CBMS204

Organic Synthesis

S1 Day 2017

Dept of Chemistry & Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
Fei Liu
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F7B 330
Students are encouraged to arrange a meeting via email.

Credit points
3

Prerequisites
CBMS103 or CBMS107

Corequisites

Co-badged status
CBMS604

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 physical, 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 fundamental 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	Hurdle	Due
Practical Component 1	10%	Yes	see iLearn for details
Practical Component 2	10%	Yes	see iLearn for details
Workshops	5%	Yes	Weeks 7 and 13
Spot test	10%	No	weeks 1-13
Mid-term Exams	15%	No	Week 7
Final Exam	50%	No	University Examination Period

Practical Component 1

Due: **see iLearn for details**
Weighting: **10%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Due Date: See iLearn/practical information for details of this practical component (Exp 1 to 3 in weeks 2-5)

These experiments have interconnected learning outcomes and demonstrate the necessary techniques for the next set of experiments in the 2nd half of the semester. 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
- 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

Practical Component 2

Due: **see iLearn for details**
Weighting: **10%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Due Date: See iLearn/practical information for details of this practical component (Exp 4 to 5 in weeks 8-12)

These are extended experiments that run over multiple practical sessions and require all of the techniques learnt in the 1st half of the semester. The student is required to attend all practical/ workshop sessions such that these experiments could be completed. Missing anyone practical without a medical certificate would result in an incomplete and failed experiment. The student is

required to perform the experiments according to instructions and complete post-lab exercises/ reports satisfactorily.

Missing one 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
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- Be able to plan a synthesis using SN1, SN2, E1, E2, SNA, SEA reactions
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- 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

Workshops

Due: **Weeks 7 and 13**
Weighting: **5%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

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
- 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

Spot test

Due: **weeks 1-13**
Weighting: **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
- 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: **Week 7**
Weighting: **15%**

Due Date: Week 7

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

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 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 CBMS204 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

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)

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

"Pushing Electrons. A Guide for Students in Organic Chemistry", 3rd 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

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.

Changes Since Last Offering

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

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 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 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. 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

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.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

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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/

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.

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

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 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 Component 1
- Practical Component 2
- Workshops
- Spot test
- 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 practicing 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 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

- 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 Component 1
- Practical Component 2

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 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 course content.

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

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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
- 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 guided problem solving is demonstrated and practiced in class.

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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- The practical and report writing skills (including how to plan a synthetic scheme and interpret the results) required for a practicing organic 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
- 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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- 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
- Carry out synthetic reactions in a safe and efficient manner

Assessment tasks

- Practical Component 1
- Practical Component 2

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 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 Component 1
- Practical Component 2

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 organic chemist are taught.