

BME8103: MANUFACTURING OF BIOMEDICAL DEVICES

Effective Term

Semester B 2024/25

Part I Course Overview

Course Title

Manufacturing of Biomedical Devices

Subject Code

BME - Biomedical Engineering

Course Number

8103

Academic Unit

Biomedical Engineering (BME)

College/School

College of Biomedicine (BD)

Course Duration

One Semester

Credit Units

3

Level

R8 - Research Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

Nil

Equivalent Courses

MBE6101/BME6101/MBE8103 Manufacturing of Biomedical Devices

Exclusive Courses

Nil

Part II Course Details

Abstract

Manufacturing of biomedical devices 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 to provide the 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. Further, this course emphasizes also on inspiring students to discover and convert newly reported technologies into products/services for the future development of biomedical applications.

Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-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.			x	
2 Explain the principles of the fabrication/manufacturing techniques for existing biomedical devices; and identify the manufacturing processes for the biomedical applications.			x	
3 Compare the pros and cons of different bio-materials and their corresponding manufacturing processes.		x	x	
4 Select the appropriate bio-related materials and manufacturing processes for specific applications; and employ basic design principles to specific bio-related products.		x	x	x
5 Discover and elaborate newly developed technologies related to biomedical manufacturing; and propose a selected technology on how it can be converted to the corresponding biomedical product/service.		x	x	x

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.

Learning and Teaching Activities (LTAs)

LTAs		Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	In the form of classroom teaching. Case studies, demonstrations of biomedical devices, discussions on selected questions will be arranged to supplement the lectures.	1, 2, 3, 4	3 hrs/week

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)	
1	Problem sets	1, 2, 3, 4	20	Three problem sets are assigned in the course and each one focuses on one CILO.
2	Individual term project (report)	1, 2, 3, 4	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.

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

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.

Assessment Rubrics (AR)**Assessment Task**

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to EXPLAIN the methodology and procedure related to manufacturing of biomedical system, and to DESIGN and MODEL defined biomedical systems

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Problem sets (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to EXPLAIN in DETAIL and with the acquired engineering methods for designing and characterizing of biomedical devices and for CONSTRUCT proper manufacturing procedures

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Individual term project (report) (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to integrate multidisciplinary science and engineering knowledge to DESIGN or CONSTRUCT a novel biomedical devices with defined applications

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

ABILITY to EXPLAIN the methodology and procedure related to manufacturing of biomedical system, and to DESIGN and MODEL defined biomedical systems

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Problem sets (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

ABILITY to EXPLAIN in DETAIL and with the acquired engineering methods for designing and characterizing of biomedical devices and for CONSTRUCT proper manufacturing procedures

Excellent

(A+, A, A-) High

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Assessment Task

Individual term project (report) (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Part III Other Information

Keyword Syllabus

- 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.

Reading List**Compulsory Readings**

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

Additional Readings

Title	
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.