

# Bachelor of Science Major in Chemistry 2016

**Accredited by the  
Royal Australian Chemical Institute**



1 <sup>st</sup> Year			
Sem 1	Chemistry 1A (Hbt-KRA113 & Ltn-KRA101)		
Sem 2	Chemistry 1B (Hbt-KRA113 & Ltn-KRA102)		
2 <sup>nd</sup> Year			
Sem 1	Chemistry 2A Organic & Bioinorganic (Hbt-KRA224)	Environmental Chemistry (Hbt & Ltn KRA211)	
Sem 2	Chemistry 2B Inorganic & Physical (Hbt-KRA225)	Chemistry 2C Chemical Analysis (Hbt-KRA223)	
3 <sup>rd</sup> Year			
Sem 1	Organic & Bioorganic Chemistry (Hbt-KRA341)	Environmental Monitoring & Remediation (Ltn KRA300)	Chemistry Research Project (Hbt & Ltn KRA337) (if not already taken in Semester 2 & 3)
	Structure & Materials (Hbt-KRA343)		
Sem 2	Catalysis and Sustainable Reaction Processes (Hbt-KRA342)	Chemistry Research Project (Hbt & Ltn KRA337) (if not already taken in Semester 1 & 3)	
	Analytical Separation Techniques & Sensors (Hbt-KRA344)		
Sem 3	Chemistry Research Project (Hbt & Ltn KRA337) (if not already taken in Semester 1 & 2)		

Shaded Units are required for an accredited major in Chemistry  
Unshaded Units are Electives

Chemistry 1A plus Chemistry 1B together allow entry to all 2<sup>nd</sup> year units.

Chemistry 2A and Chemistry 2C allow entry to all 3<sup>rd</sup> year units.

Chemistry 2A allows entry to Organic and Bioorganic Chemistry, Catalysis and Reaction Processes & Structure and Materials.

Chemistry 2C allows entry to Instrumental Methods of Analysis for the Sciences.

School of Physical Sciences

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# First Year Units in Chemistry

Students who would like to do these units but have timetable problems with lectures, tutorials or laboratory work should consult the unit coordinators.

## **KRA113 Chemistry 1A – Hobart**

Students who do not have the necessary prerequisites for this unit should enrol in KRA001 Chemistry Foundation Unit and either KMA002 or KMA003 Mathematics Foundation Units. A chemistry major is recognised by the Royal Australian Chemical Institute (RACI) as meeting the requirements for Graduate Member (MRACI) provided that either a mathematics or physics unit is also taken at 1st year level in addition to both KRA113 and KRA114.

Description: Together with Chemistry 1B, this unit is a required prerequisite for those students intending to major in Chemistry and for those intending to proceed to 2nd year chemistry. It provides students with fundamental knowledge and concepts in inorganic, physical, analytical, and organic chemistry, with applications in both the physical and biological sciences. Topics include bonding and structure, thermodynamics and the chemistry of organic functional groups. Laboratory sessions are designed to increase students' manipulative skills and, where possible, to reinforce the lecture program.

Staff: Dr Jason A Smith (Coordinator), Prof Emily Hilder, Dr Stuart Thickett

Teaching Pattern: 4 x 1-hr lecture/problem-solving sessions (13 wks), 1-hr tutorial weekly (13 wks), online assignments (12 wks) and 3-hr laboratory (8 wks)

Assessment: 1-hr mid-semester test (10%); 3-hr end-of-semester exam (60%); laboratory work (20%), assignments (10%)

Prerequisites: CHM315109 or KRA161 or [KRA001 + (MTA31510 or MTM315109 or KMA002 or KMA003)]

## **KRA114 Chemistry 1B – Hobart**

Students who do not have the necessary prerequisites for this unit should enrol in KRA001 Chemistry Foundation Unit and either KMA002 or KMA003, Mathematics Foundation Units. A chemistry major is recognised by the Royal Australian Chemical Institute (RACI) as meeting the requirements for Graduate Member (MRACI) provided that either a mathematics or physics unit is also taken at 1st year level in addition to both KRA113 and KRA114.

Description: Together with KRA113 Chemistry 1A, this unit is a required prerequisite for those students intending to major in Chemistry and for those intending to proceed to second-year chemistry. It provides students with fundamental knowledge and concepts in inorganic, physical, analytical, and organic chemistry, with applications in both the physical and biological sciences. Topics include equilibrium and acid-base chemistry, chemical kinetics, coordination chemistry, separation techniques, the chemistry of organic functional groups and an introduction to lipids, carbohydrates and proteins. Laboratory sessions are designed to increase students' manipulative skills and, where possible, to reinforce the lecture program.

Staff: Assoc Prof Michael Gardiner (Coordinator), Dr Alex Bissember, Assoc Prof Michael Gardiner, Dr Karen Stack, Prof Emily Hilder.

Teaching Pattern: 4 x 1-hr sessions (including lectures and problem solving sessions), weekly drop in help session (13 wks), online assignments (12 wks) and 3-hr laboratory (8 wks)

Assessment: 1-hr mid-sem test (10%); 3-hr end-of-sem exam (60%); lab work (20%), assignments (10%)

Prerequisites: CHM315109 or KRA161 or [KRA001 + (MTA31510 or MTM315109 or KMA002 or KMA003)]

## **KRA101 Chemistry 1A – Launceston**

Students who do not have the necessary prerequisites for this unit should enrol in KRA001, Chemistry Foundation Unit and KMA003, Mathematics Foundation Unit. A chemistry major is recognised by the Royal Australian Chemical Institute (RACI) as meeting the requirements for Graduate Member (MRACI) provided that either a mathematics or physics unit is also taken at 1st year level in addition to both KRA101 and KRA102. Lab coat and safety glasses are required.

Description: Together with Chemistry 1B, this is a core unit for the Chemistry major, and for Environmental Science, Science, Biomedical Science students, providing them with the fundamental knowledge and concepts in inorganic and physical chemistry. Inorganic Chemistry (Chemical Bonding and Structure) covers atomic structure, bonding theories, the systematic chemistry of s- and p- block elements and introduces the coordination chemistry of the transition metals, including the significance of coordination compounds in biology and the environment. Physical Chemistry in this unit involves a study of the behaviour of gases, the solubility of gases and inorganic and organic compounds, chemical and solution equilibria, colligative properties, acids, bases and buffers.

Staff: Dr Trevor Lewis (Coordinator)

Teaching Pattern: 3 hrs lectures and 1 hr tutorial weekly (13 wks), 3 hrs practical weekly (8 wks)

Assessment: Lab work (20%), 2 x 1-hr mid-sem tests (20%), 3-hr end-of-sem exam (60%).

Prerequisites: CHM315109 or (KRA161 or [KRA001 and (MTA315109 or MTM315109 or KMA002 or KMA003)])

## **KRA102 Chemistry 1B – Launceston**

Students who do not have the necessary prerequisites for this unit should enrol in KRA001, Chemistry Foundation Unit and KMA003, Mathematics Foundation Unit. A chemistry major is recognised by the Royal Australian Chemical Institute (RACI) as meeting the requirements for Graduate Member (MRACI) provided that either a mathematics or physics unit is also taken at 1st year level in addition to both KRA101 and KRA102. Lab coat and safety glasses are required.

Description: Together with Chemistry 1A, this is a core unit for the Chemistry major, and for Environmental Science, Science, Biomedical Science students, providing them with the fundamental knowledge and concepts in organic and physical chemistry. Organic Chemistry covers the preparation, properties and reactions of the major classes of organic compounds, highlights their biological applications and includes an introduction to proteins, lipids and carbohydrates. Physical Chemistry involves a study of thermochemistry, calorimetry, thermodynamics, oxidation and reduction, batteries, corrosion and kinetics.

Staff: Dr Trevor Lewis (Coordinator)

Teaching Pattern: 3 hrs lectures and 1 hr tutorial weekly (13 wks), 3 hrs practical weekly (8 wks) – pracs start Week 3

Assessment: Lab work (20%), 2 x 1-hr mid-sem tests (20%), 3-hr end-of-sem exam (60%).

Prerequisites: CHM315109 or (KRA161 or [KRA001 and (MTA315109 or MTM315109 or KMA002 or KMA003)])

# Second Year Units in Chemistry

*Students who would like to do these units but have timetable problems with lectures, tutorials or laboratory work should consult the unit coordinators.*

KRA223, KRA224 and KRA225 comprise the three 200 level Chemistry units leading to an accredited major in Chemistry. The Royal Australian Chemical Institute recommends that all three of these units be completed in order to join the Institute as a member.

## **KRA224 Chemistry 2A Organic and Bioinorganic – Hobart**

This unit is recommended for those students who intend to progress to the related 300 level units KRA341, KRA342, KRA343 and KRA344.

Description: This unit builds on first year chemistry units and consolidates this theoretical and practical framework. It is essential for students who intend to major in chemistry, or who need additional chemistry to support their studies in other science areas (such as biotechnology & medical research, biochemistry and biology). Lectures include organic spectroscopy for the structural identification of organic molecules and the synthesis, reactions and chemical properties of organic and inorganic compounds. The interrelationships of chemistry with the life sciences are emphasised with relevant biological examples.

In this unit, there is strong focus on laboratory techniques for preparation, isolation and spectroscopic analysis of organic and inorganic compounds including those of biological relevance (such as essential oils, drug precursors, and enzyme mimics).

Staff: Dr Jason Smith (Coordinator), Dr Alex Bissember, Dr Nathan Kilah

Teaching Pattern: 3 x 1-hr teaching sessions weekly (13 wks), 4-hr lab weekly (11 wks), assignments (4 wks)

Assessment: 3-hr exam (60%), lab (35%), assignments and tests (5%)

Prerequisites: (KRA113 and KRA114) or (KRA101 and KRA102)

## **KRA225 Chemistry 2B Inorganic and Physical – Hobart**

This unit is recommended for those students who intend to progress to the related 300 level units KRA341, KRA342, KRA343 and KRA344.

Description: This unit builds on first year chemistry units and consolidates the theoretical and practical framework required by students who intend to major in chemistry or who need additional chemistry to support their studies in other science areas. The inorganic chemistry topic covers the synthesis and properties of inorganic and organometallic compounds (especially transition metal coordination complexes and organometallic chemistry of the main group metals), with an underlying emphasis on modern techniques used to determine chemical structures and contemporary applications of inorganic compounds. The physical chemistry section covers topics taken from kinetics, electrochemistry, molecular orbital theory and computational chemistry. The laboratory program reinforces concepts introduced in lectures and gives students experience in good laboratory practice.

Staff: Dr Stuart Thickett (Coordinator)

Teaching Pattern: 3x1-hr teaching sessions weekly (including lectures and problem solving sessions), 4-hr lab weekly (12 wks)

Assessment: 3-hr exam (60%), lab (35%), assignments (5%)

Prerequisites: (KRA113 and KRA114) or (KRA101 and KRA102)

### **KRA223 Chemistry 2C Chemical Analysis – Hobart**

Description: This unit builds on first year chemistry units and consolidates the theoretical and practical framework required by students who intend to major in chemistry or who need additional chemistry to support their studies in other science areas.

This unit provides a sound introduction to the principles and practice underlying quantitative analytical chemistry, including some important instrumental techniques. The emphasis is on the analysis of aqueous systems relevant to environmental, industrial, forensic, and other applications including the application of spectroscopic methods (AS/GTA, UV/visible, fluorimetry) and chromatography (IC, LC, GC), and electrochemistry (potentiometry, ion selective electrodes). Particular emphasis is placed on obtaining accurate results and on statistical analysis, specifically relating to data handling and the reporting of results.

Examples are taken from the 'real-world' and thus this unit not only meets the needs of chemists but has direct relevance to students with interests in earth sciences, life sciences, environmental studies, medical and biomedical research, Antarctic science, biotechnology, marine sciences, aquaculture etc. The laboratory sessions complement lectures, provide practical experience in the analytical methods discussed and emphasise good laboratory practice especially in the area of chemical analysis and safety.

Staff: Prof Emily Hilder (Coordinator)

Teaching Pattern: 3x1hr teaching sessions weekly, 4hr laboratory weekly (11 weeks)

Assessment: 3hr exam (60%), laboratory (35%), assignments (5%)

Prerequisites: (KRA113 and KRA114) or (KRA101 and KRA102)

### **KRA211 Environmental Chemistry – Hobart and Launceston**

Description: This unit will develop an understanding of the chemical behaviour of important elements and compounds in the environment, with an emphasis on aquatic, marine, atmospheric and soil chemistry. Topics include aspects of inorganic and organic pollutants; pollutants in the aquatic environment; water treatment; introductory soil chemistry; the Greenhouse Effect and urban air pollution.

The Unit not only meets the needs of chemists but has direct relevance to students with interests in earth sciences, life sciences and environmental science.

Staff: Dr Trevor Lewis (Coordinator)

Teaching Pattern: 4x1hr lectures/ tutorials weekly, excursions, assignments and reports.

Assessment: 3 hr exam (65%), mid semester test (10%), assignments and reports (25%)

Prerequisites: KRA113 or KRA114 or KRA101 or KRA102 or KRA170

### **KRA201 Analytical Chemistry – Launceston**

Description: This unit provides a sound introduction to analytical chemistry encompassing both theoretical and practical treatment of quantitative analytical processes. Methods for sample preparation, digestion of samples and separation of sample constituents are thoroughly examined. Classical analytical methods of analysis (gravimetric and titrimetric) are studied in detail throughout this unit. Students are introduced to instrumental methods of analysis through a study of selected techniques (ultraviolet-visible spectrometry, atomic absorption spectrometry, potentiometry, gas chromatography and liquid chromatography). The laboratory component provides an authentic experience through the analysis of real and relevant environmental samples.

Staff: Dr Rebecca Gehling (Coordinator), Dr Trevor Lewis

Teaching Pattern: 3x1 hour lecture, 1 x 1 hour tutorial or equivalent weekly (13 wks), 1 x 4 hours practical (9 wks).

Assessment: Mid-sem test (10%), practical (30%), 3-hr exam (60%)

Prerequisites: (KRA101 and KRA102) or (KRA113 and KRA114)

# Third Year Units in Chemistry

*Students who would like to do these units but have timetable problems with lectures, tutorials or laboratory work should consult the unit coordinators.*

## **KRA341 Organic and Bioorganic Chemistry – Hobart**

This unit is intended for all students majoring in chemistry along with those with interests in the biotechnology, natural products, medical and biomedical research and pharmaceutical science areas.

Description: This unit extends the basic understanding of organic chemistry and chemical reactivity from level 200 units and introduces more advanced chemical reactions and the concept of rational synthetic design. The course also highlights the key reactions in the synthesis of biological molecules and provides an introduction to the role of natural products and synthetic chemistry to the pharmaceutical sector. Topics that will be included are selected from: the biosynthesis of biologically important molecules, natural products and medicinal chemistry, the chemistry of reactive intermediates, pericyclic reactions, heterocyclic chemistry, mechanisms of polymer formation and the use of retrosynthetic analysis in the design of multi-step chemical syntheses. The laboratory program is closely associated with the lecture material and introduces techniques and instrumentation that are used in modern synthetic chemistry for the synthesis of small organic molecules such as those of importance to the pharmaceutical industry.

Staff: Dr Alex Bissember (Coordinator), Dr Jason Smith, Prof Emily Hilder

Teaching Pattern: 3x1-hr sessions weekly (total 39), 4-hr laboratory weekly (10 weeks)

Assessment: 3-hr examination (60%), laboratory (35%), assignments (5%)

Prerequisites: KRA224

## **KRA343 Structure and Materials – Hobart**

This unit is intended for all students majoring in chemistry along with those with interests in the physical sciences, industrial chemistry, biotechnology, medical and biomedical research, Antarctic science, life science, earth science, pharmaceutical science, and marine science areas. The content of this unit has also been structured so that it serves many other courses within the BSc.

Description: This unit builds on a range of chemical concepts and techniques introduced in 200 level units that are widely used by modern scientists that are not restricted to the chemical sciences; including earth sciences, environmental studies, industrial chemistry, and physical, health and life sciences. It also introduces topics in materials chemistry as they apply to the development of a range of advanced components used in everyday and technological products. The material presented concentrates on giving a sound foundation to the theory and application of modern characterisation techniques with an emphasis on the elucidation of chemical structure, with major topics including advanced emission and molecular spectroscopic techniques such as NMR spectroscopic applications (including variable temperature, solid state and 2D experiments), EPR, IR, Raman, photoelectron, UV-Vis spectroscopy, the stereochemistry of inorganic and organic compounds and various aspects of the physical chemistry of surfaces. In addition, both laboratory-source and synchrotron-based X-ray techniques are introduced, including diffraction and XAS methods. The laboratory program reinforces concepts introduced in lectures and gives students experience in good laboratory practice and hands-on usage of modern research level spectroscopic, physical chemistry and diffraction instrumentation.

Staff: Dr Stuart Thickett (Coordinator)

Teaching Pattern: 3x1-hr teaching sessions weekly (including lectures and problem solving sessions), 4-hr laboratory weekly (10 weeks)

Assessment: 3-hr examination (60%), laboratory (35%), assignments (5%)

Prerequisites: KRA224

### **KRA342 Catalysis and Sustainable Reaction Processes – Hobart**

This unit is intended for all students majoring in chemistry along with those with interests in the physical sciences, biotechnology, medical and biomedical research, life sciences, earth sciences, Antarctic science, marine science, and pharmaceutical science areas. The content of this unit has also been structured so that it serves many other courses within the BSc.

Description: This unit explores the application of contemporary organometallic chemistry and advanced computational chemistry to the study of catalysis and reaction processes. The organometallic chemistry topics will include bonding and structure, catalytic reactions, and applications in organic synthesis and industrial chemistry. The computational chemistry sessions will focus on the use of modern density functional theory to study reaction processes. Laboratory work will cover aspects of organometallic synthesis, catalytic reactions, and computational chemistry.

Staff: Assoc Prof Michael Gardiner (Coordinator), Dr Jason Smith, Dr Curtis Ho

Teaching Pattern: 3x1-hr teaching sessions weekly (total 39), 4-hr lab weekly (10 weeks)

Assessment: 3-hr examination (60%), laboratory (35%), assignments (5%)

Prerequisites: KRA224

### **KRA344 Analytical Separation Techniques and Sensors – Hobart**

This unit is intended for all students majoring in chemistry along with those with interests in the physical sciences, biotechnology, medical and biomedical research, life sciences, earth sciences, Antarctic science, marine science, and pharmaceutical science. Students who would like to do this unit but have a timetable problem with either lectures or laboratory work should consult the Unit Coordinator.

Description:

This unit concentrates on instrumental methods of analysis and provides a sound foundation to the theory and application of modern analytical techniques. This unit is of importance to all who rely on the use of instrumental analysis in their field of endeavour. Topics within this unit include gas and liquid chromatography, electrophoresis, elemental and molecular spectroscopy, portable analytical technology, and electrochemistry and sensors. The laboratory program reinforces concepts introduced in lectures and gives students experience in good laboratory practice and protocol, and hands-on experience of modern analytical instrumentation. Overall this unit presents theory and practice of instrumental analysis in a context relevant and key to all areas of scientific study including, but not limited to the physical sciences, biotechnology, medical and biomedical research, life sciences, earth sciences, and pharmaceutical science areas.

Staff: Prof Michael Breadmore (Coordinator), Assoc Prof Robert Shellie, Dr Trevor Lewis, Prof Brett Paull, Prof Emily Hilder, Assoc Prof Joselito Quirino, Dr Ashley Townsend.

Teaching Pattern: 3x1-hr teaching sessions weekly (total 39), 4-hr lab weekly (10 weeks)

Assessment: 3-hr examination (60%), laboratory (35%), assignments (5%)

Prerequisites: KRA201 or KRA223 or KRA225



### **KRA300 Environmental Monitoring and Remediation – Launceston**

Description: This unit utilises the diversity of examples of environmental chemistry in natural, urban and industrial environments within Tasmania to develop an understanding of the sources and fate of chemical contaminants in the environment, and to provide an understanding of the technologies and strategies used for minimising wastes, containment of chemical contaminants, and remediation of impacted sites.

The unit will be delivered by block teaching (1 week of lectures/workshops in Launceston and excursions to 3 Tasmanian chemical industries prior to commencement of semester 1) followed by online activities/learning opportunities throughout semester 1. These online learning opportunities will focus on the development of skills required for conducting environmental assessments and preparing environmental management plans, including development of an understanding of monitoring techniques, sampling plans, environmental guidelines and mass balance techniques.

Staff: Dr Rebecca Gehling (Coordinator), Dr Trevor Lewis

Teaching Pattern: 5 days of excursions and lectures/workshops before semester 1 in Launceston, online learning opportunities during semester 1.

Assessment: Assignments (30%) presentation (10%), 3hr exam (60%)

Prerequisites: KRA211 or KRA201 or KRA223

### **KRA337 Chemistry Research Project – Hobart and Launceston**

This unit is available only to students already enrolled in a Chemistry major. Enrolment in this unit depends on the availability of a suitable project, supervisor and resources.

**This unit is classed as a restricted unit which means that a paper enrolment is required and unit coordinator approval must be obtained.**

Description: This unit comprises a one-semester research project in chemistry for advanced students. This unit will only be offered to students who are currently enrolled in units leading to a major in Chemistry (within the BSc, BBiotech, BBioTechMedRes, BMarSci or BEnvSci programs) and then only with the approval of the Head of School. Once approved, students should speak to academic staff and discuss suggestions for suitable projects before the start of semester (please refer to the unit outline for detailed timelines). The unit will involve the equivalent of 6 hours per week for 13 weeks spent in planning, conducting and reporting on a research project in an area negotiated between the student and the supervising academic staff.

Staff: Assoc Prof Michael Gardiner (Coordinator)

Teaching Pattern: 6 hours per week – flexible

Assessment: Research plan (10%), research performance (30%), written report (60%)

Co-requisite: Currently enrolled in a Chemistry major

# About the Discipline of Chemistry

Chemistry is the science of thinking about things at the molecular level. What makes a good beer? Why do compounds react in certain ways? How do chemicals interact with plants and animals? How can we best analyse the minute residues available in forensic science? All of these questions require a good understanding of the molecular basis of compounds, and the way that molecules interact with each other and with the environment. Chemistry uses sophisticated techniques to probe and measure these interactions at the molecular level. A graduate in Chemistry will end up in a variety of occupations, ranging from research and industrial laboratory work through to teaching and project management.

At the University of Tasmania we are well-placed to provide a sophisticated chemical education, with academic staff who are recognised nationally and internationally for their research and teaching ability. We pride ourselves on being friendly and open to students and we maintain a good interaction between staff and students through small class sizes and individual instruction. Combined with the unique natural features of living in Tasmania, this makes Chemistry at UTAS an attractive place to work and study. Whether you are a student or visitor, we look forward to welcoming you.

## Career Outcomes

Some of the employment opportunities for chemistry graduates are in the following fields:

- Agriculture
- Biotechnology
- Drug discovery and design
- Earth Science
- Education
- Environmental Science
- Forensic Science
- Geology
- Marine Science
- Mining
- Oceanography
- Pharmaceutical science

Typical employers include universities, CSIRO, government agencies, analytical laboratories and statutory authorities and industry. In the private sector, opportunities exist with petrochemicals, food and drink fertilisers, paper, heavy chemicals, iron and steel industries, as well as computer firms, insurance companies, mining companies and banks.

## Professional Organisation

The Royal Australian Chemical Institute (RACI) is the professional organisation of Australian Chemists. Further information concerning the RACI is available [RACI.org.au](http://RACI.org.au)