City University of Hong Kong
Course Syllabus

offered by Department of Materials Science and Engineering
with effect from Semester A 2022/23

Part I Course Overview

Course Title:	**Biomedical Materials and Devices with Nano-applications**
Course Code:	**MSE6184**
Course Duration:	**One Semester**
Credit Units:	**3**
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)*	**AP6173 Biomedical Materials and Devices: From Engineering to Clinical Applications (From the old curriculum)**
Exclusive Courses: *(Course Code and Title)*	**AP8173 Biomedical Materials and Devices: From Engineering to Clinical Applications (From the old curriculum)**

Part II Course Details

1. Abstract

(A 150-word description about the course)

Biomedical materials are substances that are manufactured or processed to interact with biological systems for either a therapeutic (treat, augment, repair or replace a tissue function of the body) or a diagnostic purpose. Based on the knowledge of various aspects of biomedical and materials engineering, this course aims to 1) provide students an overview of the properties of various biomedical materials including nanoscale materials and their clinical applications, 2) equip students with understanding of the working principles and applications of diverse biomedical materials, 3) introduce to students the research frontiers of various biomedical materials including nanoscale ones, and motivate students for discoveries and innovations.

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.	Identify and understand the concepts, preparation, and characterization of biomedical materials.	10%	√		
2.	Understand and the working principles and applications of various types of biomedical materials and devices.	30%	√		
3.	Apply the relevant methodologies to evaluate and discover the physical, mechanical, optical and biological properties of currently used or researched biomedical materials and devices.	20%		√	
4.	Innovatively apply knowledge of materials science and engineering to discover or propose new biomedical nanomaterials and devices.	20%			√
5.	Identify state-of-the-art development in the relevant areas and to form opinions on specific issues.	20%		√	
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

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)

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

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5		
1	Lectures	√	√	√	√	√		~ 24 hrs
2	Tutorials	√	√	√	√	√		~ 6 hrs
3	Laboratory/Demonstration/Visit		√	√				~ 5 hrs
4	Group projects/presentations		√	√	√	√		~ 3 hrs

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	5			
Continuous Assessment: 40 %								
Group project and presentation		√	√	√	√		20%	
Mid-term Test	√	√	√				20%	
Examination: duration: 2 hrs	√	√	√	√			60%	
** The weightings should add up to 100%.*							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 in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Mid-Term test	Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.	High	Moderate	Basic	Not reaching marginal level
2. Group project and presentation	Ability to review/investigate a specific technique or application of biomedical materials. Ability to explain the discovery and provide opinions.	High	Moderate	Basic	Not reaching marginal level
3. Examination	Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.	High	Moderate	Basic	Not reaching marginal level

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. Mid-Term test	Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.	High	Significant	Moderate	Basic	Not reaching marginal level
2. Group project and presentation	Ability to review/investigate a specific technique or application of biomedical materials. Ability to explain the discovery and provide opinions.	High	Significant	Moderate	Basic	Not reaching marginal level
3. Examination	Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.	High	Significant	Moderate	Basic	Not reaching marginal level

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.)

- Introduction to biomedical materials.
- Properties of biomedical materials (ceramics and glasses, metallic biomaterials, polymeric biomaterials, biocomposites, nanoscale materials).
  Biomaterial surfaces (protein interactions at materials surfaces, hypersensitivity). Degradable biomaterials. Hydrogels as biomaterials. Sterility and infection. Biocompatibility testing.
- Applications biomaterials to biodetection and therapy. Biosensors and diagnostic devices (Biological elements. Transduction mechanisms. Fiber optic biosensors. Nanobarcode. Photonic crystals-based sensors. Cell behaviour monitors. SPR sensors); Controlled drug delivery (molecular gates, temperature-, pH-, and light-sensitive switches).
- BioMEMS and microfluidics
  Micro/nano processing technology. Photolithography and soft Lithography. Etching (wet and dry).
- Biomaterial safety opportunities and risks

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.)

Nil

2.2 Additional Readings

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

1.	Joon Park and R. S. Lakes, "Biomaterials: An Introduction", Springer, 3rd ed., 2007, ISBN: 978-0387378794
2.	Joon B. Park and Joseph D. Bronzino, "Biomaterials: Principles and Applications", CRC Press, 1st ed., 2002, ISBN: 978-0849314919
3.	"Biomedical technology and devices", Ed. James E. Moore, et al., CRC Press, 2nd ed., 2014, ISBN: 978-1439860618
4.	"Biomaterials science: an introduction to materials in medicine," Ed. Buddy D. Ratner, et al., Academic Press, 2013, ISBN: 978-0123746269
5.	Nano-biotechnology for biomedical and diagnostic research, Eran Zahavy, Arie Ordentlich, Shmuel Yitzhaki, Avigdor Shafferman (Editors), 2012, Springer
6.	Nanofabrication towards biomedical applications: techniques, tools, applications, and impact, Challa SSR Kumar, Josef Hormes, Carola Leuschner (Editors), 2005, Wiley-VCH