# CBMS203

## Synthesis

S1 Day 2019

*Dept of Molecular Sciences*

## Contents

# General Information

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Credit points
3

Prerequisites
(CBMS107 or CBMS103) and (CBMS108 or CBMS101 or CBMS102)

Corequisites

Co-badged status
CBMS625

Unit description
This unit serves the needs of students who wish to major in chemistry or biomolecular sciences, as well as those pursuing related disciplines in biological, medical, materials and health sciences. It will be valuable to anyone with an interest in how organic and inorganic compounds react with one another, and how chemists use this knowledge of molecular interactions to synthesise new compounds with desirable properties (eg, new pharmaceuticals, new catalysts, and new materials). The unit focuses on synthetic organic and inorganic chemistry, but the principles, mechanisms and synthetic procedures that it deals with are not confined to organic/inorganic reactions: the material covered is particularly relevant to students interested in biochemistry biotechnology, medical or materials sciences. Topics include: a review of chemical reactivity; introduction to the spectroscopic identification of compounds; reaction mechanisms; and synthetic methods. The study of these mechanisms and methods provides an understanding of chemical processes and reactivities that are applicable in designed and living systems. The practical component is aimed at developing laboratory skills and deductive reasoning; it comprises syntheses of various classes of compounds and identification of unknown compounds by chemical and spectroscopic means.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

# Learning Outcomes

On successful completion of this unit, you will be able to:

Predict the relative reactivity of a series of related compounds

Assess the risks and hazards associated with working in a synthetic laboratory environment

Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner

Use spectroscopic information to deduce the structure of simple organic and inorganic molecules

Purify organic and inorganic compounds using basic synthetic techniques

Write a report in a scientific format

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|---|---|---|---|
| Practical | 20% | Yes | weeks 2-5, 7-13 |
| Workshops | 5% | No | In workshop |
| Spot tests | 10% | No | In Class |
| Mid Term Test | 15% | No | Week 7 Class |
| Final Exam | 50% | No | TBA |

## Practical

Due: **weeks 2-5, 7-13**
Weighting: **20%**
**This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)**

Practical (5 Experiments in weeks 2, 3, 4, 5, 7, 8, 9, 10, 11, and 12) 20%

These experiments have interconnected learning outcomes and demonstrate the necessary techniques. The student is required to participate in all practical/workshop sessions and allowed no more than one missed practical without a medical certificate. The student is required to perform the experiments according to instructions and complete post-lab exercises/reports satisfactorily.

Missing two or more practicals even with approved disruption-based exemptions means that the learning outcomes of this hurdle requirement have not been met. In this case, the student should consult with the lecturer-in-charge for options. Otherwise, a fail mark may result from this hurdle and ultimately a fail mark for the unit.

Details on what is expected for assessment of the practical component, including penalties for late submissions, are provided in the laboratory manual/notes (see the iLearn website). The mark will reflect the level of practical performance and safety/laboratory techniques seen within the laboratory as well as clear presentation, interpretation of results and addressing of specific questions within laboratory reports.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon,

carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Use spectroscopic information to deduce the structure of simple organic and inorganic molecules
- Purify organic and inorganic compounds using basic synthetic techniques
- Write a report in a scientific format

## Workshops

Due: **In workshop**
Weighting: **5%**

Workshops (week 6 and 13) 5%

The workshops are essentially long tutorial sessions in which students practice exam style questions and develop independence in problem solving.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Use spectroscopic information to deduce the structure of simple organic and inorganic molecules

## Spot tests

Due: **In Class**
Weighting: **10%**

Spot Tests 10%

Spot tests may be conducted at any stage in class. They are to encourage continuous learning of the course material.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Use spectroscopic information to deduce the structure of simple organic and inorganic

molecules

## Mid Term Test

Due: **Week 7 Class**
Weighting: **15%**

Mid-term Test (week 7) 15%

Mid-semester Test - There will be a 50 minute test in week 7 class (covering weeks 1-6 material).

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Use spectroscopic information to deduce the structure of simple organic and inorganic molecules

## Final Exam

Due: **TBA**
Weighting: **50%**

Final Exam 50%

The final exam will be 3 hours in length with 10 minutes reading time. It is designed to address specific understanding of all the topics presented within the course and to show that the knowledge obtained can be applied to new problems.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Use spectroscopic information to deduce the structure of simple organic and inorganic molecules

# Delivery and Resources

## Classes

CBMS203 is organized around classes and laboratory experiments/workshops.

The timetable may be subject to change so please check on the University web site at: http://www.timetables.mq.edu.au/

These are used to emphasize key points and concepts with relevant examples. Studying the material to be covered **BEFORE** coming to a class is particularly productive in maximizing the learning outcomes in class. iLectures or recorded lectures are not offered in this unit.

Spot tests will be run in class time. The lab notes, which include safety information and tips on writing the reports are available from the CBMS203 website (log in through ilearn.mq.edu.au).

Lab practicals/workshops (once every week from weeks 2-13).

Participation every week is compulsory, and no make-up labs will be available. It is your responsibility to time table your schedule so that you will be able to complete the experiments within those weeks. **Failure to attend more than once without a Medical Certificate will result in being failed**. Some of the lab sessions will be workshops on problem solving. The workshop is essentially a long tutorial session where you will be asked to answer exam style questions - some exam questions will be drawn straight from the workshop questions. Please refer to ilearn instructions/lab notes for further details.

The 1st week of practical will be devoted to completing online the risk assessments of experiments, safety review, and pre-lab preparations. Please see ilearn instructions/lab notes for details.

**Once you have chosen your practical session, you should attend on that day for the entire semester**.

## Required and Recommended Texts and/or Materials

- Online textbook “Organic Chemistry” (sign up at https://app.tophat.com/e/684308 for purchasing access; join code 684308)
- “Organic Chemistry”, 9th Edition (2016) by John McMurry; Cengage Learning (required; available at the Co-op)
- “Organic Chemistry – Study Guide and Solutions Manual”, 9th Edition (2016) by Susan McMurry; Cengage Learning (recommended; available at the Co-op)
- Molecular Model Set for Organic Chemistry (recommended; available at the Co-op)
- “Pushing Electrons. A Guide for Students in Organic Chemistry”, 4th Edition (2014) by Daniel P. Weeks, Cengage Learning (recommended; available at the Co-op).
- Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer and Donald A. Tarr, 5th Edition

(2014) Pearson (required; available at the Co-op)

- "Introduction to Solid State Chemistry" by Smart and Moore, 4th Edition (2012) Taylor and Francis (recommended; available at the Co-op)

### Technology Used and Required

You must regularly check the unit web page for course related information. The web page for this unit can be found at:

http://ilearn.mq.edu.au

### Teaching and Learning Strategy

Classes will be run as a combination of formal lectures and interactive tutorial sessions. It is essential that your in-class participation is maintained throughout the semester or you risk failing the unit. Most of the class material will be available on the unit website, while there will be some provided in class. Historically, non-attendance has a much more deleterious effect that is ultimately reflected in exam performance. **It is your responsibility to manage your own study/ work/life balance.** Circumstances such as routine demands of employment/financial need or extra-curricular activities, routine family problems, and difficulties adjusting to university life and stress associated with the demands of academic work, are not unforeseeable circumstances beyond your control and should not be used as an excuse to miss a class.

Spot tests will also be run in class time. The spot tests will cover material prior to that day's class therefore **all students are expected to keep up to date with course material through revision each week**.

There will be one mid-term test.

All laboratory experiments will be conducted individually unless specified otherwise.

# Unit Schedule

Please refer to the ilearn website for details.

# Learning and Teaching Activities

## Laboratories

The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.

## Tutorial/Workshop Sessions

Students work through problems (that are similar to those encountered in the mid-session and end of session examinations) associated with the course content.

## Classes

The theory associated with the unit content is presented and guided problem solving is demonstrated and practiced in class.

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

## Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

## Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

## Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

## Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

## IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

# Graduate Capabilities

## Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcome

- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner

### Assessment tasks

- Practical
- Workshops

- Spot tests
- Mid Term Test
- Final Exam

## Learning and teaching activities

- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.
- Students work through problems (that are similar to those encountered in the mid-session and end of session examinations) associated with the course content.
- The theory associated with the unit content is presented and guided problem solving is demonstrated and practiced in class.

# Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

## Learning outcomes

- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
- Write a report in a scientific format

## Assessment task

- Practical

## Learning and teaching activity

- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.
- Students work through problems (that are similar to those encountered in the mid-session and end of session examinations) associated with the course content.

## Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

### Learning and teaching activities

- The theory associated with the unit content is presented and guided problem solving is demonstrated and practiced in class.

## Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

### Learning outcomes

- Predict the relative reactivity of a series of related compounds
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
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- Workshops
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- Final Exam

## Learning and teaching activities

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# Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## Learning outcomes

- Predict the relative reactivity of a series of related compounds
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
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## Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

### Learning outcomes

- Predict the relative reactivity of a series of related compounds
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
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- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.
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- The theory associated with the unit content is presented and guided problem solving is

demonstrated and practiced in class.

## Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

### Learning outcomes

- Predict the relative reactivity of a series of related compounds
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner
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- Students work through problems (that are similar to those encountered in the mid-session and end of session examinations) associated with the course content.
- The theory associated with the unit content is presented and guided problem solving is demonstrated and practiced in class.

# Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

## Learning outcomes

- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon, carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner

## Assessment tasks

- Practical
- Spot tests

## Learning and teaching activities

- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.
- The theory associated with the unit content is presented and guided problem solving is demonstrated and practiced in class.

# Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

## Learning outcomes

- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Plan and carry out different types of synthetic reactions: specifically, perform functional group transformations to change one molecule into another and use carbon-carbon,

carbon-nitrogen, carbon-oxygen, and metal-based bond forming reactions to construct larger molecules in a laboratory setting with confidence in a safe and efficient manner

## Assessment task

- Practical

## Learning and teaching activity

- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing synthetic chemist are taught.

# Changes from Previous Offering

CBMS 203 in 2019 may differ from its previous offering in 2018 in terms of the sequence in which materials are presented.