UNIVERSITY OF LINCOLN

Programme Specification

Title:

Chemistry for Drug Discovery and Development

Final Award: **Master of Chemistry (MChem)**

With Exit Awards at:
Certificate of Higher Education (CertHE)
Diploma of Higher Education (DipHE)
Bachelor of Science with Honours (BSc (Hons))
Master of Chemistry (MChem)

To be delivered from: 1 Sep 2017

Level	Date
Level 1 or Certificate of Higher Education (CertHE)	2022-23
Level 2 or Diploma of Higher Education (DipHE)	2023-24
Level 3 or Bachelor of Science with Honours (BSc (Hons))	2024-25
Level 4 or Master of Chemistry (MChem)	2025-26

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1. Introduction

This document describes one of the University of Lincoln's programmes using the protocols required by the UK National Qualifications Framework as defined in the publication *QAA guidelines for preparing programme specifications*.

This programme operates under the policy and regulatory frameworks of the University of Lincoln.

2. Basic Programme Data

Final Award:	Master of Chemistry (MChem)
Programme Title:	Chemistry for Drug Discovery and Development
Exit Awards and Titles	Certificate of Higher Education (CertHE) Diploma of Higher Education (DipHE) Bachelor of Science with Honours (BSc (Hons)) Master of Chemistry (MChem)
Subject(s)	Chemistry
Mode(s) of delivery	Full Time Part Time
Is there a Placement or Exchange?	Yes
UCAS code	F152
Awarding Body	University of Lincoln
Campus(es)	Lincoln Campus
School(s)	School of Chemistry
Programme Leader	Tasnim Munshi (TMunshi)
Relevant Subject Benchmark Statements	
Professional, Statutory or Regulatory Body Accreditation	
Programme Start Date	2019-20

3. Programme Description

3.1 Overview

The aim of this programme/pathway is to develop skills in the design and development of active molecule to the pharmaceutical product, this programme develops experience of synthetic chemistry and develop experience in drug formulation, manufacture within the regulatory context for the pharmaceutical industry. This course is designed to develop skills in the design and development of active molecules, all the way through to the final pharmaceutical products available to patients. Students can develop experience of synthetic chemistry and gain experience in drug formulation and manufacture within the regulatory context of the pharmaceutical industry. This will involve substantial practical experience of advanced laboratory techniques.
The chemistry curriculum of this programme has been devised to integrate the main sub-disciplines of chemistry effectively, relating physical chemistry concepts to aspects of organic and inorganic chemistry, and to the methods used for analyzing substances. In these programmes, a comprehensive knowledge of chemistry is augmented with subject-specific and generic skills (particularly in practical chemistry) to develop a strong understanding of how chemistry is applied to problems with direct impact on society. In this way, the chemistry education at Lincoln is designed to produce highly employable graduates with a broad background in academic chemistry and significant experience of the application of chemistry in contexts relevant to society and industry.

3.2 Aims and Objectives

General Aims:
• To provide a stimulating and supportive learning environment that inspires students in the study of chemistry and instills within them an enthusiasm for study of the chemical sciences;
• To develop an enthusiasm for chemistry and an appreciation of its application in different contexts
• To enable the development of a broad appreciation of the importance of chemistry in a variety of application contexts: academic, industrial, economic, environmental and social and its role in establishing a sustainable society;
• To develop a range of skills relating to professional practice in chemistry that are relevant both to chemistry and other graduate-level employment

Main aims
•To understand the drug development process from drug invention or discovery, through to market.
• To develop a detailed understanding of how drugs are formulated and delivered to the desired target.
• To provide students with a broad appreciation of key chemical concepts and the interrelationship between traditional discipline areas in chemistry;
• To develop a skill set that enables the implementation of sound professional practice in chemistry that ensures safe operation in chemical laboratory environments based on effective risk assessment;
• To provide students with a range of experiences that enable the effective application of defined methodologies to appropriate standards;
• To provide students with knowledge of the application of chemistry in key sectors including an awareness of the importance of regulatory compliance;
• To instill a broad range of knowledge and skills required for graduate-level employment or as a base for advanced level study in chemistry and the chemical sciences.
• To extend understanding of chemical concepts and develop an in-depth appreciation of specialized areas in chemistry through engagement with advanced materials;
• To develop an ability to design scientific investigations, independently execute suitable experimentation and critically evaluate study outcomes;

• To develop capabilities to analyse unfamiliar problems and adapt defined methodologies to devise effective solutions;
• To develop an awareness of advances at the forefront of chemistry and instill an ability for critical assessment of research in the chemical sciences;
• To prepare students for professional chemistry careers or doctoral research employment through knowledge of advanced practices.

3.3 Variations to Standard Regulations and Guidance

none

4. Programme Outcomes

Programme-level learning outcomes are identified below.

Refer to *Appendix I – Curriculum Map* for details of how outcomes are deployed across the programme.

4.1 Knowledge and Understanding

On successful completion of this programme a student will have knowledge and understanding of:

1 Chemical terminology, nomenclature, conventions and units
2 Fundamental physicochemical principles
3 Molecular and bulk properties of a range of inorganic, organic and bio-molecular materials
4 The synthesis of inorganic, organic and bio-molecular compounds including related isolation, purification and characterisation techniques
5 Principles and procedures used in chemical analysis for characterisation and quantitation
6 Industrial, economic, social and environmental contexts that demonstrate the importance of chemistry and the interface with other disciplines in tackling future challenges in these contexts
7 Advanced topics in chemistry
8 Research methodology and specialist knowledge within the chemistry research field
9 Principles that underpin what a therapeutic agent is and the interactions between the varied and multitudinous disciplines that combine to bring the drug towards safe and effective clinical use.
10 Overlying regulatory and quality framework covering the pharmaceutical industry as well as the legal and ethical aspects

4.2 Subject Specific Intellectual Skills

On successful completion of this programme a student will be able to:

11 Demonstrate an appreciation of the regulatory umbrella under which the pharmaceutical industry operates, the importance of the GxPs and the ethical and legal framework governing animal studies and clinical trials.
12 Evaluate, interpret and synthesise chemical information and data from a variety of sources
13 Use models, computational chemistry and data-processing relating to chemical information and data
14 Communicate scientific material and arguments in a variety of forms
15 Adapt and apply methodology to the solution of unfamiliar problems
16 Assimilate, evaluate and present research results objectively
17 Undertake a research project the outcome of which is of a quality that is potentially publishable
18 Demonstrate knowledge and understanding of essential facts, concepts, principles and

theories

19 Principles that constitute a therapeutic substance, give the classes of therapeutic substances (eg small molecules, biologics, vaccines etc), their design, discovery or invention, selection of druggable targets for selected diseases and therapeutic areas.

20 Solve qualitative and quantitative problems

21 Formulate drugs in relation to the drugs physicochemical properties from solution to solid form.

22 Recognise and analyse problems and plan strategies for their solution

23 Explain the drug development process from design and discovery, proof of mechanism, through preclinical and initial clinical trials (phase-I and phase-II), proof of concept, through to the major clinical trials (phase-III), proof of principle and market approval or attrition, together with an appreciation of drug synthesis and manufacture.

4.3 Subject Specific Practical Skills

On successful completion of this programme a student will be able to:

24 Work independently and be self-critical in the evaluation of risks, experimental procedures and outcomes

25 Recognise the professional, moral and ethical standards required for experimental work

26 Handle chemical materials safely, taking into account their physical and chemical properties including any specific hazards associated with their use and conduct risk assessments

27 Carry out documented laboratory procedures and standard operating procedures involved in synthetic and analytical work, in relation to both inorganic and organic systems

28 Monitor, record and document observations and measurements of chemical properties, events or changes

29 Operate standard chemical instrumentation

30 Interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory

31 Plan, design and execute experiments taking into account the results from previous experimental work

4.4 Transferable Skills and Attributes

On successful completion of this programme a student will be able to:

32 Demonstrate time management and organisational skills, as evidenced by the ability to plan and implement efficient and effective modes of working

33 Communicate and interact with professionals from other disciplines

34 Exercise initiative and personal responsibility

35 Demonstrate independent learning ability required for continuing professional development

36 Make decisions in complex and unpredictable situations

37 Communicate chemistry to a variety of audiences using a range of formats including written and oral

38	Solve qualitative and quantitative problems demonstrating self-direction and originality
39	Apply numeracy and mathematics, including error analysis, order-of-magnitude estimations, correct use of units and modes of data presentation
40	Use information retrieval, in relation to primary and secondary information sources, including online computer searches
41	Use a range of IT hardware and software for a variety of chemistry-specific and generic applications
42	Interact with other people and work as a member of a team, recognising and respecting the views, opinions and roles of other members of the team

For details of each module contributing to the programme, please consult the module specification document.

5. Learning, Teaching and Assessment Strategies

5.1. Learning and Teaching Strategy

An Integrated Curriculum

We have chosen to interpret the presentation of the breadth of chemistry using an integrated approach that retains a clear delineation of traditional sub-disciplines. The teaching and learning strategy adopted within MChem Chemistry derives from the programme outcomes and is based upon an integration of the curriculum through five main components: Core and Extension Chemistry modules, Practical modules, Professional Practice modules and Project modules.

Core Modules

• The theoretical concepts of the main disciplines of chemistry (inorganic, organic and physical) are taught together in Core Chemistry modules based on a ‘spine’ of physical chemistry concepts. The physical chemistry key themes of: systems at equilibrium, systems under change, and the structure and bonding of systems are developed at each stage. The themes are contextualized with relevant organic and inorganic conceptual topics and these are exemplified to, respectively, build an organic chemistry reaction toolkit and, assemble a comprehensive survey of the chemistry of the elements. Together these modules provide the depth and breadth of core chemistry required for study of chemistry at this level.

• At level 4, Advanced Topics in Chemistry add depth to the programmes and facilitate student specialization in selected areas of chemistry or drug discovery and development. The array of (optional) short courses presented reflect the research themes of the School and facilitate the participation of external academic and industry speakers in the programmes, broadening the exposure of students to professionals in their field.

• The ‘Core Chemistry’ modules use lectures as the primary vehicle to deliver content. Student development is facilitated by interactive enquiry-based tasks and, in this context, emphasis is placed upon application of knowledge to solve problems. Seminars are used to support problem solving activities and provide opportunity for students to experience different learning techniques such as peer tutoring and collaborative learning. On moving from level 1 to 3, a systematic progression is established with both increasing subject depth and in the challenge from problems requiring adaptation of methods and extended strategies for their solution.

Practical Chemistry Modules

• Practical skills and associated data interpretation capabilities are developed in Practical Chemistry modules linked to professional practice. Practicals are explicitly linked to core chemistry programmes and the use of brief/debrief sessions around each laboratory class helps contextualize studies. Key skills in analytical and structural methods (e.g. chromatography, NMR, mass spectrometry, X-Ray crystallography) are developed in parallel using integrated lectures and workshops that focus on the development of skills for robust experimental design and interpretation of experimental data.

• At level 4, instrumental analytical techniques are presented as (optional) short-course ‘at-instrument’ programmes providing students with qualification as independent users. Emphasis is placed on developing expertise in analyzing requirements, then selecting and, where appropriate, adapting analytical methods to the outcomes of a task.

• Practical skills are developed at the bench in professional laboratory settings. Strong emphasis on gaining competence in techniques and with appropriate documentation of activities inline with industry practice. Routine and regular use of industry standard equipment and software support characterization of products and generation of reports. There is progression in the nature and demand of tasks and the style of teaching moving through the programme levels. Level 1 is concerned with developing confidence in manipulation of equipment and providing training in basic skills and techniques. Level 2 introduces more complex procedures and more sophisticated interpretation is required. Skills are further developed at level 3 but students are expected to work with increasing independence. There is a transition from fully documented procedures and laboratory exercises to investigative style tasks where students are involved in experimental design, planning, preparation and execution. Extensive use is made of pre- and post-laboratory briefing sessions that link the learning experience to theoretical contexts. Student participation and increasing leadership of these meetings is expected as student autonomy and expertise increase.

• Level 4 provides opportunity to develop skills and gain experience in the independent use of advanced techniques both in analytical and synthetic procedures. This ‘at-instrument’ training corresponds with the training given to research students.

• At level 4, students undertake an independent learning programme and will be expected to undertake activities be in the area of specialism drug discovery and development, these will be based on reflective practice to consolidate and enhance their personal and professional development. A broad range of activities can be included in this portfolio including specialist training undertaken during off-site placements.

• At level 4, the students will have the opportunity to develop and manage their own learning portfolio through experiential learning. Students will have the opportunity to direct their own learning process and will control its nature and direction through self-evaluation (reflection). They develop and follow an agreed learning plan (corresponding with directed study) and undergo on-going evaluation of chosen learning activities through a reflective blog and meetings with academic tutor(s). A blog (web log) is maintained as a progress record of the agreed learning plan and to periodically enable reflection of that progress. Academic tutor(s) review and will add commentary to the student’s blog.

Extended Projects

• Independent research and professional experience is undertaken through Research Projects and will usually be in the area of specialism so drug discovery and development. These activities build from group projects undertaken in Practical modules but are introduced at an individual level at level 3 through the structured Research Project. This encourages students to draw together their experience and plan and execute a significant study with the support of the research teams at the University.

• At level 4, the student experience is centred on a placement – either within a research group at Lincoln or with an external hosting company/institution. This provides the opportunity for students to develop original and independent research corresponding to the standards required of industrial regulations and/or of publishable standard for the peer-reviewed academic literature.

Management of External Placements

• In the chemical sciences, funded placements in industry are usually organized through competitive recruitment programmes operated by the hosting companies. In this context, students normally apply for placement opportunities and undergo selection processes (assessment centres, interviews etc.) in the preceding year (level 3). Students are systematically supported in preparation of applications through the extensive skills profiling and CV development work integrated into level 2 Professional Practice modules, through work with Careers and Employability Advisors, and in through the personal tutoring system. In addition, aspects of coursework assessment at level 3 are designed to mirror assessment centre components (e.g. panel HR and technical interviews, observed group work and oral presentations) and hence offer students an opportunity for formal feedback in advance of external selection processes.

• Confirmation of the student placement requires direct liaison with the hosting company by the School's Employer Engagement Officer and the level 4 Tutor to ensure that the proposed placement programme has suitable scope to include an investigative project and facilitate release for short course study. Positioning hosting arrangements with partner organisations forms a key activity for the School's employer engagement programme.

•Student placements are managed by a supervisory team consisting of:

•Project supervisor. In external placements, this will typically be the Industry Tutor with primary responsibility for managing and supervising the student. For on-site placements, this will be the primary academic supervisor of the project. In each case, the project supervisor will have responsibility for project oversight, technical advice in context, and student engagement and progress monitoring.

•Academic supervisor. In each placement context, an academic/personal tutor will be appointed to monitor and enhance the student experience. In on-site cases where, coincidentally, the personal tutor is also the project supervisor, the level 4 tutor will offer additional pastoral support. In addition to being the primary point of contact for external hosting organisations, the academic tutor will supervise the design and execution of the student-centred learning portfolio for the Personal and Professional Development module through regular tutorial sessions.

Student as Producer Principles

• The programme fully embraces the principles of Student as Producer. Problem solving is core to the teaching, learning and assessment strategy. Students will encounter a variety of problem types including those of a familiar and unfamiliar nature and open-ended problems. Problem solving is seen as an active method of learning the core chemistry material and all core chemistry modules will have a programme of seminars specifically for problem solving and the development of problem solving skills. These provide opportunity for students to work individually or in groups and for peer collaboration and tutoring. Seminars will include student-led sessions with the tutor taking more of a facilitator role. Core chemistry module examinations will assess problem solving learning outcomes. Professional practice will provide students with an opportunity of open-ended 'industry informed' real life problems. These will be worked upon in small groups and teams with both tutor and industrial support. Outputs will consist of reports and presentations to industrial panels.

• Modules at level 3 and 4 are informed by academic staff research. Lectures will include personal

research activities and papers will be used as part of the teaching material for modules. Some practicals will be designed to have an investigatory approach to allow students to work as a 'researcher' while carrying out experimental work. Team work on these tasks will be encouraged along with independent work to reflect the variety of environments likely to be encountered by chemistry graduates in employment. Project based learning plays a significant role at level 3 and for the MChem also at level 4. Students will carry out independent research projects within the research groups of academic staff or, if on external placement, within industrial research teams. Students will be involved in the planning and design of the project and will present their findings using a range of formats thus providing a full experience of working as a researcher.

• Technology will be at the forefront of the student experience. Blackboard will be used to provide module information and teaching material and to engage with students through discussion groups and on-line teaching activities.
• The learning environment for chemistry is excellent. Modern, well equipped teaching laboratories are housed in the science building. A significant proportion of time is spent within the laboratory and students gain hands-on experience of a range of chemical equipment and chemical analysis instruments. Large laboratories have demonstration facilities with A/V systems so that students can be instructed without having to leave their work stations. Organisation of laboratory classes will ensure that demonstrators are available to support small groups of students. Research laboratory and equipment facilities in the new Joseph Banks Laboratories will be available for project work.

• Learning is supported by a core pack of textbooks covering inorganic, organic and physical chemistry. A range of other supporting texts and journals are available through the library. Students will have an opportunity of a library induction provided by the chemistry librarian. The library also provides a range of workshops to support learning skills and these are made available to all students.

• A number of mechanisms are used to obtain student views about their learning. Subject committees are an important forum for obtaining feedback through elected student reps however reps are encouraged to work closely with programme teams throughout the academic year to ensure that issues are resolved in a timely manner. Other mechanisms for obtaining feedback include meetings with academic tutors, student meetings with external examiners, module evaluation forms and discussion groups.

• Employability is an integral part of the curriculum. Professional practice provides a vehicle for students to engage and experience a variety of chemical science commercial sectors. Professional practice also deals with the practical aspects of skill profiling, personal development and job applications. For the MChem Chemistry, professional practice will support students in applying for final year placements and the external placement will provide opportunities for work place experience within the programme. Summer placements both external and on-campus are also encouraged and support is provided to help students obtain suitable placements and to apply for sources of funding.

5.2. Assessment Strategy

A variety of assessment methods are used that enable students to demonstrate attainment of the programme learning outcomes. Methods include:
• Unseen examinations
• Laboratory and professional reports

• Problem-solving exercises
• Presentations (oral, poster, individual, group)
• Project work (individual, group)
• Literature review
• Personal development portfolios (including RSC Skills and Personal and Professional Blogs)

Assessment is a fundamental component of the teaching and learning process and is used to enable the student to confirm their achievement of learning outcomes. It is seen, therefore, as having two functions – formative and summative. Formative assessment is primarily delivered in small group seminars, laboratory or team-based settings relating to continuous assessment of problem-solving activities or practical and project work including proposals and experimental design. Formative feedback forms the basis for routine structured feedback to students. Summative assessment is derived from examinations, and written assignments and dissertations as final module assessments. Summative feedback also provides a vehicle for student feedback, either through discussion of individual pieces or as part of overall performance profiling within personal academic tutoring.

• Knowledge and understanding. Summative assessment of knowledge and understanding is achieved through traditional-style examinations that are used at each Stage of the course and are, almost exclusively, composed from unseen problems. These are taken at the end of each semester and are the main assessment vehicle for the Core Chemistry modules. At Level 1, confirmation breadth of learning is the main objective and so examinations consist mainly of short structured questions. At Level 2, greater depth of analysis and understanding is expected and so examinations include combination of short and long answer questions and introduce problem-based components. At Levels 3 and 4, the primary aim of formal examination is to assess an individual's depth of specialist knowledge and of an independent ability to adapt methods to unfamiliar problems. Examination tends therefore to focus on analysis and interpretation in problem-based contexts. Where possible, use is made of primary scientific literature, assessing abilities to engage with, and critically evaluate research level material.

• Subject specific intellectual skills. Analysis of information and problem solving is assessed through a range of methods – primarily problem-solving exercises in continuous assessment and unseen examinations. Problem-solving activities concepts are assessed continuously through a programme of seminars and tutorials and these comprise a primary vehicle for student feedback and reflection. Group work activities in Practical Chemistry mini-projects also incorporate problem-solving activities – generally focused towards method selection and project design. By their nature, problems in these contexts are open-ended and contribute to the development and assessment of research and transferable skills.

• Subject specific practical skills. The range of skills developed in practical work requires a variety of assessment types. Student portfolios are used to audit the acquisition of manipulative and practical skills including at-bench evaluation and competency tests. These tests are used for on-going in-class feedback and additionally function as qualification training for independent use of instrumentation. Competence in data acquisition, recording and analysis is assessed through inspection of laboratory records and through structured report sheets contributing to student portfolios for final assessment. Familiarity with a range of formal reporting methods is assessed through formally submitted reports and these allow interrogation of abilities to contextualise laboratory studies, interpret and validate experimental results, and draw conclusions from experimental data. Formal reports form the basis for summative assessment in Practical Chemistry modules.

• Research skills are assessed through individual research projects (at Stage 3 and 4) and group work in mini-projects in Practical chemistry and Professional Practice modules. These include project planning through a portfolio of tasks, execution of the planned work that is assessed continuously by the project supervisor and through the written report, analysis and interpretation of results that are assessed by the written report and individual or group presentation.

• Presentation and written communication skills are assessed at all levels. Written skills are assessed using a range of written tasks that include laboratory reports, scientific articles, job application, literature review, dissertation, professional report. Competence is developed through feedback through the programme Levels with the expectation that students will produce written outputs corresponding with recognised professional practice. These are many-fold but include presentation, structure and quality of writing that would satisfy the criteria for publication. Oral presentations are assessed formatively in group-working and seminar contexts. These include both individual and group presentations. Summative assessment of presentation skills is through group and individual presentations. Peer assessment of presentation skills is additionally used for informal feedback.

6. Programme Structure

The total number of credit points required for the achievement of Certificate of Higher Education (CertHE) is 120.
The total number of credit points required for the achievement of Diploma of Higher Education (DipHE) is 240.
The total number of credit points required for the achievement of Bachelor of Science with Honours (BSc (Hons)) is 360.
The total number of credit points required for the achievement of Master of Chemistry (MChem) is 480.

Level 1

Title	Credit Rating	Core / Optional
Introduction to Pharmaceutical Science 2019-20	15	Core
Professional Practice 1: Analytical Sciences 2020-21	15	Core
Introduction to Professional Practice 2020-21	15	Core
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21	15	Core
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21	15	Core
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20	30	Core
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21	15	Core

Level 2

Title	Credit Rating	Core / Optional
Drug Formulation and Delivery 2020-21	15	Core
Drug Design and Development 2020-21	15	Core
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22	15	Core
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22	15	Core
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22	15	Core
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22	30	Core
Fundamentals of Pharmacology & Toxicology 2020-21	15	Core

Level 3

Title	Credit Rating	Core / Optional
Advanced Pharmacology 2021-22	15	Core
Structured project 2022-23	30	Core
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23	15	Core
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23	30	Core
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and	15	Core

Nanoscience 2022-23		
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22	15	Core

Level 4

Title	Credit Rating	Core / Optional
Commercial Research Project 2023-24	60	Optional
Advanced Topics in Chemistry 2023-24	30	Core
Academic Research Project 2023-24	60	Optional
Professional and Personal Development 2023-24	30	Core

Appendix I - Curriculum Map

This table indicates which modules assume responsibility for delivering and ordering particular programme learning outcomes.

Key: ✓ Delivered and Assessed Delivered ✓ Assessed

Level 1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20	✓	✓	✓	✓	✓							✓
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21	✓	✓	✓	✓	✓							
Introduction to Pharmaceutical Science 2019-20									✓			
Introduction to Professional Practice 2020-21	✓											
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21	✓	✓	✓		✓							
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21	✓	✓	✓	✓	✓							
Professional Practice 1: Analytical Sciences 2020-21												✓

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20	✓	✓				✓		✓		✓		
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21						✓		✓				
Introduction to Pharmaceutical Science 2019-20									✓			
Introduction to Professional Practice 2020-21	✓	✓						✓				

Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21						✓		✓				
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21		✓				✓		✓				
Professional Practice 1: Analytical Sciences 2020-21		✓				✓		✓				

	PO25	PO26	PO27	PO28	PO29	PO30	PO31	PO32	PO33	PO34	PO35	PO36
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20												
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21												
Introduction to Pharmaceutical Science 2019-20												
Introduction to Professional Practice 2020-21												
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21		✓	✓	✓		✓						
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21		✓	✓	✓	✓	✓						
Professional Practice 1: Analytical Sciences 2020-21						✓						

	PO37	PO38	PO39	PO40	PO41	PO42
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20	✓	✓	✓			
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21		✓	✓			
Introduction to Pharmaceutical Science 2019-20						
Introduction to Professional Practice 2020-21	✓		✓		✓	✓
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21		✓	✓			
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21	✓	✓	✓			
Professional Practice 1: Analytical Sciences 2020-21	✓		✓	✓		

Level 2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22	✓	✓	✓	✓	✓							✓
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22	✓	✓	✓	✓								✓
Drug Design and Development 2020-21									✓	✓		
Drug Formulation and Delivery 2020-21									✓	✓		
Fundamentals of Pharmacology & Toxicology 2020-21										✓		
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22				✓	✓							✓
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22	✓	✓		✓								✓

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22	✓	✓				✓		✓		✓		
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22						✓		✓		✓		
Drug Design and Development 2020-21							✓		✓			
Drug Formulation and Delivery 2020-21							✓		✓			
Fundamentals of Pharmacology & Toxicology 2020-21							✓					
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22		✓								✓		
Practical Chemistry 2.2: Inorganic synthesis		✓						✓		✓		

and structural methods 2021-22												

	PO25	PO26	PO27	PO28	PO29	PO30	PO31	PO32	PO33	PO34	PO35	PO36
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22												
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22												
Drug Design and Development 2020-21												
Drug Formulation and Delivery 2020-21												
Fundamentals of Pharmacology & Toxicology 2020-21												
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22		✓	✓	✓	✓	✓						
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22			✓	✓	✓	✓						

	PO37	PO38	PO39	PO40	PO41	PO42
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22	✓	✓	✓			
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22		✓	✓			
Drug Design and Development 2020-21						
Drug Formulation and Delivery 2020-21						
Fundamentals of Pharmacology & Toxicology 2020-21						
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22		✓	✓			
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22	✓	✓	✓			

Level 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Advanced Pharmacology 2021-22										✓		

Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23	✓	✓	✓	✓	✓							✓
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23	✓	✓	✓	✓	✓							✓
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23	✓	✓	✓	✓	✓	✓						✓
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22	✓	✓			✓		✓	✓		✓		✓
Structured project 2022-23	✓				✓	✓						✓

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Advanced Pharmacology 2021-22							✓					
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23	✓	✓				✓		✓		✓		
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23	✓	✓				✓		✓		✓		
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23	✓	✓				✓		✓		✓		
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22		✓	✓			✓	✓	✓		✓		
Structured project 2022-23	✓	✓								✓		

	PO25	PO26	PO27	PO28	PO29	PO30	PO31	PO32	PO33	PO34	PO35	PO36
Advanced Pharmacology 2021-22												
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23												
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23												
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23			✓	✓	✓	✓						
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22												
Structured project 2022-23	✓			✓	✓	✓		✓				

	PO37	PO38	PO39	PO40	PO41	PO42
Advanced Pharmacology 2021-22						
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23	✓	✓	✓			
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23		✓	✓	✓	✓	
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23	✓		✓		✓	✓
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22		✓	✓			
Structured project 2022-23	✓		✓	✓		

Level 4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Academic Research Project 2023-24	✓	✓			✓	✓	✓	✓				✓
Advanced Topics in Chemistry 2023-24	✓	✓	✓				✓					
Commercial Research Project 2023-24	✓	✓			✓	✓	✓	✓				✓
Professional and Personal Development 2023-24					✓	✓		✓				

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Academic Research Project 2023-24	✓	✓	✓	✓	✓	✓		✓		✓		✓
Advanced Topics in Chemistry 2023-24			✓			✓		✓				
Commercial Research Project 2023-24	✓	✓	✓	✓	✓	✓		✓		✓		✓
Professional and Personal Development 2023-24		✓								✓		✓

	PO25	PO26	PO27	PO28	PO29	PO30	PO31	PO32	PO33	PO34	PO35	PO36
Academic Research Project 2023-24						✓	✓	✓		✓	✓	✓
Advanced Topics in Chemistry 2023-24												
Commercial Research Project 2023-24						✓	✓	✓		✓	✓	✓
Professional and Personal Development 2023-24								✓	✓	✓	✓	✓

	PO37	PO38	PO39	PO40	PO41	PO42
Academic Research Project 2023-24	✓	✓	✓	✓	✓	
Advanced Topics in Chemistry 2023-24		✓	✓			
Commercial Research Project 2023-24	✓	✓	✓	✓	✓	
Professional and Personal Development 2023-24	✓				✓	

Appendix II - Assessment Map

This table indicates the spread of assessment activity across the programme. Percentages indicate assessment weighting.

Level 1

	01	02	03	04	05	06	07	08	09	10	11	12
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20												30
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21												
Introduction to Pharmaceutical Science 2019-20										20	40	40
Introduction to Professional Practice 2020-21												
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21												
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21												
Professional Practice 1: Analytical Sciences 2020-21												

	13	14	15	16	17	18	19	20	21	22	23	24
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20				70								
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21												
Introduction to Pharmaceutical Science 2019-20												
Introduction to Professional Practice 2020-21	25			75								
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21	100											

Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21												
Professional Practice 1: Analytical Sciences 2020-21												

	25	26	27	28	29	30	31	32	33	34	35	36
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20												
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21							30					
Introduction to Pharmaceutical Science 2019-20												
Introduction to Professional Practice 2020-21												
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21												
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21				30		70						
Professional Practice 1: Analytical Sciences 2020-21				60					40			

	37	38	39	40	41	42	43	44	45	46	47	48
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20												
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21												
Introduction to Pharmaceutical Science 2019-20												
Introduction to Professional Practice 2020-21												
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21												
Practical Chemistry 1.2: Introduction to												

synthetic methodologies and molecular characterisation 2020-21												
Professional Practice 1: Analytical Sciences 2020-21												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Core Chemistry 1.1: Introduction to Energy, Change and Electronic Structure 2019-20						
Core Chemistry 1.2: Molecular Structure, Bonding and Mechanism 2020-21						70
Introduction to Pharmaceutical Science 2019-20						
Introduction to Professional Practice 2020-21						
Practical Chemistry 1.1: Fundamental laboratory techniques 2020-21						
Practical Chemistry 1.2: Introduction to synthetic methodologies and molecular characterisation 2020-21						
Professional Practice 1: Analytical Sciences 2020-21						

Level 2

	01	02	03	04	05	06	07	08	09	10	11	12
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22												30
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22												
Drug Design and Development 2020-21										20		40
Drug Formulation and Delivery 2020-21											40	
Fundamentals of Pharmacology & Toxicology 2020-21												
Practical Chemistry 2.1: Organic synthesis,										70		

purification and advanced characterisation 2021-22												
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22												

	13	14	15	16	17	18	19	20	21	22	23	24
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22				70								
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22												
Drug Design and Development 2020-21												
Drug Formulation and Delivery 2020-21												
Fundamentals of Pharmacology & Toxicology 2020-21										50		
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22	30											
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22												

	25	26	27	28	29	30	31	32	33	34	35	36
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22												
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22							30					
Drug Design and Development 2020-21												
Drug Formulation and Delivery 2020-21												
Fundamentals of Pharmacology & Toxicology 2020-21												
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22												
Practical Chemistry 2.2: Inorganic synthesis							70	30				

and structural methods 2021-22												

	37	38	39	40	41	42	43	44	45	46	47	48
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22												
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22												
Drug Design and Development 2020-21												
Drug Formulation and Delivery 2020-21												
Fundamentals of Pharmacology & Toxicology 2020-21												
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22												
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Core Chemistry 2.1: Stability, Structure and Mechanism in Molecular Systems 2021-22						
Core Chemistry 2.2: Chemistry of Activated Systems and Radicals 2021-22						70
Drug Design and Development 2020-21					40	
Drug Formulation and Delivery 2020-21					60	
Fundamentals of Pharmacology & Toxicology 2020-21						50
Practical Chemistry 2.1: Organic synthesis, purification and advanced characterisation 2021-22						
Practical Chemistry 2.2: Inorganic synthesis and structural methods 2021-22						

Level 3

	01	02	03	04	05	06	07	08	09	10	11	12
Advanced Pharmacology 2021-22								10				40
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23												30
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23												
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23												
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22												
Structured project 2022-23												

	13	14	15	16	17	18	19	20	21	22	23	24
Advanced Pharmacology 2021-22												
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23				70								
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23												
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23	70			30								
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22	50											
Structured project 2022-23												

	25	26	27	28	29	30	31	32	33	34	35	36
Advanced Pharmacology 2021-22												
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23												
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23							30					

Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23												
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22												
Structured project 2022-23				75		25						

	37	38	39	40	41	42	43	44	45	46	47	48
Advanced Pharmacology 2021-22												
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23												
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23												
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23												
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22												
Structured project 2022-23												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Advanced Pharmacology 2021-22					50	
Core Chemistry 3.1: Defining Shape, Symmetry and Stereochemistry 2022-23						
Core Chemistry 3.2: Heterogeneous Systems, Surfaces and Nanoscience 2022-23						70
Practical Chemistry 3.1: Advanced techniques in IO-chemistry 2022-23						
Regulation, Quality and Ethics for the Pharmaceutical Scientist 2021-22					50	
Structured project 2022-23						

Level 4

	01	02	03	04	05	06	07	08	09	10	11	12
Academic Research Project 2023-24												20
Advanced Topics in Chemistry 2023-24												50
Commercial Research Project 2023-24												20
Professional and Personal Development 2023-24					30							

	13	14	15	16	17	18	19	20	21	22	23	24
Academic Research Project 2023-24												
Advanced Topics in Chemistry 2023-24				50								
Commercial Research Project 2023-24											60	20
Professional and Personal Development 2023-24												

	25	26	27	28	29	30	31	32	33	34	35	36
Academic Research Project 2023-24							60	20				
Advanced Topics in Chemistry 2023-24												
Commercial Research Project 2023-24												
Professional and Personal Development 2023-24							70					

	37	38	39	40	41	42	43	44	45	46	47	48
Academic Research Project 2023-24												
Advanced Topics in Chemistry 2023-24												
Commercial Research Project 2023-24												
Professional and Personal Development 2023-24												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)

Academic Research Project 2023-24						
Advanced Topics in Chemistry 2023-24						
Commercial Research Project 2023-24						
Professional and Personal Development 2023-24						

Appendix III - Benchmark Analysis

This table maps programme learning outcomes to relevant QAA subject benchmark statements or PSRB guidelines.

Knowledge and Understanding

	ChemHons 01	ChemHons 02	ChemHons 03	ChemHons 04	ChemHons 05	ChemHons 06	ChemHons 07	ChemHons 08	ChemMstr0 1
PO1	✓	✓		✓		✓		✓	
PO2	✓	✓						✓	
PO3	✓	✓				✓			
PO4	✓	✓	✓	✓		✓	✓	✓	
PO5	✓	✓	✓	✓		✓	✓	✓	
PO6	✓	✓			✓				✓
PO7	✓	✓			✓	✓			✓
PO8	✓	✓			✓				✓
PO9	✓	✓							
PO10	✓	✓							

	ChemMstr0 2	ChemMstr0 3	ChemMstr0 4	ChemMstr0 5
PO1	✓			
PO2				
PO3	✓			
PO4		✓		
PO5		✓		
PO6				✓
PO7	✓			✓
PO8	✓		✓	✓
PO9				
PO10				

Subject Specific Intellectual Skills

	ChemHons 01	ChemHons 02	ChemHons 03	ChemHons 04	ChemHons 05	ChemHons 06	ChemHons 07	ChemHons 08	ChemMstr0 1
PO11	✓	✓			✓	✓			✓
PO12	✓	✓	✓			✓			
PO13	✓	✓	✓			✓			
PO14	✓	✓				✓			
PO15	✓	✓			✓	✓			
PO16	✓	✓				✓			✓
PO17	✓	✓				✓	✓		✓
PO18	✓	✓				✓			
PO19	✓	✓			✓	✓			
PO20	✓	✓			✓	✓			
PO21	✓	✓				✓	✓		
PO22	✓	✓			✓	✓			
PO23	✓	✓				✓			

	ChemMstr0 2	ChemMstr0 3	ChemMstr0 4	ChemMstr0 5
PO11				
PO12				
PO13				
PO14				
PO15				
PO16	✓			
PO17	✓	✓	✓	
PO18				
PO19				
PO20				
PO21				
PO22				

PO23								

Subject Specific Practical Skills

	ChemHons 01	ChemHons 02	ChemHons 03	ChemHons 04	ChemHons 05	ChemHons 06	ChemHons 07	ChemHons 08	ChemMstr0 1
PO24			✓					✓	
PO25			✓					✓	
PO26			✓					✓	
PO27			✓					✓	
PO28			✓					✓	
PO29			✓					✓	
PO30			✓					✓	
PO31			✓					✓	

	ChemMstr0 2	ChemMstr0 3	ChemMstr0 4	ChemMstr0 5
PO24		✓		
PO25		✓		
PO26		✓		
PO27		✓		
PO28		✓		
PO29		✓		
PO30		✓		
PO31		✓		

Transferable Skills and Attributes

	ChemHons 01	ChemHons 02	ChemHons 03	ChemHons 04	ChemHons 05	ChemHons 06	ChemHons 07	ChemHons 08	ChemMstr0 1

PO32				✓				✓	
PO33				✓				✓	
PO34				✓				✓	
PO35				✓				✓	
PO36				✓				✓	
PO37				✓				✓	
PO38				✓				✓	
PO39				✓				✓	
PO40				✓				✓	
PO41				✓				✓	
PO42				✓				✓	

	ChemMstr02	ChemMstr03	ChemMstr04	ChemMstr05
PO32				✓
PO33				✓
PO34				✓
PO35				✓
PO36				✓
PO37				✓
PO38				✓
PO39				✓
PO40				✓
PO41				✓
PO42				✓

Appendix IV:
Benchmark Benchmark Statement(s)

ChemHons01 - *A basic knowledge and understanding of the content covered in the programme is evident*

ChemHons02 - *Problems of a routine nature are generally adequately solved*

ChemHons03 - *Standard laboratory experiments are carried out safely and with reasonable success*

ChemHons04 - *Professional skills (For example, interpersonal, time management and organsiational skills) have been developed to a basic level*

ChemHons05 - *Knowledge base covers essential aspects of subject matter dealt with in the programme and shows some evidence of enquiry beyond this. Conceptual understanding is good*

ChemHons06 - *Problems of a familiar nature are solved in a logical manner, and solutions are generally correct or acceptable*

ChemHons07 - *Experimental work is carried out in a reliable, safe and efficient manner, with demonstrable understanding of the significance and limitations of experimental data and observations*

ChemHons08 - *Professional skills are sound and show no significant deficiencies*

ChemMstr01 - *Knowledge base extends to a systematic understanding and critical awareness of current research in the subject*

ChemMstr02 - *Problems of an unfamiliar nature are tackled with appropriate methodology and taking into account the possible absence of complete data*

ChemMstr03 - *Experimental work is carried out independently, with some evidence of originality, and with appropriate risk assessments*

ChemMstr04 - *A substantial research project at the forefront of the subject is completed effectively*

ChemMstr05 - *Professional skills are developed appropriately for the workplace*