



# CBMS204

## Organic Synthesis

S1 Day 2016

*Dept of Chemistry & Biomolecular Sciences*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Unit Convenor

Fei Liu

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Contact via [fei.liu@mq.edu.au](mailto:fei.liu@mq.edu.au)

F7B 330

Students are encouraged to arrange a meeting via email.

Credit points

3

Prerequisites

CBMS103

Corequisites

Co-badged status

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 and health sciences. It will be valuable to anyone with an interest in how organic compounds (including biological molecules) react with one another, and how chemists use this knowledge of molecular interactions to synthesise new compounds with desirable properties (eg, new pharmaceuticals and new materials). The unit focuses on traditional organic chemistry, but the principles, mechanisms and synthetic procedures that it deals with are not confined to organic reactions: the material covered is particularly relevant to students interested in biochemistry, biotechnology, medical sciences or biological chemistry. Topics include: a review of chemical reactivity; introduction to the spectroscopic identification of organic compounds; reaction mechanisms; and synthetic methods commonly used in organic synthesis. The study of these mechanisms and methods provides an understanding of life processes on a molecular level. The practical component is aimed at developing laboratory skills and deductive reasoning; it comprises several multi-step syntheses 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
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Carry out synthetic reactions in a safe and efficient manner
- Purify organic compounds using extraction and recrystallisation techniques
- Write a report in a scientific format

## Assessment Tasks

Name	Weighting	Due
<u>Practical</u>	25%	TBA
<u>Spot tests</u>	5%	weeks 1-13
<u>Mid-term Exams</u>	20%	Weeks 5 and 9
<u>Final Exam</u>	50%	University Examination Period

### Practical

Due: **TBA**

Weighting: **25%**

**Due Date:** See unit information for the practical component

details on what is expected for assessment of the practical component is provided in the laboratory manual (see the web site at printed notes). The mark will reflect the level of safety and 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

- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Carry out synthetic reactions in a safe and efficient manner
- Purify organic compounds using extraction and recrystallisation techniques
- Write a report in a scientific format

## Spot tests

Due: **weeks 1-13**

Weighting: **5%**

Spot tests may be conducted at any stage within the lectures. They are to encourage continuous learning of the lecture material.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules

## Mid-term Exams

Due: **Weeks 5 and 9**

Weighting: **20%**

**Due Date:** Week 5 & 9

Mid-semester Test - There will be a 50 minute test in week 5 (covering week 1-3 material) and week 9 (covering week 4-7 material).

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Use functional group transformations to change one molecule into another

- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules

## Final Exam

Due: **University Examination Period**

Weighting: **50%**

**Due Date:** University Examination Period

**Weight:** 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.

Your final mark will be based primarily on the aggregate mark, but the minimum requirement to achieve a passing grade is satisfactory performance in separately both the final exam and the laboratory component.

On successful completion you will be able to:

- Predict the relative reactivity of a series of related compounds
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules

## Delivery and Resources

### Classes

CBMS204 is organized around lectures and laboratories (5 different experiments).

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 lecture is particularly productive in maximizing the learning outcomes from attending lectures. iLectures are not offered in this unit.

Spot tests will be run in the lecture classes. The lab notes, which include safety information and tips on writing the reports are available from the CBMS204 website (log in through [ilearn.mq.edu.au](http://ilearn.mq.edu.au)).

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

Attendance 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 your lab manual for further details.

The 1<sup>st</sup> week of practical will be devoted to completing the risk assessments of experiments, safety review, and pre-lab preparations. Please see the lab manual for details.

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

## Required and Recommended Texts and/or Materials

Required texts

“Organic Chemistry”, 8th Edition (2012) by John McMurry; Brooks/Cole (required)

“Organic Chemistry – Study Guide and Solutions Manual”, 8th Edition (2012) by Susan McMurry; Brooks/Cole (required)

“Practical Spectroscopy : the rapid interpretation of spectral data : for McMurry's Organic Chemistry, fifth edition”, 5th Edition (2000) by Paul R. Young (required)

Molecular Model Set for Organic Chemistry (recommended, from CBMS103)

“Pushing Electrons. A Guide for Students in Organic Chemistry”, 3<sup>rd</sup> Edition (1998) by Daniel P. Weeks, Saunders College Publishing (recommended, from CBMS103).

## 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

Lectures will be presented as a combination of formal lectures and interactive tutorial sessions. Most of the lecture material will be available on the unit website, while there will be some provided in the lecture class. Historically, non-attendance at lectures 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 lecture.

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

**There will be two mid-term tests (TBA).**

All laboratory experiments will be conducted individually unless specified otherwise.

## Changes Since Last Offering

Changes will be related to the lecture content and these will only be of a minor nature.

## Unit Schedule

Weeks 1-2: Reactivity-aromatics

Weeks 3-5: Alkenes/Alkynes/Reactivity/Stereochemistry

Weeks 6-8: Alky halides/alcohols

Weeks 9-10: Aldehydes/ketones/carboxylic acids

Weeks 12-13: Structure/spectroscopy

## Learning and Teaching Activities

### Lectures

The theory associated with the unit content is presented and problem solving demonstrated.

### Laboratories

The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practising organic 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 content of the relevant module

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students

should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

**New Assessment Policy in effect from Session 2 2016** [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html). For more information visit [http://students.mq.edu.au/events/2016/07/19/new\\_assessment\\_policy\\_in\\_place\\_from\\_session\\_2/](http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/)

Assessment Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html) *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of 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/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Results

Results shown in *iLearn*, 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](http://ask.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](http://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](http://ask.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/](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 outcomes

- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
- Carry out synthetic reactions in a safe and efficient manner

### Assessment tasks

- Practical
- Spot tests
- Mid-term Exams
- Final Exam

### Learning and teaching activities

- The theory associated with the unit content is presented and problem solving demonstrated.
- The practical and report writing skills (including how to plan a synthetic scheme and

interpret the results) required for a practising organic 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 content of the relevant module

## 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

- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Carry out synthetic reactions in a safe and efficient manner
- Write a report in a scientific format

### Assessment tasks

- Practical
- Spot tests
- Mid-term Exams
- 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 practising organic 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 content of the relevant module

## 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 outcomes

- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
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- The theory associated with the unit content is presented and problem solving demonstrated.
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## 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
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions

- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Carry out synthetic reactions in a safe and efficient manner
- Purify organic compounds using extraction and recrystallisation techniques
- Write a report in a scientific format

## Assessment tasks

- Practical
- Spot tests
- Mid-term Exams
- Final Exam

## Learning and teaching activities

- The theory associated with the unit content is presented and problem solving demonstrated.
- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practising organic 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 content of the relevant module

## 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
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to

construct larger molecules

- Use spectroscopic information to deduce the structure of simple organic molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
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## Assessment tasks

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- Spot tests
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- Final Exam

## Learning and teaching activities

- The theory associated with the unit content is presented and problem solving demonstrated.
- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practising organic 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 content of the relevant module

## 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
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
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- Perform basic synthetic reactions in a laboratory setting with confidence
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## Assessment tasks

- Practical
- Spot tests
- Mid-term Exams
- Final Exam

## Learning and teaching activities

- The theory associated with the unit content is presented and problem solving demonstrated.
- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practising organic 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 content of the relevant module

## 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
- Use functional group transformations to change one molecule into another
- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
- Use carbon-carbon carbon-nitrogen and carbon-oxygen bond forming reactions to construct larger molecules
- Use spectroscopic information to deduce the structure of simple organic molecules
- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory

environment

- Carry out synthetic reactions in a safe and efficient manner
- Write a report in a scientific format

## Assessment tasks

- Practical
- Spot tests
- Mid-term Exams
- 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 practising organic 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 content of the relevant module

## 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
- Carry out synthetic reactions 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 practising organic chemist are taught

## 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

- Perform basic synthetic reactions in a laboratory setting with confidence
- Assess the risks and hazards associated with working in a synthetic laboratory environment
- Carry out synthetic reactions in a safe and efficient manner

## Assessment tasks

- Practical
- Spot tests

## Learning and teaching activities

- The theory associated with the unit content is presented and problem solving demonstrated.
- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practising organic 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 content of the relevant module