

**City University of Hong Kong  
Course Syllabus**

**offered by  
Department of Biomedical Engineering  
with effect from Semester A 2022 / 2023**

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**Part I Course Overview**

<b>Course Title:</b>	<u>Biorobotics</u>
<b>Course Code:</b>	<u>BME8129</u>
<b>Course Duration:</b>	<u>1 Semester</u>
<b>Credit Units:</b>	<u>3</u>
<b>Level:</b>	<u>R8</u>
<b>Medium of Instruction:</b>	<u>English</u>
<b>Medium of Assessment:</b>	<u>English</u>
<b>Prerequisites :</b> <i>(Course Code and Title)</i>	<u>Nil</u>
<b>Precursors:</b> <i>(Course Code and Title)</i>	<u>Nil</u>
<b>Equivalent Courses:</b> <i>(Course Code and Title)</i>	<u>MBE6115/BME6115 Biorobotics</u>
<b>Exclusive Courses:</b> <i>(Course Code and Title)</i>	<u>Nil</u>

## Part II Course Details

### 1. Abstract

This course aims to expose students to (i) robotic systems developed by applying concepts from nature and biology to engineered systems; and (ii) biomedical robots. The objective is for students to learn the principles behind the bio-inspired robots from biological counterparts, to learn how robotics are applied in biological engineering from molecular to macro levels, and to translate extracted biological solutions into robotic systems. The course intends to enhance students' knowledge in dynamics, physics of scaling, sensing, biomechanics, and locomotion, taking inspiration and examples from nature and biomedical devices.

### 2. Course Intended Learning Outcomes (CILOs)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	To <b>compare</b> and <b>give</b> account of the bio-inspired robots and biomedical robots.		✓	✓	
2.	To <b>derive</b> the dynamics and governing laws for flying, walking, and different locomotion seen in creatures and robots.			✓	
3.	To <b>master</b> the working principles underpinning biorobotics (control, sensing, kinematics, dynamics, biomechanics).			✓	
4.	To <b>analyse, identify</b> novel underlying principles of biological or biorobotics systems of interest and <b>illustrate</b> how to critically <b>apply</b> them to engineering systems.			✓	✓
*If weighting is assigned to CILOs, they should add up to 100%.		N.A.			

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 self-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.*

### 3. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	The main teaching activity.	√	√	√		3 hrs/week for 10 weeks
Discussion	Seminar-style interactive activities with virtual experiments.				√	3 hr/week for three weeks (week 8,9 and 10)

### 4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.				Weighting*	Remarks
	1	2	3	4		
Continuous Assessment: 50%						
Mid-term test	√	√	√		10%	
Tutorial				√	15%	Three tutorials, 5% for each report submission.
Group Presentation				√	25%	Maximum group size of five students.
Examination: 50%						
Examination	√	√	√		50%	Duration: 2 hours
* The weighting should add up to 100%.					100%	

## 5. Assessment Rubrics

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
Mid-term exam	1. ABILITY to IDENTITY/CONTRAST similarities and differences between engineering, bio-inspired, and bio-mimetic systems. 2. ABILITY to EMPLOY robotic principles to ANALYSE different locomotion seen in creatures and robots.	High	Significant	Basic	Not even reaching marginal levels
Tutorials	1 ABILITY to LEARN and APPLY robotic technologies in simulated scenarios 2. ABILITY to technically SUMMARIZE and ELABORATE the implemented methodology and outcomes effectively.	High	Significant	Basic	Not even reaching marginal levels
Group Presentation	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.	High	Significant	Basic	Not even reaching marginal levels
Examination	ABILITY to understand working principles, design methods and related to bio-inspired robots and biomedical devices.	High	Significant	Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
Mid-term exam	1. ABILITY to IDENTITY/CONTRAST similarities and differences between engineering, bio-inspired, and bio-mimetic systems. 2. ABILITY to EMPLOY robotic principles to ANALYSE different locomotion seen in creatures and robots.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Tutorials	1 ABILITY to LEARN and APPLY robotic technologies in simulated scenarios 2. ABILITY to technically SUMMARIZE and ELABORATE the implemented methodology and outcomes effectively.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Group Presentation	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.	High	Significant	Moderate	Basic	Not even reaching marginal levels
Examination	ABILITY to understand working principles, design methods and related to bio-inspired robots and biomedical devices.	High	Significant	Moderate	Basic	Not even reaching marginal levels

**Part III Other Information** (more details can be provided separately in the teaching plan)

**1. Keyword Syllabus**

Bio-inspiration, Biomimetics, Flying, Aerial robots, Walking, Dynamics, Stability, Physics of scaling, Sensing, Biomechanics, Rehabilitation, Medical robots, Micro/nano robots.

**2. Reading List**

**2.1 Compulsory Readings**

N. A.

**2.2 Additional Readings**

1.	Tennekes, Hendrik. The simple science of flight: from insects to jumbo jets. MIT press, 2009.
2.	Russ Tedrake. Underactuated Robotics: Algorithms for Walking, Running, Swimming, Flying, and Manipulation (Course Notes for MIT 6.832). Downloaded on June 2016 from <a href="http://underactuated.mit.edu/">http://underactuated.mit.edu/</a>
3.	Haberland, M., and S. Kim. "On extracting design principles from biology: I. Method? General answers to high-level design questions for bioinspired robots." <i>Bioinspiration &amp; biomimetics</i> 10.1 (2015): 016010.
4.	Achim S, Floris E, 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.