

<b>Academic Year</b>	2020/21	<b>Semester</b>	1
<b>Course Coordinator</b>	Xing Bengang		
<b>Course Code</b>	CM4053 <sup>1</sup>		
<b>Course Title</b>	Pharmaceutical Chemistry		
<b>Pre-requisites</b>	CM1031 Basic Organic Chemistry with Laboratory and CM1051 Basic Biological and Biochemistry and CM2011 Analytical Chemistry and CM2031 Organic and Bioorganic Chemistry and CM3031 Organic Reaction mechanisms and Synthesis or by permission		
<b>Mutually Exclusive</b>	CM4016		
<b>No of AUs</b>	3		
<b>Contact Hours</b>	Lectures: 39 hours (13 weeks x 3 hours per week)		

### Course Aims

Pharmaceutical Chemistry, is one interdisciplinary course to train the chemistry students with extensive knowledge of pharmacology and biomedical sciences. In this course, the students will learn how the drug molecules will sustain their activities, their basic metabolism process, the essential pharmacokinetics and pharmacodynamics of drugs, biomedical analysis assay, biomedical microbiology and the antibiotic bacterial inactivation, basic concepts in clinical antitumor treatment. At the same time, one of the key objective of the course is to train the chemistry students with extensive knowledge of pharmacology and biomedical sciences. Moreover, brand new techniques in biomedical molecular imaging, and functional nanotechnology in nano-medicine will be also extensively covered in this class.

### Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. Identify the basic concept of drug – bio-receptors interactions and explain their activity mechanism.
2. Explain and apply the concept of pharmacokinetics, pharmacodynamics to drug molecule in pharmaceutical industry.
3. Describe the metabolism of drug processing during the treatment.
4. Interpret and predict the biological pathways during the diseases therapy (For example in the area of Antitumor and bacteria inactivation).
5. Illustrate and describe the principles of pharmacogenetics
6. Describe and judge applicability of new modalities for biomedical sensing and imaging in a range of pharmaceutical chemistry situation.
7. Explain the future perspective of functional nanomaterials towards biomedical applications: Drug delivery, diseases therapy and diagnostics (Theranostics)

### Course Content

1. Introduction to Pharmaceutical Chemistry
2. General concept of Drug metabolism
3. Pharmacodynamic and Pharmacokinetics
4. Anticancer Therapeutics
5. Antibiotics and biomedical microbiology
6. Principle of Pharmacogenetics I and II
7. Biomedical Fluorescent imaging
8. Nanomedicine

<sup>1</sup> Replaced course

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

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
1. Final Examination	1-7	Competence, written communication	60%	Individual	Pending Marking Guide.
2. Midterm Examination	1-3	Competence, written communication	20%	Individual	Pending Marking Guide.
3. Literature Review	1-7	Competence, written communication creativity	20%	Individual	Pending Marking Guide.
Total			100%		

**Formative feedback**

- Clicker questions will be given in lectures to monitor the progression of the students. If concepts are misunderstood will be immediately clarified during the class
- Mass tutorial will also be given in class to ensure students have sufficient practice and clarifying possible queries that they may have.

**Learning and Teaching approach**

Approach	How does this approach support students in achieving the learning outcomes?
Lecture with Clicker questions	The students will be required to answer clicker questions assigned during the formal lecture. This approach will ensure the students are thinking critically and actively learning new formation.
Video animations	Using animation, video, or movie to illustrate certain concepts in class. This will function as an effective tool to simplify complicated theory for better understanding of the students.

**Reading and References**

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry 12<sup>th</sup> ed. J. M. Beale Jr & J. H. Block ed. (on-line version only) By Lippincott Williams & Wilkins, 2010, ISBN-13: 978-0781779296
2. Foye's Principles of Medicinal Chemistry, Ed. by David Williams 2012. Edition 7<sup>th</sup>. ) By Lippincott Williams & Wilkins, 2012 ISBN-13: 978-1609133450

## Course Policies and Student Responsibilities

### (1) General

Students are expected to complete all assigned pre-class readings and activities, attend all lectures punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. Students are expected to participate in all lectures discussions and activities.

### (2) Absenteeism

There will be no make up given for the students should he/she miss the class. The student will have to independently learn the concept from NTU learn online recording or make private consultation with the professor.

Students who are absent without a valid reason during the midterm/final year examinations will definitely affect his overall grades. A make up examination is possible if 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.

### (3) Literature Review

You are required to submit a literature review of a topic of your choice within the context of Pharmaceutical Chemistry. Failure to submit the literature before the deadline, will affect the student overall grades.

## 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
XING Bengang	SPMS-CBC-04-20	(65) 6316 8758	<a href="mailto:bengang@ntu.edu.sg">bengang@ntu.edu.sg</a>

## Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to Pharmaceutical Chemistry	1,2	#
2	Pharmacodynamic and Pharmacokinetics	1,2	#
3	Pharmacodynamic and Pharmacokinetics	3	#
4	General concept of Drug Metabolism	4	#
5	General concept of Drug Metabolism	4	#
<b>6</b>	<b>Recess</b>		
7	Anticancer Therapeutics	5	MT1
8	Antibiotics and biomedical microbiology	5	#
9	Principles Pharmacogenetics I	6	#
10	Principles Pharmacogenetics II	6	#
11	Biomedical fluorescent imaging	7	#
12	Biomedical fluorescent imaging	7	#
13	Nanomedicine	7	#

# Pre/Post-lecture reading assignments.

MT1 Midterm- to be conducted during class

## Appendix 1: Assessment Criteria for Continuous Assessment

### By grades.

Standards	Criteria
A+ to A-	<p>1. Excellent work which is clearly outstanding and is characterized by:</p> <p>2. The candidate has extremely good insight into Pharmaceutical Chemistry and demonstrates Pharmaceutical Chemistry expertise at an outstanding level.</p> <p>3. The candidate is able to select and apply relevant scientific theories and methods at an outstanding level.</p> <p>4. The candidate is able to produce an outstandingly relevant and clear approach to the issue addressed.</p> <p>5. This is an advanced and/or innovative contribution. The analysis and discussion have an outstandingly good scientific foundation and justification and are very relevant to the issue that is addressed.</p> <p>The candidate demonstrates extremely good critical reflection and distinguishes clearly between his/her contribution and the contributions from others.</p> <p>6. The form, dissemination, structure and language are at an extremely high level.</p>
B+ to B-	<p>1. Very good work that is characterized by:</p> <p>2. The candidate has very good insight into Pharmaceutical Chemistry and demonstrates a very good level of Pharmaceutical Chemistry expertise.</p> <p>3. The candidate is able to select and apply relevant scientific theories and methods at a very good level.</p> <p>4. The candidate is able to produce a very relevant and clear approach to the issue addressed</p> <p>5. This is a very good and/or innovative contribution. The analysis and discussion have a very good scientific foundation and justification and are clearly relevant to the issue that is addressed. The candidate demonstrates very good critical reflection and distinguishes clearly between his/her contribution and the contributions from others.</p> <p>6. The form, dissemination, structure and language are at a very high level.</p>
C+ to C	<p>1. Good work that is characterized by:</p> <p>2. The candidate has good insight into Pharmaceutical Chemistry and demonstrates a good level of Pharmaceutical Chemistry expertise.</p> <p>3. The candidate is able to select and apply relevant scientific theories and methods at a good level.</p> <p>4. The candidate is able to produce a relevant and generally clear approach to the issue addressed.</p> <p>5. This is a good contribution with some creative elements. The analysis and discussion have a good scientific foundation and are relevant to the issue that is addressed. The candidate demonstrates good critical reflection and generally distinguishes between his/her contribution and the contributions from others.</p> <p>6. The form, dissemination, structure and language are at a good level.</p>
D+ to D	<p>1. Clearly acceptable work that is characterized by:</p> <p>2. The candidate has satisfactory insight into Pharmaceutical Chemistry and demonstrates a satisfactory level of Pharmaceutical Chemistry expertise</p>

	<p>3. The candidate is generally able to apply relevant scientific theories and methods.</p> <p>4. The candidate is able to produce a fairly relevant and clear approach to the issue addressed.</p> <p>5. This is a satisfactory contribution. The analysis and discussion have a good scientific foundation and are relevant to the issue addressed but there is potential for improvement. The candidate demonstrates critical reflection and has some problems distinguishing between his/her contribution and the contributions from others.</p> <p>6. The form, dissemination, structure and language are at an acceptable level.</p>
F	<p>1. Work that does not meet the minimum criteria and is characterized by:</p> <p>2. The candidate does not have the necessary insight into Pharmaceutical Chemistry and has an inadequate level of Pharmaceutical Chemistry expertise.</p> <p>3. The candidate lacks the competence to apply relevant scientific theories and methods.</p> <p>4. The candidate does not have the ability to adequately address the issue. The objectives are neither clearly defined nor described. The planning and execution of the work is not acceptable.</p> <p>5. This is a very limited and fragmentary contribution. The analysis and discussion have an inadequate scientific foundation and are loosely tied to the issue addressed. The candidate demonstrates an insufficient ability for critical reflection and fails to distinguish between his/her contribution and the contributions from others.</p> <p>6. The presentation has significant deficiencies in terms of form, structure and language.</p>

## 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.