

BME8129: BIOROBOTICS

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Biorobotics

Subject Code

BME - Biomedical Engineering

Course Number

8129

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

MBE6115/BME6115 Biorobotics

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to expose students to (i) biorobotics and biomedical microsystems, focusing on bio-inspired robotics, biohybrid robotics, medical micro/nanorobotics, and AI-assisted design for materials and locomotion efficiency. Students

will explore how nature inspires robotic designs, how biohybrid systems integrate biological principles with robotic engineering, the applications of micro/nanorobotics in precision medicine, and AI-assisted tools for enhancing material compatibility, predicting degradation, and optimizing microrobotic Locomotion. The course integrates biorobotics and biomedical microsystems, examining their roles in diagnostics, drug delivery, and therapeutic applications. By the end of the course, students will gain a comprehensive understanding of advanced biorobotics and their biomedical applications.

Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	To compare and evaluate bio-inspired and biohybrid robotic systems.	x	x	
2	To analyse the design, dynamics scaling laws and actuation strategies of medical micro/nanorobotics.		x	
3	To master the working principles of biorobotic system design with AI-assisted optimization.		x	
4	To analyse identify novel underlying principles of biological or biorobotics systems of interest and illustrate how to critically apply them to address clinical challenges.		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	The main teaching activity.	1, 2, 3	3 hrs/week for 10 weeks
2	Discussion	Seminar-style interactive activities with virtual experiments.	4	3 hrs/week for three weeks (Week 8, 9, and 10)

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks ("- for nil entry)	Allow Use of GenAI?	
1	Mid-term test	1, 2, 3	15	-	No
2	Group presentation	4	35	Maximum group size of five students.	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Mid-term test (for students admitted from Semester A 2024/25 & thereafter)

Criterion

1. ABILITY to COMPARE and ANALYZE the principles of bio-inspired and biohybrid robotics.
2. ABILITY to APPLY scaling laws and dynamics to micro/nano-robotics.

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 presentation (for students admitted from Semester A 2024/25 & thereafter)

Criterion

1. CAPACITY for SELF-DIRECTED LEARNING to study biological and robotic systems.
2. ABILITY to COMMUNICATE and PRESENT the finding in robotic framework.
3. ABILITY to critically APPLY biological and physic principles to engineering 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

Examination (for students admitted from Semester A 2024/25 & thereafter)

Criterion

ABILITY to understand working principles, design methods and related to biorobotics and biomedical microsystems.

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

Part III Other Information**Keyword Syllabus**

Bio-inspired robotics, Biohybrid robotics, Micro/nano-robotics, AI-assisted robotic design, Biomaterials, Biomedical microsystems, Precision medicine, Healthcare devices, Medical robots.

Reading List**Compulsory Readings**

Title	
1	N. A.

Additional Readings

Title	
1	Sitti, M. Mobile Microrobotics. MIT Press, 2017.
2	Zhang, L., Chiu, P., Chan, K., Recent Progress in Medical Miniature Robots: from Bench to Bedside, Academic Press, 2024.
3	Zhang, L., Zhang, J., Xia, N., Dong, Y., Untethered Miniature Soft Robots: Materials, Fabrications, and Applications, Wiley-VCH Verlag GmbH, 2023
4	Schweikard, A., & Ernst, F. Medical Robotics. Springer, 2015.

5	Fukuda T, Arai F, Nakajima M. Micro-nanorobotic manipulation systems and their applications. Springer Science & Business Media, 2013.
6	Yi G, Selected topics in micro/nano-robotics for biomedical applications. Springer, 2013.