Subject Description Form

Subject Code	BME31116
Subject Title	**Biosignal Processing**
Credit Value	3
Level	3
Prerequisite	AMA2511 Applied Mathematics I; and AMA2512 Applied Mathematics II
Objectives	To equip students with basic knowledge of signal processing, and supply with examples in biomedical applications. So that the students are capable of designing fundamental processing methods to analyze biomedical signals.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Demonstrate theoretical foundation on digital signal processing; b. Classify biomedical signals into different categories according to various features; c. Demonstrate understanding the relationship between systems and signals; d. Describe systems or filters using input–output equation, impulse response, frequency response, and transfer function; e. Use FFT for signal analysis with the understanding of sampling effects and windowing effects; f. Use MATLAB to implement filters for the processing of biomedical signals to improve signal quality; g. Design basic digital signal processing approaches using MATLAB with the consideration of data acquisition, signal frequency analysis, and filter selection.
Contribution to Programme Outcomes (Refer to Part I Section 10)	▪ Programme Outcome 1: Demonstrate an ability to apply knowledge of mathematics, science, and engineering appropriate to the Biomedical Engineering (BME) discipline. (Teach, Practice and Measure) ▪ Programme Outcome 2: Demonstrate an ability to design and conduct BME experiments, as well as to analyze and interpret data. (Teach, Practice and Measure) ▪ Programme Outcome 8: Demonstrate an ability to use the computer/IT tools relevant to the BME discipline along with an understanding of their processes and limitations. (Teach, Practice and Measure)

Subject Synopsis/ Indicative Syllabus

- Biomedical signals and systems; discrete-time signals properties.
- Discrete-time systems; system properties; LTI systems.
- System impulse response; system output by convolution.
- Frequency response; Fourier representation of LTI systems.
- Fourier transform and fast Fourier transform (FFT) of discrete-time signals.
- Filters (low pass, high pass, and band pass filters); filter design.
- Fundamentals of biomedical imaging; different modalities and their applications.
- Basic biomedical image processing techniques; image enhancement, registration, classification, etc.

Teaching and Learning Methodology

Students will learn the principles of biomedical signal processing in lectures. Laboratory sessions will provide the students with practical experiences for biosignal processing using MATLAB.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
Homework assignments	15%	√	√	√	√	√	√	
Project and presentation	10%	√	√	√	√	√		
Lab Performance and Lab Report	10%	√	√	√	√	√	√	√
Attendance and quiz	10%	√	√	√	√	√	√	
Midterm quiz	15%	√	√	√	√	√	√	
Final exam	40%	√	√	√	√	√	√	
Total	100%							

Note: To pass this subject, students must obtain grade D or above in both continuous assessment and final examination.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The assignments and exams are used to assess the degree that the students understand the knowledge and ability to apply the knowledge to solve problems.

	The lab sessions are focused on testing the student on how much they gain practical experience and apply knowledge to solve real questions.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	30 Hrs.
	▪ Lab experiments	6 Hrs.
	▪ Presentation	3 Hrs.
	Other student study effort:	
	▪ Self-study	63 Hrs.
	▪ Assignment and lab report	15 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	▪ Northrop RB. Signals and Systems Analysis in Biomedical Engineering. CRC Press, Boca Raton, FL, 2010 ▪ Hsu, Hwei P., Signals and Systems (Fourth Edition). McGraw Hill, New York. 2020 ▪ Stefan Bernhard, Andreas Brensing, and Karl-Heinz Witte. Biosignal Processing: Basics and Recent Applications with MATLAB ® (De Gruyter Textbook) 1st Edition. De Gruyter Oldenbourg, 2022 ▪ Parker S. Ruth and Christopher M. Neils. Biosignal Processing: Foundations for Biomedical Engineers. Independently published, 2020	
Date of Last Major Revision	19 August 2020	
Date of Last Minor Revision	20 December 2022	