NCAD DUBLIN
National College of Art and Design
A Recognised College of University College Dublin

Bioinstrumentation
PGDES1013

MODULE DESCRIPTOR

ECTS credits[1]	5	**Programme**	MSc Medical Device Design
NQF level	9	**School**	School of Design
Stage	1	**Module Co-ordinator**	Enda O'Dowd, Derek Vallence
Trimester	Spring	**Module Team**	Medical Physics & Bioengineering Dept, St. James's Hospital – Coordinated by Dr Gerard Boyle & Dr Chris Soraghan
Contact	odowde@staff.ncad.ie or vallenced@staff.ncad.ie		
Responsibility	The NCAD Academic Council, and the School of Design have responsibility for this module.		

1. Introduction

General Information

This Bioinstrumentation Module is delivered between NCAD and the Department of Medical Physics & Bioengineering at St. James's Hospital Dublin.

Module Description

The aim of this module is to introduce the basic principles of bioinstrumentation as applied to medical device design. There is a focus on having the student gain familiarity with terminology and conceptions of bioinstrumentation. It includes both theory and applied learning in a lab setting. The student will gain basic hands-on experience with sensors and electronics during continuous assessment work (e.g. detecting sensor inputs using an Arduino).

2. What will I learn?

The focus of the module is on the measurement of physiological signals as implemented in common medical and wearable technologies.

Learning Outcomes

On successful completion of this module, students will be able to:

1. Explain in depth the physiology, applicable sensor(s), measurement system and signal features of one bio-signal; breathing (airflow); body temperature; ECG, Glucometer; Galvanic Skin Response; Blood pressure (sphygmomanometer)/SpO2; EMG; body location/motion/gait (accelerometer).

[1] European Credit Transfer and Accumulation System, where 60 ECTS credits equate to the workload of a full-time academic year

2. Describe and distinguish between the basic concepts of electrical voltage, current, resistance, power.
3. Define what a signal is.
4. Define what noise is, the difference between signal and noise; describe how filtering can be employed to improve signal and remove noise.
5. Describe the basic electrical characteristics of resistors, capacitors, and inductors.
6. Illustrate the role of analog signal processing and digital signal processing in a medical device.
7. Describe the path of a generic signal from the human body through typical electronic elements (amplification, ADC, etc) from sensor to output.
8. Appraise the quality of a signal and select methods to improve it.
9. Outline the electrical safety issues of medical devices (including housing) and list techniques to ensure patient safety.
10. Discuss the function of microprocessors in medical devices in terms of their advantages over simple electronic circuits.
11. Define the terms electrodes, sensors, transducers and discriminate between which sensors would be appropriate for specific physiological measurements and how they work.
12. Explain the etymology of ECG, EMG, EEG and identify the anatomical/physiological origin of the features in their corresponding measured signals.
13. Outline the bio-signals and sensors used in brain-computer interfacing cerebral control of electronic devices without muscular interaction; including the pros and cons of each.
14. Describe the physiology and measurement techniques of the five vital signs – blood pressure; temperature; heart rate; respiration (breathing) rate; blood oxygen level (SpO2).
15. Recall and describe the operation of the main medical devices used in tertiary care for patients across the spectrum of care needs, including time-critical devices such as heart-lung machines, infusion pumps, and defibrillators.
16. Outline the basic elements in infection control of medical devices; with a case study on device use of endoscopes throughout a medical institution.
17. Implement basic signal sensing and signal processing functions on a hardware platform (e.g. an Arduino).

Module content

This module will be delivered through a combination of lectures, tutorials and labs.

Lecture and Tutorial Content

- Introduction to Bioinstrumentation
- Analogue Electronics
- Digital Electronics & Microprocessors

- Sensors & Transducers
- Signal Processing
- Instrumentation, Noise & Communications
- Introduction to physiology of bio-signals
- ECG –EMG – EEG
- Brain-Computer Interfacing
- Body Temperature and Respiration sensors
- Glucometer sensor
- Galvanic Skin Response (GSR) sensor
- Medical Devices in Hospitals & Electrical Safety
- Medical Devices & Infection Control
- Blood Pressure I
- Blood Oxygenation (SpO2)
- Gait & Biometrics

Practical Labs

- Analog Electronics
- Digital Electronics & Microprocessors
- ECG / EMG Sensing
- Body Temperature, Respiration, Glucometer, and GSR Sensing
- Blood Pressure, SPO2, and NIRS
- Gait & Biometrics

3. How will I learn?

Learning tool	Hours
Lectures and seminars	20 (10 weeks x 2 hours)
Specified Learning Activities	10 (10 weeks x 1 hours)
Practical Laboratory Sessions	12 (4 weeks x 3 hours)
Autonomous Student Learning	48
Total Workload	**100**

4. What learning supports are provided?

All equipment and materials will be supplied by the teaching staff.

5. Am I eligible to take this module?

Being an enrolled student on the MSc Medical Device Design course you are required to complete this course.

Module Requisites and Incompatibles

Pre-requisites	None
Co-requisites	None
Incompatibles	None
Prior learning	None
Recommended	None

6. How will I be assessed?

Assessment tool	% of final grade	Timing
In-class worksheets	16% (4 x 4% each)	Throughout the module
Instrumentation labs	60% (4 x15% each)	Throughout the module
Present assignment work	24% (1)	End of module
Total	**100%**	

Assessment tool	Learning outcomes assessed
In-class worksheets	1-17
Instrumentation labs	1-17
Presentation of work	1-17

7. Feedback, results and grading

This module will be graded in accordance with the standard NCAD grading criteria and will contribute to the overall programme award of PGDip/MSc Medical Device Design.

8. What happens if I fail?

Resit Opportunities

Opportunities will be provided during or at the end of Trimester 3 to students who do not complete all assessments in Trimester 2, but students will not be able to progress to the next stage of the programme until they have successfully completed all Trimester 1 and 2 modules, equivalent to 60 credits.

9. When and where is this module offered?

The module is delivered in Medical Device Design Studios, the Seminar room as well as Online in the Spring Trimester (January to May).

10. How will I have the chance to evaluate the module?

It is important to NCAD that students inform the development of teaching and learning at NCAD. We encourage all students to communicate their concerns and their observations about their study to members of staff so that any changes can be made in a timely manner.

About two-thirds of the way through the year, a student forum will be convened to gather students' comments about their study and the delivery of the programme. In addition, at the end of Trimester 2, students have the opportunity to complete an online evaluation of their study and experience at NCAD. These evaluation events are important to current and future students, to ensure we can enhance the delivery of programmes at NCAD.

In addition, you are invited to discuss your experience on the module with your lecturers at any point during the year. You can also relay your comments to the class student representative who will communicate your comments to the staff.

For further details on the content of your module and teaching arrangements, consult your Programme or Module Handbook