Nanyang Technological University
Division of Chemistry and Biological Chemistry

Academic Year	AY21/22	**Semester**	1
Course Coordinator	Leung Pak Hing		
Course Code	CM4031		
Course Title	Asymmetric Synthesis		
Pre-requisites	CM3031 or by permission		
No of AUs	3		
Contact Hours	Lectures: 39 hours (3 hours per week)		
Proposal Date	26 July 2021		

Course Aims

This course aims to introduce the principles of asymmetric synthesis. You will learn about various methodologies for controlling the absolute stereochemistry of the desired product in chemical synthesis, including natural product and catalyst syntheses. The course will focus on advanced topics such as asymmetric catalysis and their applications in selected pharmaceutical and material sciences. However, the scientific development in the field will also been reviewed systematically.

Intended Learning Outcomes (ILO)

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

1. Explain the basic concept of chirality. Describe the importance of chirality in everyday life, in medical science and in chemistry, including the classification, representation, and determination of chirality
2. Describe the various approaches to asymmetric synthesis, including the use of a chiral pool of reagents, chiral metal complexes promoted reactions, diastereoselective synthesis, and enatioselective synthesis
3. Relate thermodynamic, kinetic, steric and electronic factors that determine the outcomes of asymmetric synthetic reactions
4. Describe various asymmetric synthesis methods for bond formation reactions. Explain their underlying mechanisms, and apply them to the synthesis of various target molecules, including natural products and catalysts
5. Employ the concepts of catalyst design in specific asymmetric transformation reactions.

Course Content

Review of the basic principles of chirality and stereochemistry, and their importance in human life. The historical development of these topics, including optical resolutions

Asymmetric synthesis involving C–H and C-C bond formations from non-chiral starting materials via addition reactions and Diels-Alder reactions

Asymmetric C-C and hetero bond formation reactions via transition metal complex promoted reactions.

Describe and apply the concepts of catalyst design in asymmetric catalysis

Application of advanced synthetic techniques to the synthesis of natural products and asymmetric catalysts

Assessment (includes both continuous and summative assessment)

Component	Course ILO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
1. Midterm Test 1	1-3	Competence, Creativity	20%	Individual	Point-based marking (not rubrics based)
2. Midterm Test 2	4, 5	Competence, Creativity	20%	Individual	Point-based marking (not rubrics based)
3. Examination	1-5	Competence, Creativity	60%	Individual	Point-based marking (not rubrics based)
Total			100%		

Formative feedback

You will be given feedback in three ways:

1. By working through examples provided during lectures
2. By response to postings on the course discussion board
3. By attending consultation hours
4. By studying the comments provided by the instructor after the grading of the midterms

Learning and Teaching approach

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

Reading and References

Recommended textbook: Principles of Asymmetric Synthesis, 2nd Ed. (2012), by Robert Gawley and Jeffrey Aube, Elsevier; ISBN-13: 9780080448602 (paperback) or 9780080914138 (e-book).

Selected reviews on the topic of asymmetric synthesis and asymmetric catalysis.

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.

(2) Absenteeism

When you miss a lecture, you are expected to make up for the lost learning activities. If you are sick and not able to attend the tests, you have to submit the original Medical Certificate (or another relevant document) to the school administration to obtain official leave. In this case, the missed assessment component will not be counted towards the final grade.

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
Leung Pak Hing	SPMS-CBC-06-01	6513 8471	pakhing@ntu,edu,sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/Activities
1	Classification of chirality, representation of chirality, identification of stereoisomers, number of stereoisomers	1	Lecture,
2	History of natural chiral molecules, biological significance of stereoisomers, separation of stereoisomers	1	Lecture,
3	Approaches to symmetric synthesis via chiral pool, diastereoselective, and enantioselective methods	2	Lecture
4-10	Established techniques and mechanistic in asymmetric synthesis and asymmetric catalysis	2-4	Lecture assessments
11-12	Latest developments in asymmetric syntheses and catalysis	5	Lecture assessment
13	Revision of lecture topics	1-5	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.