

**City University of Hong Kong
Course Syllabus**

**offered by
Department of Biomedical Engineering
with effect from Semester A 2024/25**

Part I Course Overview

Course Title: Physiological Modeling

Course Code: BME6122

Course Duration: 1 semester

Credit Units: 3 credits

Level: P6

Medium of Instruction: English

Medium of Assessment: English

Prerequisites :
(Course Code and Title) Nil

Precursors:
(Course Code and Title) Nil

Equivalent Courses:
(Course Code and Title) BME8133 Physiological Modeling

Exclusive Courses:
(Course Code and Title) Nil

Part II Course Details

1. Abstract

This course will introduce students to the mathematical models of bioelectric, biomechanical and bioacoustic activities from physiological systems such as neuromuscular systems, cardiovascular systems, auditory systems etc. The purpose is to gain a solid theoretical understanding of the human physiological processes. The main topics include:

- The structure and function of the neuromuscular systems; fundamentals in biological neural networks.
- Compartment models and the electrical properties of single neurons; Nernst and Goldman equations; IF models; Hodgkin-Huxley model; cable equation.
- Stochastic point process, performance analysis of myoelectric channels, myoelectric control of robotic arms and applications in cyborg systems.
- Random electrical neuromuscular stimulations, spectral analysis.
- Transmission of sound through the outer-middle-inner ear; otoacoustic emissions and its models, mechano-electrical model of auditory hair cells; concepts of bionic wavelet transform; cochlear implants.
- Heart sounds analysis; high-order statistics; modeling of arterial blood pressure and pulse wave velocity.
- Current topics of interests.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	Describe basic concepts relevant with physiological systems.		✓		
2.	Describe fundamentals in biological neural networks and discuss bioelectrical signal propagation mechanisms in neuromuscular systems.			✓	
3.	Modeling and interpreting of various components in physiological systems such as neuromuscular, cardiovascular and auditory systems.		✓	✓	✓
4.	Modeling applications in the design of biomedical instrumentation, bionic signal processing techniques, and cyborg systems.			✓	✓
		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 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.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Introduce the fundamental concepts, explain modeling approaches and discuss their applications.	✓	✓	✓	✓	3 hrs/week
Projects/literature reviewing/presentations	Problem-based learning, problem identifications and creative solution proposals	✓	✓	✓	✓	3 hrs/week for 2-3 weeks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 60%						
Problem-based learning and presentations		✓	✓	✓	30%	
Mid-term and In-class Quiz	✓	✓	✓	✓	30%	
Examination: 40%						
Examination	✓	✓	✓	✓	40%	Duration: 2 hours
					100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Ability to understand basic concepts, modeling methodologies, and fundamentals of biomedical signal processing.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mid-term and In-class Quiz	Ability to understand the fundamentals of physiological systems and modeling techniques.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Problem-based Learning and presentations	Ability to identify problems and propose possible solutions in physiological modeling.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C,)	Failure (F)
1. Examination	Ability to understand basic concepts, modeling methodologies, and fundamentals of biomedical signal processing.	High	Significant	Basic	Not even reaching marginal levels
2. Mid-term and In-class Quiz	Ability to understand the fundamentals of physiological systems and modeling techniques.	High	Significant	Basic	Not even reaching marginal levels
3. Problem-based Learning and presentations	Ability to identify problems and propose possible solutions in physiological modeling.	High	Significant	Basic	Not even reaching marginal levels

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

1. Keyword Syllabus

(An indication of the key topics of the course.)

Physiological modeling
Neuromuscular modeling
OAE and bionic wavelet transform
HH equations
Cable equations
Cyborg systems
Random point process
Myoelectric control
BP-PTT relationship

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Bioelectromagnetism by J. Malmivuo, R. Plonsey, Oxford University Press, 1995 (or) Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields by Jaakko Malmivuo and Robert Plonsey, Oxford Scholarship Online, 2012
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2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Neural Engineering by Bin He, Springer, 2013
2.	Probability, Random Variables and Stochastic Processes by Athanasios Papoulis, McGraw-Hill Europe, 2002