COURSE CONTENT

Academic Year	2022/2023	**Semester**	2
Course Coordinator	Assoc. Prof. Tan Meng How / Assoc. Prof. Kevin Pethe / Asst. Prof. Navin Kumar Verma		
Course Code	CH4213		
Course Title	Pharmacokinetics & Biopharmaceutics		
Pre-requisites	nil		
No of AUs	3		
Contact Hours	39 hours lecture, 0 hours tutorial		
Proposal Date	5 November 2019		

Course Aims

This course is designed to provide you with a basic understanding on the importance of drug actions, including administration, absorption, distribution, therapeutic effects, metabolism, and toxicity. Basic principles in pharmacodynamics and pharmacokinetics will be examined. In addition, the interplay between pharmacogenetics and pharmacokinetics will also be analysed. The impact of such dynamic interplay on future drug design and targeted delivery will be discussed.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, students should be able to:
1) Describe the major drug receptors and the downstream signalling pathways
2) Explain how various drugs are metabolized in the body
3) Explain how various drugs are transported throughout the body
4) Identify and explain on-target and off-target adverse drug effects on different organs
5) Describe the process of drug development
6) Apply the basics of pharmacokinetics
7) Describe how pharmacogenetics can affect the action, metabolism, transport, and toxicity of drugs
8) Explain the interplay between pharmacogenetics and pharmacokinetics

Course Content

Drug-receptor interactions
Drug metabolism
Drug transporters
Drug toxicity
Overview of drug development
Pharmacokinetics
Pharmacogenetics and pharmacogenomics

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
Team Project	All	a, b, c, d, f, h, i, j, l	40%	Individual	See Appendix 1a
Final Examination (2hrs, closed book, exam paper not allowed to be removed from exam hall)	All	a, b, c, d, f	60%	Individual	See Appendix 1b
Total			100%		

Mapping of Course ILOs to EAB Graduate Attributes

Course Intended Learning Outcomes	Cat	EAB's 12 Graduate Attributes*											
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	Core	◐	◐	○	●		○		○	●	●		○
Describe the major drug receptors and the downstream signalling pathways		a, b, c, d, f, l											
Explain how various drugs are metabolized in the body		a, b, c, d, f, l											
Explain how various drugs are transported throughout the body		a, b, c, d, f, l											
Identify and explain on-target and off-target adverse drug effects on different organs		a, b, c, d, f, l											
Describe the process of drug development		a, b, c, d, f, h, i, j, l											
Apply the basics of pharmacokinetics		a, b, c, d, f, l											
Describe how pharmacogenetics can affect the action, metabolism, transport, and toxicity of drugs		a, b, c, d, f, l											
Explain the interplay between pharmacogenetics and pharmacokinetics		a, b, c, d, f, l											

Legend:
- ● Fully consistent (contributes to more than 75% of Intended Learning Outcomes)
- ◐ Partially consistent (contributes to about 50% of Intended Learning Outcomes)
- ○ Weakly consistent (contributes to about 25% of Intended Learning Outcomes)
- Blank Not related to Student Learning Outcomes

Formative feedback

Regular discussions on team projects;
Examination results;
Marker's report on overall project and examination performance will be uploaded to NTULearn;
Self-practice questions will be discussed in class

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Demonstrate how to carry out a procedure such as working through a problem, use incomplete handouts which enable you to participate in class.
Tutorial	Not applicable

Reading and References

L Shargel, S Wu-Pong, A.B.C. Yu, Applied Biopharmaceutics and Pharmacokinetics, 5th Edition, McGraw Hill, 2005

Course Policies and Student Responsibilities

General: Students are expected to complete all online and project activities 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. Students are expected to participate in all discussions on the course material and activities related to the course.

Continuous assessments (including project work): Students are required to attend all continuous assessments. Absenteeism: Continuous assessments make up a significant portion of students' course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect students' overall course 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
Tan Meng How	N1.2-B2-33	6513-8063	mh.tan@ntu.edu.sg
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Navin Kumar Verma	Experimental Medicine Building (Level 4)	6592-3951	nkverma@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Drug-receptor interactions	1	Lecture Notes
2	Drug metabolism	2	Lecture Notes
3	Drug transporters	3	Lecture Notes
4	Drug toxicity	4	Lecture Notes
5	Overview of drug development	5	Lecture Notes
6	Basics of pharmacokinetics	6	Lecture Notes
7	Pharmacokinetics of intravenous bolus drug administration	6	Lecture Notes
8	Pharmacokinetics of constant-rate intravenous drug administration	6	Lecture Notes
9	Pharmacokinetics of extravascular drug administration	6	Lecture Notes
10	Pharmacogenetics and pharmacogenomics	7, 8	Lecture Notes
11	Review	All	Lecture Notes
12	Student Presentations	All	Not applicable

Appendix 1a: Assessment Criteria (Project)

Criteria	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90%
Knowledge & Comprehension Understanding the principles of biopharmaceutics, pharmacokinetics, and pharmacogenetics	Lacks understanding of basic principles	Fair understanding of some aspects of biopharmaceutics, pharmacokinetics, or pharmacogenetics	Satisfactory understanding of most principles	Good understanding of most principles	Very good and comprehensive understanding of all principles
Presentation Skills Able to present the project coherently and clearly in the written report and oral presentation	Unable to express oneself well in verbal and/or written communication.	Just meets expectations on ability to convey the essence of the project in the written report and oral presentation.	Meets expectations on ability to express oneself well in verbal and/or written communication. Has some eye contact and ability to answer questions during oral presentation. Written report is acceptable but can be improved.	Exceeds expectations on ability to express oneself well in verbal and/or written communication. Project is easily understood in most aspects (both written report and oral presentation).	Far exceeds expectations on ability to express oneself well in verbal and/or written communication. Written report and oral presentation are both excellent.

Even though the project is team-based, you will be graded based on your own contributions. In the written report, you have to indicate which portions are your own work. During the presentation, every student must take turns speaking. After the presentation, your instructors will ask you questions on the spot to test your knowledge of the subject matter. It will be obvious if you have not pulled your weight, as you will not be able to answer the questions well.

Appendix 1b: Assessment Criteria (Final Examination)

Criteria	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90%
Knowledge & Comprehension Understanding the principles of biopharmaceutics, pharmacokinetics, and pharmacogenetics	Lacks understanding of basic principles	Fair understanding of some aspects of biopharmaceutics, pharmacokinetics, or pharmacogenetics	Satisfactory understanding of most principles	Good understanding of most principles	Very good and comprehensive understanding of all principles
Problem Solving Able to analyze real-life problems related to biopharmaceutics, pharmacokinetics, and pharmacogenetics	Unable to solve any problems.	Able to solve only a few problems. Logic may be shaky.	Able to solve some problems, but no ability to think outside the box.	Able to solve all straightforward problems. Limited ability to think outside the box and solve more challenging problems.	Able to solve all problems related to the course. Clear logic.

Appendix 2: The EAB (Engineering Accreditation Board) Accreditation SLOs (Student Learning Outcomes)

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems

b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change