Quality Assessment exercise in 1993 the course was judged "excellent".

The Report comments:

“The overall objective of the Oxford chemistry degree course is to immerse undergraduates in a demanding, thorough course focussed on academic aspects of the subject but remaining flexible in the light of modern developments. Due attention is paid to the overlap of the subject with other sciences, particularly biology and physics. The assessors regard all the aims, and the specific objectives which enable their achievement, to be appropriate to this particular institution, and accept that they are largely achieved.

“The School of Chemistry is successful in achieving its aims and objectives. High calibre students are afforded a variety of chemical experience, mostly of very high quality, and are able to develop intellectually. There is considerable evidence of independent thought on the part of undergraduates, and clear evidence of the acquisition of transferable skills. Oral skills and individual confidence are particularly strong features of Oxford students.”

In both the Research Assessment Exercises carried out in 1996 and 2001 the chemistry department was awarded a 5* rating.

There was a review of Chemistry in 2005, followed by a Task Force to make recommendations about revising the degree. These recommendations were accepted, and this specification has been developed in response to these recommendations.