Nanyang Technological University
Chemistry and Biological Chemistry

Academic Year	2025/26	**Semester**	1
Course Coordinator	Liu Xuewei		
Course Code	CM5081[1]		
Course Title	Medicinal Chemistry		
Pre-requisites	(CM1031 and CM1051) or (CM1051 and CM9001/CM5000) or (BS1003 and CM1051) or (BS1005 and CM1031) or (BS1005 and CM9001/CM5000) or (BS1003 and BS1005) or (BS1013 and BS1005) or CM1002 or CY1101 or By permission		
No of AUs	3		
Contact Hours	Lectures: 39 hours (13 weeks x 3 hours per week)		
Proposal Date	22 October 2024		

Course Aims

Medicinal chemistry is a chemistry-based discipline, involving aspects of biological, medical and pharmaceutical sciences. The primary goals for this course are for everyone to gain: 1) an understanding of drug behavior in the body; 2) an appreciation of drug development, from lead optimization, to patents and drug registration and to drugstore shelf; and 3) an awareness of drug toxicity (side effects), from acute responses to long-term effects. Having successfully completed this course, you will not only develop the necessary knowledge and skills for a career that involves medicinal chemistry for research and pharmaceutical application in industry, but also a working knowledge of how and where to find information on any drug you may encounter as you continue your lives, even if your own career choice does not involve health care.

Intended Learning Outcomes (ILO)

Upon the successful completion of this course, you (as a student) would be able to:

1. Essential concepts of pharmacodynamics (PD) of drugs:
    a. Describe common drug targets and mode of action;
    b. Identify and describe the underlying mechanism of therapeutic effects and possible side effects;
    c. Provide a holistic account of what the drug does to our body.
2. Essential concepts of pharmacokinetics (PK) of drugs:
    a. Describe the absorption, distribution, metabolism and excretion (ADME) of drugs;
    b. Identify and explain the role of medicinal chemistry in improving these parameters;
    c. Provide a holistic account of what our body does to the drug.
3. Special case studies:
    a. Investigate new practices in nanomedicine.
4. Drug discovery, design and development:
    a. describe the overall process of drug discovery and development, and the concepts of lead optimizations and structural activity relationships in medicinal chemistry, and
    b. identify the current challenges and opportunities in medicinal chemistry.
5. Getting the drug to the market:

[1] Previously listed as CM9081

a. identify the key timelines of a utility patent,
b. relate its importance to the drug discovery cycle and
c. describe how new drugs are registered.

6. Case studies:
   a. discuss examples of drug families (antibacterial, anticancer, antiviral and other specific types) to demonstrate an understanding of concepts such as pharmacodynamics, pharmacokinetics, lead optimization, medicinal chemistry and drug discovery and development process.

Course Content

1. Course overview
2. Biomolecules as drug targets
3. Proteins & enzymes as drug targets
4. Drug receptors as drug targets
5. Genetic components as targets
6. ADME: absorption, distribution, metabolism & excretion
7. Nanomedicine
8. Drug discovery and development; medicinal chemistry
9. Patents and new drug registration
10. Specific drug families (topics to be decided, based on students' interest and guest lecturers' availability)

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 (MCQ and short answer questions)	1-3	Competence, written communication	25%	Individual	Point-based marking (not rubrics based)
2. Midterm test 2 (MCQ and short answer questions)	4-5	Competence, written communication	25%	Individual	Point-based marking (not rubrics based)
3. Final Examination (MCQ and short answer questions)	1-6	Competence, written communication creativity	50%	Individual	Point-based marking (not rubrics based)

Total	*100%*		

Formative feedback

1. You will receive written and verbal feedback from the lecturer for Component 1 and 2.
2. The lecturer will provide you with timely feedback to improve your understanding during lecture.
3. You will be given opportunities to express your ideas and discuss them with lecturers as course progresses.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lectures	Present the key ideas and important steps used to solve different types of problems. Case studies will be delivered by guest lecturers to provide industrial relevance and impact to students.

Reading and References

1. Recommended textbook:
   An Introduction to Medicinal Chemistry
   6th Edition, G.L. Patrick, Oxford University Press, 2017. ISBN: 9780198749691
2. Optional reference 1:
   The Organic Chemistry of Drug Design and Drug Action
   3rd Edition, R. B. Silverman, Elsevier, 12 Jan 2015. ISBN: 9780123959034
3. Optional reference 2:
   Foye's Principles of Medicinal Chemistry
   8th Edition; V. F. Roche, S. W. Zito, T. L. Lemke and D. A. Williams, Lippincott Williams & Wilkins: Philadelphia, 2019. ISBN: 9781496385024
4. Optional reference 3:
   Medicinal Chemistry: An Introduction
   2nd edition; G. Thomas; John Wiley & Sons Inc, 2008. ISBN: 9780470025970
5. Optional reference 4:
   Molecules and Medicine
   E. J. Corey, B. Czakó and L. Kürti. John Wiley & Sons Inc, 2012. ISBN: 9780470260968

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned pre-class readings and activities, attend all lectures classes punctually and take all scheduled assignments and tests by due dates. You are expected to participate in all lectures discussions and activities.

(2) Absenteeism

Absence from the midterm without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

Academic Integrity

Good academic work depends on honesty and ethical behavior. 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
LIU Xuewei	CCEB-05-02	6316 8901	xuewei@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	Course overview	1,2,3	Patrick Chapter 1
2	Biomolecules as drug targets; Proteins & enzymes as drug targets	1	Patrick Chapter 2, 3, 7
3	Drug receptors as drug targets	1	Patrick Chapter 4, 5, 8
4	Drug receptors as drug targets	1	Patrick Chapter 4, 5, 8
5	Genetic components as targets	1	Patrick Chapter 6, 9
6	ADME: absorption, distribution, metabolism & excretion	2	Patrick Chapter 10 Midterm test 1
7	ADME: absorption, distribution, metabolism & excretion	2	Patrick Chapter 10
Recess week			
8	ADME: absorption, distribution, metabolism & excretion	2	Patrick Chapter 10
9	Nanomedicine, Course review	3 1-3	Assigned reference paper
10	Drug discovery process and medicinal chemistry	4	Patrick Chapter 12-15
11	Medicinal chemistry and patents	4,5	Patrick Chapter 12-15
12	Case studies	6	Assigned reference paper Midterm test 2
13	Case studies, course review	6, 4-6	Assigned reference paper

CBC Programme Learning Outcome

The 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.