BME3103: BIO-SENSORS AND BIO-DEVICES

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Bio-sensors and Bio-devices

Subject Code
BME - Biomedical Engineering
Course Number
3103

Academic Unit
Biomedical Engineering (BME)

College/School
College of Biomedicine (BD)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course provides an overview of the available and advanced technologies related to sensing techniques with practical biomedical applications. The course starts with an introduction of electronic circuit design and fabrication. Advanced

biomedical related sensing principles and devices will also be introduced in this course, including MEMS/Nano-based immunosensors, medical diagnostics biosensors, and biochips for detecting pathogens and drug compounds. It also covers conventional biomedical imaging, sensing, and analyses techniques, including X-ray imaging, computed X-ray tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and ultrasound imaging.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic principles of biomedical imaging and sensing.			x	
2	Identify relevant knowledge and technologies to obtain solutions for bio-detection problems.			x	
3	Apply the principles of biomedical imaging and sensing to analyse selected real life problems.			x	x
4	Demonstrate reflective practice in an engineering context.				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	Students will develop an understanding of key concepts related to bio-sensors and bio-devices.	1, 2, 3, 4	3 hrs/week
2	Laboratory Works	Students will gain hands-on experience via two weeks of laboratory sessions.	2, 3, 4	3 hrs/week for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Project	1, 2, 3, 4	20	Students are required to form teams to perform literature surveys and engineering design and analysis to address a real-life bio-engineering problem. The project includes a report and a final report.
2	Assignment	1, 2, 3	10	One or two assignments on the basic principles of bio-devices and the devise modelling.
3	Laboratory Report (In-Class)	2, 3, 4	20	Two labs on practical experience of bio-sensing techniques and data analyses.

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

Project

Criterion

Ability to work in a team environment and perform the following:
1) provide an up-to-date literature survey of a given topic in bio-engineering;
2) execute engineering design and analysis of the given problem;
3) give a professional presentation on the team’s findings.

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
Assignment

Criterion
Ability to use the fundamental scientific and engineering principles learned in class to solve bio-sensing and bio-imaging related problems.

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
Laboratory Report (In-class)

Criterion
Ability to work with team members to perform lab procedures provided by the course instructor(s) and collect/analyse experimental results.

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

Criterion

Ability to apply the concepts and principles learned in class to solve engineering problems related to bio-sensing and bio-devices.

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

- Sensor transducer, biosensor
- Electronic circuit resistor, diode, transistor, operational amplifier, Wheatstone bridge
- Temperature sensor thermocouple, thermistor, Zener diode
- Piezoelectric sensor piezoelectricity, quartz crystal, pressure sensing,
- Light sensor photoresistor, photodiode, phototransistor, light emitting diode, spectrophotometry, pulse oximeter, fluorescence
- Micro/nano-sensor Lap on a Chip, soft lithography, paper based sensor, nanoparticle, quantum dots
- Bioimaging X-ray, ultrasound, magnetic resonance imaging

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Gabor Harsanyi, Sensors in Biomedical Applications: Fundamentals, Technology and Applications, CRC Press, 2000 (ISBN 9781566768856).
2	Jeong-Yeol Yoon. Introduction to Biosensors: from Electric Circuits to Immunosensors. (2nd Edition) Springer, 2016. (ISBN 978-3-319-27411-9)