BME8136: ADVANCED BIOMATERIALS FOR HEALTHCARE AND BIOMEDICAL APPLICATIONS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Advanced Biomaterials for Healthcare and Biomedical Applications

Subject Code
BME - Biomedical Engineering
Course Number
8136

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
BME6136 Advanced Biomaterials for Healthcare and Biomedical Applications

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the basic concepts and principles of advanced biomaterials	30	x	x	x
2	Analyse the basic working principles of different biomaterials for healthcare and biomedical applications	30	x	x	x
3	Identify suitable materials, formulations and devices that can potentially be used to serve certain healthcare and biomedical purposes	20		x	x
4	Design formulations structures and devices that can achieve effective healthcare and biomedical performance	20		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	Explain concepts of advanced biomaterials and the design of such system	1, 2, 3, 4	2 hrs/week

2	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, 2, 3, 4	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Midterm Test	1, 2	20	-	No
2	Group Project	2, 3, 4	20	Promote team-work	Yes
3	Assignment (including presentation)	1, 2, 3, 4	20	Encourage independence	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

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

Criterion

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.

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

Criterion
Ability to identify essential strategies to develop advanced biomaterials in considering biological, physical and chemical elements in therapy, and to explain the principles behind.

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

Criterion
Ability to utilize the materials taught in lectures to analyse and choose customized biomaterials for health and biomedical conditions.

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

Criterion
Ability to apply the engineering concepts precisely to solve the existing challenges that can not be addressed in current biomaterials.

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 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.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Midterm Test (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Ability to identify essential strategies to develop advanced biomaterials in considering biological, physical and chemical elements in therapy, and to explain the principles behind.

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

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Assessment Task
Assignment (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Part III Other Information

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

Reading List

Compulsory Readings

	Title
1	Advanced biomaterials: fundamentals, processing, and applications, by Bikramjit Basu, Dhirendra Katti, and Ashok Kumar, Hoboken, N.J. John Wiley & Sons
2	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
3	Novel Biomaterials for Regenerative Medicine, Heung Jae Chun, Kwideok Park, Chun-Ho Kim, Gilson Khang
4	Materials for Biomedical Engineering: Biopolymer Fibers, 1st Edition by Valentina Grumezescu Alexandru Grumezescu, ISBN: 9780128168721, eBook ISBN: 9780128168738, Imprint: Elsevier, 27th March 2019

Additional Readings

	Title
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