UNIVERSITY of BRADFORD

Faculty of Life Sciences

Master of Chemistry (Mathematical and Computational Chemistry) Programme Specification

Academic Year:	**2020/21**
Degree Awarding Body:	**University of Bradford**
Final and interim award(s):	**MChem** [Framework for Higher Education Qualifications (FHEQ) level 7] **BSc (Honours) Chemistry** [Framework for Higher Education Qualifications (FHEQ) level 6] **BSc Chemistry** [Framework for Higher Education Qualifications (FHEQ) level 6] **Diploma of Higher Education** [Framework for Higher Education Qualifications (FHEQ) level 5] **Certificate of Higher Education** [Framework for Higher Education Qualifications (FHEQ) level 4]
Programme accreditation	**Students can apply for membership of the Royal Society of Chemistry (RSC)**
Programme duration:	**4 Years Full Time**
UCAS code:	**F1GL**
QAA Subject benchmark statement(s):	**Chemistry (2015)**
Date last confirmed and/or minor modification approved by Faculty Board	**October 2020**

Please note: This programme specification has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but changes may occur given the interval between publishing and commencement of teaching. Any change which impacts the terms and conditions of an applicant's offer will be communicated to them. Upon commencement of the programme, students will receive further detail about their course and any minor changes will be discussed and/or communicated at this point.

Introduction

The Chemistry programmes at the University of Bradford are designed around the university's key mission statement 'Making Knowledge Work'. Our degrees will give students a solid background in the chemical sciences, but then allow students to focus on the application of chemistry in specific areas of modern chemistry. These areas have been chosen to reflect the main employment destinations for 21st century chemistry graduates: Materials Chemistry, Analytical Chemistry, Medicinal Chemistry and Computational Chemistry.

The Mathematical and Computational chemistry degree programme has been structured to give the students an integrated experience between the core chemistry and computational aspects of the work. During the first two years, students will develop a sound understanding of theoretical and practical aspects of chemistry with core content delivered in the traditional inorganic, organic and physical chemistry areas. At the same time their

mathematical and computational skills will be developed through specialised modules in these topics.

The third year will introduce students to specialist content in medicinal, materials and analytical chemistry, whilst the computational chemistry content will investigate the applicability of methods covered in first and second year to current research topics and industrial applications. Students will also have the opportunity to study a specific subject to a greater depth during an extended dissertation.

It is possible to exit after stage 3 with a BSc (Honours) in Chemistry.

In the Masters year, students will specialise in computational chemistry. The advanced study in the chosen area will allow students to develop a deeper understanding of the application of chemistry to solving real-world problems. Masters-level training focuses on deploying training in real-world settings. Academic research experience involves working on students' own project as part of a research team alongside post-graduate and post-doctoral researchers at the University.

As a Bradford Chemistry graduate, students will be uniquely placed to deploy the skills that have developed across the programmes to 'Make Knowledge Work'.

Programme Aims

The programme is intended to:

- develop an enthusiasm for chemistry and an appreciation of its application in different contexts
- provide opportunities for students to develop a systematic knowledge and understanding of the core principles of chemistry
- develop computational and mathematical skills required to solve problems within chemical sciences.
- enable students to develop a core range of chemistry-related practical skills
- develop students' ability to think critically and creatively
- develop collaborative and group working skills
- develop awareness of sustainability in the context of the chemical sciences
- equip students with subject and key skills necessary to facilitate transition to employment in both chemical and non-chemical employment or further study
- extend students comprehension of key chemical concepts and provide an in-depth understanding of applied areas of chemistry
- provide a supportive educational environment, which meets the needs of students from a variety of backgrounds
- enable students to become autonomous learners and prepare students for the lifelong learning skills required to be adaptable over the course of their career
- enable students to develop the ability to carry out experiments independently and assess the significance of their outcome

- develop the ability to adapt and apply methodology to the solution of unfamiliar problems
- instil a critical awareness of advances at the forefront of the chemical sciences

Programme Learning Outcomes

To be eligible for the award of **Certificate of Higher Education** at FHEQ level 4, students will be able to:

PLO 1 Describe the physical world using the language of chemistry.

PLO 2 Describe chemical reactions in terms of the change in structure of organic and inorganic compounds and materials, and in the change of measurable physical attributes of these.

PLO 3 Accurately and reliably communicate the results of practical experiments in sufficient detail to allow the experiment to be reproduced from their description alone.

PLO 4 Locate the information required to handle potentially hazardous material with due reference to COSHH protocols and regulations, and risk assessment procedures.

PLO 5 Work collaboratively to analyse a given problem, and to prepare an oral presentation.

PLO 6 Quantify the environmental impact of experiments using Green Chemistry metrics.

PLO 7 Develop and demonstrate computational development skills to solve numerical chemical problems.

Additionally, to be eligible for the award of **Diploma of Higher Education** at FHEQ level 5, students will be able to:

PLO 8 Interpret the structure and reactivity of organic and inorganic molecules and compounds by considering appropriate bonding models.

PLO 9 Discuss the way in which organic and inorganic compounds react at a molecular level with emphasis on mechanistic tools of interpretation.

PLO 10 Explain and apply computational models to describe molecular structure and bonding.

PLO 11 Explain physical processes, both in terms of classical thermodynamics and in terms of the quantisation of energy.

PLO 12 Interpret results of computational experiments, commenting specifically on the significance of the data produced.

PLO 13 Interpret the results of practical experiments, commenting specifically on the significance of the associated data produced.

PLO 14 Use appropriate technology and media to effectively communicate scientific ideas to their peers.

PLO 15 Evaluate their skill sets against subject-specific requirements and identify areas for professional and personal development.

PLO 16 Establish a collaborative approach to tackling chemical problems.

Additionally, to be eligible for the award of Ordinary **Degree of Bachelor** at FHEQ level 6, students will be able to:

PLO 17 Accurately apply the range of theories contained within computational, organic, physical and inorganic chemistry to interdisciplinary areas of the chemical sciences.

Additionally, to be eligible for the award of **Honours Degree of Bachelor** at FHEQ level 6, students will be able to:

PLO 18 Solve scientific problems by effectively consulting the primary scientific literature and utilising specialist software.

PLO 19 Work independently to critically appraise an area of current research within computational chemistry.

PLO 20 Use mechanistic concepts to rationalise and discuss the outcome of complex reactions.

PLO 21 Justify the application of suitable computational methods to solve problems of chemical structure, bonding and reactivity with reference to theoretical and computational factors.

PLO 22 Describe the commercial implications of computational chemistry.

PLO 23 Articulate complex scientific arguments in an interview setting.

Additionally, to be eligible for the award of **Degree of Master** at FHEQ level 7, students will be able to:

PLO 24 Structure a research project to answer a question at the forefront of the computational chemical sciences.

PLO 25 Design and implement experiments with due consideration of health and safety protocols in a professional environment.

PLO 26 Critically evaluate recent developments in international computational chemistry in the light of the underlying science.

PLO 27 Plan and organise themselves independently, so as to make effective use of their time during the implementation of a significant research project.

PLO 28 Present the conclusions of their research in a professional and scientifically rigorous manner to their peers, and specialist and non- specialist audiences.

Curriculum

Stage 1

FHEQ Level	Module Title	Type	Credits	Study Period	Module Code
4	Organic Chemistry 1	Core	20	1 + 2	CFS4023-B
4	Physical Chemistry 1	Core	20	1 + 2	CFS4024-B
4	Inorganic Chemistry 1	Core	20	1 + 2	CFS4022-B
4	Practical Chemistry 1 for Computational Chemistry	Core	40	1 + 2	CFS4027-D
5	Further Engineering Mathematics and Statistics	Core	20	1 + 2	ENM5005-B

At the end of stage 1, students will be eligible to exit with the award of Certificate of Higher Education if they have successfully completed at least 120 credits and achieved the award learning outcomes.

Stage 2

FHEQ Level	Module Title	Type	Credits	Study Period	Module Code
5	Organic Chemistry 2	Core	20	1 + 2	CFS5017-B
5	Physical Chemistry 2	Core	20	1 + 2	CFS5018-B
5	Inorganic Chemistry 2	Core	20	1 + 2	CFS5016-B
5	Practical Chemistry 2	Core	40	1 + 2	CFS5019-D
5	Computational Chemistry	Core	20	1 + 2	CFS5020-B

At the end of stage 2, students will be eligible to exit with the award of Diploma of Higher Education if they have successfully completed at least 240 credits and achieved the award learning outcomes.

Stage 3

FHEQ Level	Module Title	Type	Credits	Study Period	Module Code
6	Organic Chemistry 3	Core	20	2	CFS6017-B
6	Introduction to Polymer Science	Core	20	1	CFS6031-B
6	Bio-organic and Bio-inorganic Chemistry	Core	20	1	CFS6014-B
6	Molecular Analysis	Core	20	2	CFS6016-B
6	Computational Chemistry Skills and Independent Research	Core	40	1 + 2	CFS6023-D

Students will be eligible to exit with the award of Ordinary Degree of Bachelor if they have successfully completed 120 credits in both Level 4 and 5 and 60 credits at level 6 and achieved the award learning outcomes.

Students will be eligible for the award of Honours Degree of Bachelor if they have successfully completed at least 360 credits and achieved the award learning outcomes.

Stage 4

FHEQ Level	Module Title	Type	Credits	Study Period	Module Code
7	Advanced Computational Chemistry	Core	20	1	CFS7031-B
7	Scientific Computation	Option	20	1	CFS7032-B
7	Modelling Reactivity and Spectroscopy	Option	20	1	CFS7033-B
7	Solid State Modelling	Option	20	2	CFS7034-B
7	Computational Biophysics and Structural Biology	Option	20	2	CFS7035-B
7	Stage Four Research Project	Core	60	1 + 2	CFS7005-E

Students will be eligible for the award of MChem if they have successfully completed at least 480 credits and achieved the award learning outcomes.

Placement and/or Study Abroad

This programme does not provide the option for students to undertake a work placement or period of study abroad as part of their Masters Year. Students wishing to take this option will be transferred to the 4 year MChem Chemistry (Industrial Experience) programme.

For further information about study abroad opportunities please refer to https://www.bradford.ac.uk/study/abroad/

For further information about placement opportunities please refer to https://www.bradford.ac.uk/chemistry-and-biosciences/chemistry/careers/

Learning and Teaching Strategy

The programme articulates with the Teaching and Learning strategies of the University. Students will be exposed to a variety of teaching methods designed to develop the learning outcomes and to cater for different preferences for learning. A wide variety of teaching methods appropriate to the learning outcomes of the individual modules is employed throughout the programme. These methods progressively focus on student-centred approaches to learning. Thus, students will be expected to take responsibility for their learning as they progress through the programme. In this way, students will develop the attributes needed for life-long learning and continuing professional development.

Learning outcomes 1-17, 20, 21 and 26 will be developed in a number of modules, through a mix of lectures, seminars, tutorials, laboratory practicals, workshops and directed study. Lectures, seminars and tutorials will be delivered on-campus or using a blended delivery style with material delivered through structured online learning packages. Directed study will include directed reading of selected textbooks, specified source literature and open learning materials, directed web-based materials, report writing and other assignments. In addition, individual project/dissertation work will further help to develop learning outcomes 18, 19, 22-28.

Assessment Strategy

Students will demonstrate their achievement via written closed-book examinations using constructed (essays, short answers) and selected response (MCQ) questions and a variety

of coursework assignments, including laboratory reports, oral presentations and dissertations.

The development of learning outcomes 3, 4, 13, 16, 22, 23, 24 and 26 will be through involvement in laboratory, small-group workshops, case-based work and projects (individual and small group). They will be assessed by critical appraisal, case analysis and critique, case presentations, laboratory reports and dissertations

Assessment Regulations

This Programme conforms to the standard University Undergraduate Assessment Regulations which are available at the link: http://www.bradford.ac.uk/regulations/

However, there are four exceptions to these regulations as listed below:

- Students who, at initial attempt, do not achieve a module mark of 35.0% or more for Practical Chemistry 1 for Computational Chemistry (stage 1 students) or Practical Chemistry 2 (stage 2 students) will forfeit the right to supplementary assessment and will be required to repeat the modules with attendance.
- In order for students to progress from Stage 2 to 3 of the programme of the Integrated Degree of Master, students must have an average mark of 55.0% at the first attempt across all 120 credits studied in Stage 2. Students who do not achieve this will be required to transfer to the BSc (Hons) Chemistry Programme.
- In order to progress between Stage 3 and 4 of the programme of the Integrated Degree of Master, students must have completed 120 credits at stage 3 with a mark of 40.0% or more in each module. Compensation is not permitted.
- The MChem award is calculated based on the marks accrued in stages 2, 3 and 4 of the programme in the following weightings: Stage 2: 10%, Stage 3: 40%, Stage 4: 50%. The fall-back award of BSc (Hons) will be calculated according to the standard university regulations: Stage 2: 20% and stage 3: 80%.

Admission Requirements

We take into consideration a number of factors when assessing your application. It's not just about your grades; we take the time to understand your personal circumstances and make decisions based on your potential to thrive at university and beyond. Consideration of applications will be based on a combination of formal academic qualifications and other relevant experience.

The minimum entry requirements for the programme are GCSE passes including English, Mathematics and a Science at grade C or 4. For students whose first language is not English, they will need a Minimum IELTS of 6.0, with no sub-test less than 5.0, or the equivalent score in another recognised language test.

A typical offer to someone seeking entry through the UCAS scheme would be 112 UCAS points (equivalent to BBC) with at least 80 points in Chemistry and Mathematics (old tariff: 280 points with at least 200 points in Chemistry and Mathematics). The UCAS tariff applicable may vary and is published here https://www.brad.ac.uk/courses/ug/mathematical-and-computational-chemistry-mchem/

Please note: This link provides admission information relevant to the current recruitment cycle and therefore may be different to when this document was originally published.

On completion of a UCAS form students will be invited to the School for an Open Day when they will have the opportunity to meet staff, view the facilities and discuss "the Bradford experience" with current students.

Recognition of Prior Learning

Applications are welcome from students with non-standard qualifications or mature students (those over 21 years of age on entry) with significant relevant experience.

If applicants have prior certificated learning or professional experience which may be equivalent to parts of this programme, the University has procedures to evaluate and recognise this learning in order to provide applicants with exemptions from specified modules or parts of the programme.

Minor Modification Schedule

Version Number	Brief description of Modification	Date of Approval (Faculty Board)
1	CFS6015-B replaced by CFS6031-B	March 2019
2	Modified delivery approach to include blended learning	September 2020
3	Specification reformatted and made accessible	November 2020