Nanyang Technological University
Division of Chemistry and Biological Chemistry

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| **Academic Year** | 2022/23 | **Semester** | 2 |
| **Course Coordinator** | Shingo Ito, Qiao Yuan | | |
| **Course Code** | CM2031 | | |
| **Course Title** | Organic and Bioorganic Chemistry | | |
| **Pre-requisites** | CM1031 or CM9001/CM5000 or CY1101 or CM1002 or by permission | | |
| **No of AUs** | 3 | | |
| **Contact Hours** | Lectures: 39 hours (3 hours per week), Tutorials: 5 hours (1 hour x 5 times) | | |
| **Proposal Date** | 21 October 2021 | | |

**Course Aims**

This course aims to introduce a series of fundamental organic reactions with their detailed reaction mechanisms and a concept of retrosynthetic analysis for students to be able to plan chemical synthesis of more complex organic molecules than previously discussed.

**Intended Learning Outcomes (ILO)**

Upon successful completion of this course, you should be able to:

1. Explain the structure and reactivity of various organic/inorganic reagents that are used for synthesis of organic compounds
2. Explain the reasonable reaction mechanism of various organic reactions using curved arrows.
3. Predict the product structures of the organic reactions given.
4. Propose and describe reasonable synthesis plans for complex organic molecules using a concept of retrosynthetic analysis.

**Course Content**

1. Nucleophilic substitution reactions
2. Introduction to retrosynthesis
3. Aromatic compounds: nucleophilic aromatic substitution reactions
4. Chemistry of alkenes and epoxides
5. Reduction
6. Oxidation
7. Acid/base, nucleophile/electrophile
8. Chemistry of carbonyl compounds
9. Radical chemistry

10. Protecting groups

**Assessment (includes both continuous and summative assessment)**

| Component | Course ILO Tested | Related Programme LO or Graduate Attributes | Weighting | Team/ Individual | Assessment rubrics |
|---|---|---|---|---|---|
| 1. Continuous Assessment 1 (CA1): Midterm Test 1 | 1, 2, 3, 4 | Competence, Creativity | 20% | Individual | Point-based marking (not rubrics based) |
| 2. Continuous Assessment 2 (CA2): Midterm Test 2 | 1, 2, 3, 4 | Competence, Creativity | 20% | Individual | Point-based marking (not rubrics based) |
| 3. Group Presentation | 1, 2, 4 | Competence, Creativity, Communication | 10% | Team* | Point-based marking |
| 4. Examination | 1, 2, 3, 4 | Competence, Creativity | 50% | Individual | Point-based marking (not rubrics based) |
| Total | | | 100% | | |

**To do well on the team assessment, it is necessary for you to demonstrate positive interdependence and teamwork. In principle, you will receive the same marks as your team. However, your individual score may vary based on instructor observations and peer feedback about your contributions to the group project.*

**Formative feedback**

You will be given feedback in four ways:

1. By working through examples provided during lectures
2. By response to postings on the course discussion board
3. By attending consultation hours and tutorials
4. By studying the comments provided by the instructor after the grading of the midterms
5. By receiving comments to your Group Presentation from lectures and peers

**Learning and Teaching approach**

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| **Lectures** | Face-to-face lectures will be employed to enable you to interact directly with the instructors. |

**Reading and References**

Recommended textbook:

Organic Chemistry 8th Ed., John E. McMurry, CENGAGE, ISBN: 978-0-8400-5444-9

Organic Chemistry 2nd Ed., J. Clayden, N. Greeves, S. Warren, Oxford, ISBN: 978-0-19-927029-3

**Course Policies and Student Responsibilities**

**(1) General**

You are expected to read the lecture materials prior to the lecture session in question. This will help you to learn much more efficiently as you will already have an impression on the topics to be covered. You should also read the textbook and to attempt the exercises provided in the problem sets. It is recommended to attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to participate in all discussions and activities, especially in Group Presentation.

**(2) Absenteeism**

If you miss a lecture, you are expected to make up for the lost learning activities. If you miss the mid-term test with approval, you will either be offered a make-up test or grading based upon the final exam score.

**Academic Integrity**

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

**Course Instructors**

| Instructor | Office Location | Phone | Email |
|---|---|---|---|
| Shingo Ito | SPMS-CBC-05-17 | 6592-7581 | sgito@ntu.edu.sg |
| Qiao Yuan | SPMS-CBC 04-22 | 6904-4477 | yuan.qiao@ntu.edu.sg |
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**Planned Weekly Schedule**

| Week | Topic | Course ILO | Readings/Activities |
|---|---|---|---|
| 1 | Nucleophilic substitution reactions | 1,2,3 | Lecture |

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| 2 | Introduction to retrosynthesis | 4 | Lecture |
| 3 | Aromatic compounds: nucleophilic aromatic substitution reactions | 1,2,3 | Lecture |
| 4 | Chemistry of alkenes and epoxides | 1,2,3 | Lecture |
| 5 | Reduction, and Midterm Test 1 | 1,2,3,4 | Lecture, assessment |
| 6 | Reduction, Oxidation | 1,2,3 | Lecture |
| 7 | Oxidation | 1,2,3 | |
| 8 | Acid/base, nucleophile/electrophile | 1,2,3 | Lecture |
| 9 | Chemistry of carbonyl compounds: reactivity of carbonyl compounds, chemistry of enol/enolates<br>Group presentation (tutorial) | 1,2,3 | Lecture |
| 10 | Chemistry of carbonyl compounds: Michael addition<br>Group presentation (tutorial) | 1,2,3 | Lecture |
| 11 | Chemistry of carbonyl compounds: Miscellaneous (but still important) Carbonyl Topics | 1,2,3 | Lecture |
| 12 | Radical Chemistry, Protecting groups, and Midterm Test 2 | 1,2,3,4 | Lecture, assessment |
| 13 | Review | 1,2,3,4 | Lecture |

**CBC Programme Learning Outcome**

The Division of Chemistry and Biological Chemistry (CBC) offers an undergraduate degree major in Chemistry that satisfies the American Chemical Society (ACS) curricular guidelines and equips students with knowledge relevant to the industry. Graduates of the Division of Chemistry and Biological Chemistry should have the following key attributes:

**1. Competence**

Graduates should be well-versed in the foundational and advanced concepts of chemical science, be able to evaluate chemistry-related information critically and independently, and be able to use complex reasoning to solve emergent chemical problems.

**2. Creativity**

Graduates should be able to synthesize and integrate multiple ideas across the curriculum, and propose innovative solutions to emergent chemistry-related problems based on their training in chemistry.

**3. Communication**

Graduates should be able to demonstrate clarity of thought, independent thinking, and sound scientific analysis and reasoning through written and oral reports to audiences with varying technical backgrounds. They should also be able to effectively engage other professional chemists in collaborative endeavours.

**4. Character**

Graduates should be able to act in responsible ways and uphold the high ethical standards that the society expects of professional chemists.

**5. Civic-mindedness**

Graduates should be aware of the impact of chemistry on society, and how chemistry can be applied to benefit mankind. They should also be aware of and uphold the best chemical safety practices.