City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Engineering Principles for Drug Delivery
Course Code:	BME6135
Course Duration:	1 semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	BME8135 Engineering Principles for Drug Delivery
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Drug delivery aims to modify the exposure of the drugs to people using engineering principles and materials science. It allows the potential of reducing toxicity, increasing efficacy, and improved use. This course is a lecture-based and project-based class. Topics include drug delivery fundamentals and transport mechanisms, materials and formulations for drug delivery, and biomedical applications.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	**Explain** basic concepts and principles of drug delivery (clinical needs)		✓	✓	
2.	**Analyse** the basic working principles of different drug delivery systems in human body		✓	✓	✓
3.	**Identify** suitable materials, formulations, and devices that can potentially be used to achieve clinically-effective drug delivery			✓	✓
4.	**Design** formulations and devices that can achieve clinically-effective delivery of drugs			✓	✓
		N.A.			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Explain concepts of drug delivery and the design of drug delivery system	✓	✓	✓	✓	2 hrs/week
Tutorial	Recap and expand the materials taught in lectures	✓	✓	✓	✓	1 hr/week
Group project	Provide opportunities for students to integrate the principles taught in lectures through case studies		✓	✓	✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 60%						
Midterm Test	✓	✓			30%	
Group Project		✓	✓	✓	20%	Promote team-work
Assignment (including presentation)	✓	✓	✓	✓	10%	Encourage independence
Examination: 40%						
Examination	✓	✓	✓	✓	40%	Duration: 2.5 hours
					100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
Midterm Test	Ability to identify essential strategies to transport drugs across the biological barriers in therapy, and to explain the engineering principles behind.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Group Project	Ability to utilize the materials taught in lectures to analyse and develop customized formulations/devices for specific medical conditions.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Assignment	Ability to apply the engineering concepts precisely to solve the existing challenges that can not be addressed in current formulation/devices.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Examination	Ability to analyse the challenges of drug delivery in details, from molecular to cell to system level; and to apply the engineering approach to address these problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C,)	Failure (F)
Midterm Test	Ability to identify essential strategies to transport drugs across the biological barriers in therapy, and to explain the engineering principles behind.	High	Significant	Basic	Not even reaching marginal levels
Group Project	Ability to utilize the materials taught in lectures to analyse and develop customized formulations/devices for specific medical conditions.	High	Significant	Basic	Not even reaching marginal levels

Assignment	Ability to apply the engineering concepts precisely to solve the existing challenges that can not be addressed in current formulation/devices.	High	Significant	Basic	Not even reaching marginal levels
Examination	Ability to analyse the challenges of drug delivery in details, from molecular to cell to system level; and to apply the engineering approach to address these problems.	High	Significant	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Drug delivery barriers

- Pharmacokinetics & Pharmacodynamics
- Drug transport in cells, between cells, and through tissues/organs

Formulations

- Conventional pharmaceutical formulations
- Nanoparticle-based drug delivery systems
- Device-based drug delivery systems

Applications

- Topical/transdermal delivery
- GI delivery
- Systematic delivery

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

- Allen, Theresa M., and Pieter R. Cullis. Drug delivery systems: entering the mainstream. Science, 2004, 303: 1818-1822.
- Tibbitt M W, Dahlman J E, Langer R. Emerging frontiers in drug delivery. Journal of the American Chemical Society, 2016, 138(3): 704-717.
- Fenton O S, Olafson K N, Pillai P S, et al. Advances in biomaterials for drug delivery. Advanced Materials, 2018, 30(29): 1705328.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	W. Mark Saltzman. *Drug Delivery: Engineering Principles for Drug Therapy (Topics in Chemical Engineering)*. 03/2001, Oxford University Press.
2.	Anya M Hillery, Kinam Park. *Drug Delivery: Fundamentals and Applications*, CRC Press, 09/2016.
3.	Chenjie Xu, Xiaomeng Wang, Manojit Pramanik. *Imaging Technologies and Transdermal Delivery in Skin Disorders*. 11/2019, Wiley-VCH