BME6115: BIOROBOTICS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Biorobotics

Subject Code
BME - Biomedical Engineering
Course Number
6115

Academic Unit
Biomedical Engineering (BME)

College/School
College of Biomedicine (BD)

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
MBE6115/MNE6115 Bio-Inspired Robots/BME8129 Biorobotics

Exclusive Courses
Nil

Part II Course Details

Abstract
This course introduces aims to expose students to 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 exam (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.