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:	Manufacturing of Biomedical Devices
Course Code:	BME6101
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)*	MBE6101/MBE8103/BME8103 Manufacturing of Biomedical Devices
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Biomedical manufacturing is currently a rapidly growing industry over the past decades. It can be viewed as the application of manufacturing technology to biomedical products, of which the development processes are often tedious and multidisciplinary, involving advanced 3D modelling, surgical machining, pharmaceutical production and biomechanics. This course aims at providing essential knowledge in the biomedical product development (e.g. material properties, fabrication processes and design techniques for different applications) in order to provide ways to speed up the product development cycle. This course is multidisciplinary and covers the principles in mechanical, chemical, biological, and physiological aspects. Students can learn the techniques to apply the acquired knowledge for particular applications they are interested.

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.	**Describe** the mechanical and biochemical properties of bio-related materials, as well as their major applications as medical devices or other bio-products.			✓	
2.	**Explain** the principles of the fabrication/manufacturing techniques for existing biomedical devices; and identify the manufacturing processes for the biomedical applications.			✓	
3.	**Compare** the pros and cons of different bio-materials and their corresponding manufacturing processes.		✓	✓	
4.	**Select** the appropriate bio-related materials and manufacturing processes for specific applications; and **employ** basic design principles to specific bio-related products.		✓	✓	✓
		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	In the form of classroom teaching. Case studies, demonstrations of biomedical devices, discussions on selected questions will be arranged to supplement the lectures.	✓	✓	✓	✓	3 hrs/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: 50%						
Problem sets	✓	✓	✓	✓	20%	Three problem sets are assigned in the course and each one focuses on one CILO.
Individual term project (report)	✓	✓	✓	✓	30%	Grading of this individual term project is based on a presentation and a final report. The project should focus on review of an existing biomedical product.
Examination: 50%						
Examination	✓	✓		✓	50%	There is a 2-hour examination at the end of the semester. A part of the examination contains questions specifically designed for the BME6101 students.
					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 EXPLAIN the methodology and procedure related to manufacturing of biomedical system, and to DESIGN and MODEL defined biomedical systems	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Problem sets	ABILITY to EXPLAIN in DETAIL and with the acquired engineering methods for designing and characterizing of biomedical devices and for CONSTRUCT proper manufacturing procedures	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Individual term project (report)	ABILITY to integrate multidisciplinary science and engineering knowledge to DESIGN or CONSTRUCT a novel biomedical devices with defined applications	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 EXPLAIN the methodology and procedure related to manufacturing of biomedical system, and to DESIGN and MODEL defined biomedical systems	High	Significant	Basic	Not even reaching marginal levels
2. Problem sets	ABILITY to EXPLAIN in DETAIL and with the acquired engineering methods for designing and characterizing of biomedical devices and for CONSTRUCT proper manufacturing procedures	High	Significant	Basic	Not even reaching marginal levels
3. Individual term project (report)	ABILITY to integrate multidisciplinary science and engineering knowledge to DESIGN or CONSTRUCT a novel biomedical devices with defined applications	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.)

- **Materials:** metals, ceramics, polymers, adhesives.
- **Material properties:** biomaterials, biocompatibility, haemocompatibility, elastic modulus, surface roughness, porosity, nanostructures.
- **Fabrication:** scaffolds, nano/microparticles, rapid prototyping, electro-spinning, self-assembly, solid freeform fabrication, polymer coating, vapour deposition, biomodelling, 3D medical imaging, reverse engineering.
- **Considerations:** cell-material interaction, tissue attachment, bonding criteria, surface pretreatment, corrosion, degradation, ion release, implants, sterilization, surgery and infection.
- **Applications:** biosensors, drug delivery, tissue engineering, orthopaedic devices, internal fixation, joint prostheses, cartilage reconstruction.

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.)

1.	Lam, R. H. W., and Chen, W. (2019). *Biomedical Devices: Materials, Design and Manufacturing*, New York: Springer Publishing.

2.2 Additional Readings

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

1.	Migonney V. (2014). *Biomaterials*, England: John Wiley & Sons, Inc.
2.	Kucklick, T. R. (2012). *The Medical Device R&D Handbook*, Florida: CRC Press.
3.	Masataka, Y. (2010). *System Design Optimization for Product Manufacturing*, London: Springer Publishing.