

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:	<u>Advanced Biomaterials for Healthcare and Biomedical Applications</u>
Course Code:	<u>BME6136</u>
Course Duration:	<u>1 semester</u>
Credit Units:	<u>3</u>
Level:	<u>P6</u>
Medium of Instruction:	<u>English</u>
Medium of Assessment:	<u>English</u>
Prerequisites: <i>(Course Code and Title)</i>	<u>Nil</u>
Precursors: <i>(Course Code and Title)</i>	<u>Nil</u>
Equivalent Courses: <i>(Course Code and Title)</i>	<u>BME8136 Advanced Biomaterials for Healthcare and Biomedical Applications</u>
Exclusive Courses: <i>(Course Code and Title)</i>	<u>Nil</u>

Part II Course Details

1. Abstract

A biomaterial, different from a biological material, is any substance that is engineered to interact with biological systems for biomedical and medical purposes - either therapeutic or diagnostic. Advanced biomaterials refer to those with novel properties, multi-functions, smart features, high-performance characteristics and for more demanding applications or for improved outcomes and by different mechanisms. The science of biomaterials encompasses elements of medicine, biology, chemistry, physics, tissue engineering, materials science and engineering. This course is a lecture-intensive and project-based class. Topics include conceptual fundamentals and general theories, materials design, fabrication, device evaluation and their functional mechanisms as well as applications in healthcare and biomedical areas.

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 the basic concepts and principles of advanced biomaterials	30%	✓	✓	✓
2.	Analyse the basic working principles of different biomaterials for healthcare and biomedical applications	30%	✓	✓	✓
3.	Identify suitable materials, formulations and devices that can potentially be used to serve certain healthcare and biomedical purposes	20%		✓	✓
4.	Design formulations, structures and devices that can achieve effective healthcare and biomedical performance	20%		✓	✓
		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 advanced biomaterials and the design of such system	✓	✓	✓	✓	2 hrs/week
Tutorial	1. Recap and expand the materials taught in lectures 2. Provide opportunities for students to integrate the principles taught in lectures through case studies and enhance their team-working and peer-learning capabilities	✓	✓	✓	✓	1 hr/week

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	✓	✓			20%	
Group Project		✓	✓	✓	20%	Promote team-work
Assignment (including presentation)	✓	✓	✓	✓	20%	Encourage independence
Examination: 40%						
Examination	✓	✓	✓	✓	40%	Duration: 2 hours
					100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

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)
1. Examination	Ability to analyse the challenges of advanced biomaterials in details, from molecular design to device fabrication, to applications at cell, tissue and system levels and to apply the scientific and engineering approaches to address these problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Midterm Test	Ability to identify essential strategies to develop advanced biomaterials in considering biological, physical and chemical elements in therapy, and to explain the principles behind.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Group Project	Ability to utilize the materials taught in lectures to analyse and choose customized biomaterials for health and biomedical conditions.	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Assignment	Ability to apply the engineering concepts precisely to solve the existing challenges that can not be addressed in current biomaterials.	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)
1. Examination	Ability to analyse the challenges of advanced biomaterials in details, from molecular design to device fabrication, to applications at cell, tissue and system levels and to apply the scientific and engineering approaches to address these problems.	High	Significant	Basic	Not even reaching marginal levels

2. Midterm Test	Ability to identify essential strategies to develop advanced biomaterials in considering biological, physical and chemical elements in therapy, and to explain the principles behind.	High	Significant	Basic	Not even reaching marginal levels
3. Group Project	Ability to utilize the materials taught in lectures to analyse and choose customized biomaterials for health and biomedical conditions.	High	Significant	Basic	Not even reaching marginal levels
4. Assignment	Ability to apply the engineering concepts precisely to solve the existing challenges that can not be addressed in current biomaterials.	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.)

Functions and smart behaviour

- Stimuli sensitive: physically, chemically and biologically
- Novel and multi functions: biological, chemical, physical and mechanical

Materials origin

- Synthetic polymer-based
- Metal and ceramics-based
- Natural macromolecule-based
- Genetically engineered
- Nano and composites
- Fibre and textiles

Applications

- Tissue engineering/regeneration
- Drug delivery
- Healthcare
- Personal protection

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.)

- Advanced biomaterials: fundamentals, processing, and applications, by Bikramjit Basu, Dharendra Katti, and Ashok Kumar, Hoboken, N.J. John Wiley & Sons
- Smart Biomaterials (NIMS Monographs) 2014th Edition, by Mitsuhiro Ebara, Yohei Kotsuchibashi, Ravin Narain, Naokazu Idota, Young-Jin Kim, John M. Hoffman, Koichiro Uto, Takao Aoyagi, Springer
- Novel Biomaterials for Regenerative Medicine, Heung Jae Chun, Kwideok Park, Chun-Ho Kim, Gilson Khang
- Materials for Biomedical Engineering: Biopolymer Fibers, 1st Edition by Valentina Grumezescu Alexandru Grumezescu, ISBN: 9780128168721, eBook ISBN: 9780128168738, Imprint: Elsevier, 27th March 2019

2.2 Additional Readings

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

1.	Advances in Biomaterials for Biomedical Applications, Tripathi, Anuj, Melo, Jose Savio (Eds.) SPRINGER, 2017
2.	Biomaterials and Their Applications, Authors: Reza Rezaie, Hamid, Bakhtiari, Leila, Öchsner, Andreas, Springer, 2015
3.	Handbook of Fibrous Materials, Jinlian Hu, Bipin Kumar; Jing Lu, Volume 2 Applications in Energy, Environmental Science and Healthcare, ISBN13 9783527342204, Wiley-VCH, Germany, total page: 499-1003, 22 June 2020
4.	Topics in Multifunctional Biomaterials and Devices, November 2008, Publisher: Oulu University, EU Network of excellence on tissue engineering