City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester A 2022 / 2023

Part I Course Overview

Course Title:	Advanced Biomaterials for Healthcare and Biomedical Applications
Course Code:	BME8136
Course Duration:	1 semester
Credit Units:	3
Level:	R8
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)*	BME6136 Advanced Biomaterials for Healthcare and Biomedical Applications
Exclusive Courses: *(Course Code and Title)*	Nil

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)

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%		✓	✓
** If weighting is assigned to CILOs, they should add up to 100%.*		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 self-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. Teaching and Learning Activities (TLAs)

TLA	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)

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
** The weighting should add up to 100%.*					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

Applicable to students admitted in Semester A 2022/23 and thereafter

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

Applicable to students admitted before Semester A 2022/23

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

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

1. Keyword Syllabus

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

- Advanced biomaterials: fundamentals, processing, and applications, by Bikramjit Basu, Dhirendra 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

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