

# MSE6184: BIOMEDICAL MATERIALS AND DEVICES WITH NANO-APPLICATIONS

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Biomedical Materials and Devices with Nano-applications

### Subject Code

MSE - Materials Science and Engineering

### Course Number

6184

### Academic Unit

Materials Science and Engineering (MSE)

### College/School

College of Engineering (EG)

### Course Duration

One Semester

### Credit Units

3

### Level

P5, P6 - Postgraduate Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

Nil

### Precursors

Nil

### Equivalent Courses

AP6173 Biomedical Materials and Devices: From Engineering to Clinical Applications (From the old curriculum)

### Exclusive Courses

AP8173 Biomedical Materials and Devices: From Engineering to Clinical Applications (From the old curriculum)

## Part II Course Details

### Abstract

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.

### Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe and explain the concepts, preparation, and characterization of biomedical materials.	10	x		
2	Describe the working principles and applications of various types of biomedical materials and devices.	30	x		
3	Apply the relevant methodologies to evaluate and demonstrate the physical, mechanical, optical and biological properties of currently used or researched biomedical materials and devices.	20		x	
4	Innovatively apply knowledge of materials science and engineering to design or propose new biomedical nanomaterials and devices.	20			x
5	Discuss state-of-the-art development in the relevant areas and to form opinions on specific issues.	20		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	Lectures	1, 2, 3, 4, 5	~ 24 hrs
2	Tutorials	1, 2, 3, 4, 5	~ 6 hrs
3	Laboratory/ Demonstration/Visit	2, 3	~ 5 hrs
4	Group projects/ presentations/peer- discussion	2, 3, 4, 5	~ 3 hrs

**Assessment Tasks / Activities (ATs)**

	<b>ATs</b>	<b>CILO No.</b>	<b>Weighting (%)</b>	<b>Remarks ("- " for nil entry)</b>	<b>Allow Use of GenAI?</b>
1	Group project and presentation	2, 3, 4, 5	20	-	Yes
2	Mid-term Test and quizzes	1, 2, 3	20	-	No

**Continuous Assessment (%)**

40

**Examination (%)**

60

**Examination Duration (Hours)**

2

**Assessment Rubrics (AR)****Assessment Task**

Mid-term and quizzes (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.

**Excellent**

(A+, A, A-) High

**Good**

(B+, B, B-) Significant

**Fair**

(C+, C, C-) Moderate

**Marginal**

(D) Basic

**Failure**

(F) Not reaching marginal level

**Assessment Task**

Group project and presentation (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Ability to review/investigate a specific technique or application of biomedical materials. Ability to explain the discovery and provide opinions.

**Excellent**

(A+, A, A-) High

**Good**

(B+, B, B-) Significant

**Fair**

(C+, C, C-) Moderate

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**Assessment Task**

Mid-term and quizzes (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Understanding concepts of biomedical materials, their working principles, characterization techniques, and applications.

**Excellent**

(A+, A, A-) High

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## Part III Other Information

**Keyword Syllabus**

- 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

**Reading List**

**Compulsory Readings**

Title	
1	Nil

### Additional Readings

Title	
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