LABS C2602: Medical Devices and Instrumentation

Module Title:	Medical Devices and Instrumentation
Language of Instruction:	English

Credits:	5

NFQ Level:	6

Module Delivered In	2 programme(s)

Teaching & Learning Strategies:	(a) Teaching will be conducted using lectures, tutorials and practical laboratory sessions. (b) The Institute's VLE will be used to evaluate the students understanding of the basic concepts during each section using online quizzes. (c) At the end of each section, self-test tutorial question sheets will be issued to the students. They will have one week to complete these questions. Any difficulties arising from the self-test question sheets will be addressed in class or laboratory sessions. (d) At various stages of the module students will be directed to online materials and resources and will also have to conduct independent research on specific topics for purpose of completing practical exercises and assignments. (e) The practical laboratory sessions will offer the students hands on laboratory experience using real measurement and test equipment, experimental apparatus, and computational software environments. These applied experiments will serve to reinforce the theoretical knowledge and understanding of real-world systems.

Module Aim:	The aim of this module is to provide the student with knowledge and understanding in relation to medical instrumentation in terms of the principle, applications and design considerations for medical instrumentation circuits and systems. The module focuses on the main concepts of medical instrumentation, sensors and principles, biopotentials, electrodes and amplifier design considerations, blood pressure, measurement of flow and volume, respiratory system, measurement and modelling, clinical laboratory instrumentation approaches, and finally, the operation of various therapeutic and prosthetic devices.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Explain the main concepts of medical instrumentation, sensors and principles.
LO2	Demonstrate knowledge of biopotentials, electrodes and amplifier design considerations.
LO3	Analyse blood pressure, measurement of flow and volume.
LO4	Explain the respiratory system, measurement and modelling approaches.
LO5	Examine clinical laboratory instrumentation approaches, and describe the operation of various therapeutic, prosthetic devices and medical implants.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*
No requirements listed

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Module Content & Assessment

Indicative Content
Concepts of Medical Instrumentation: (i) Terminology of Medicine and Medical Devices, (ii) Classification of Instrumentation Systems, (iii) Compensation techniques, (iv) Biostatistics, (v) Static and dynamic characteristics, (vi) Amplifiers, (vii) Rectifiers, Integrators, Differentiators and Filters, (viii) Offset Voltage, Bias Current, I/O Resistance, (ix) Commercial Medical Instrumentation Development Process.
Sensors and Principles: (i) Displacement and resistive sensors, (ii) Bridge circuits, (iii) Inductive, capacitive, piezoelectric, and accelerometer sensors, (iv) Temperature sensors, (v) Optical measurements, (vi) Radiation sensors.
Origin of Biopotentials: (i) Electrical activity of excitable cells, (ii) Volume conductor fields, (iii) Functional organisation of the peripheral nervous system, (iv) Electroneurogram, (v) Electromyogram, (vi) Electrocardiogram, (vii) Electroretinogram, (viii) Electroencephalogram, (ix) Magnetoencephalogram.
Biopotentials Electrodes: (i) Electrode-electrolyte interface, (ii) Polarisation, (iii) Polarisable and non-polarisable electrodes, (iv) Electrode behaviour, characterisation, and circuit models, (v) Electrode-skin interface, (vi) Body surface recording electrodes, (vii) Internal electrodes, (viii) Electrode arrays and micro electrodes, (ix) Electrodes for electric stimulation of tissue.
Biopotentials Amplifiers: (i) Requirements, (ii) Electrocardiography, (iii) Transient protection, (iv) Common-mode and interference reduction circuits, (v) Amplifiers for biopotential signals, (vi) Preamplification, (vii) Biopotential signal processors, cardiac monitors, and biotelemetry.
Blood Pressure: (i) Direct measurements, (ii) Harmonic analysis, (iii) Dynamic properties of pressure measurement systems, (iv) System response measurement, (v) Pressure waveform distortion, (vi) Measurement of venous pressure, (vii) Heart sounds, (viii) Phonocardiography and cardiac catheterisation, (ix) Indirect measurements of blood pressure.
Measurement of Flow and Volume of Blood: (i) Indicator-dilution method using continuous infusion or rapid injection, (ii) Electromagnetic and Ultrasonic flowmeters, (iii) Thermal convection velocity sensing, (iv) Chamber and Electrical Impedance Plethysmography, (v) Photoplethysmography.
Respiratory System: (i) Respiratory system and models, (ii) Measuring pressure and gas flow, (iii) Lung volume, (iv) Respiratory plethysmography, (v) Testing respiratory mechanics, (vi) Measuring gas concentration and testing gas transport.
Clinical Laboratory Instrumentation: (i) Spectrophotometry, (ii) Chemical analysers, (iii) Chromatology, (iv) Electrophoresis, (v) Hematology.
Therapeutic and Prosthetic Devices: (i) Cardiac pacemakers and electric stimulators, (ii) Defibrillators and cardioverters, (iii) Mechanical cardiovascular orthotic and prosthetic devices, (iv) Hemodialysis, (v) Lithotripsy.
Medical Device Implants: (i) Sensory and neurological, (ii) Cardiovascular, (iii) Orthopedic, (iv) Contraception, (v) Cosmetic, (vi) Other, gastrointestinal, respiratory, autoimmune, and urological systems.

Assessment Breakdown	%
Continuous Assessment	60.00%
Project	20.00%
Practical	20.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	Class Assessment.	1,2,3	30.00	Week 7
Examination	Class Assessment.	4,5	30.00	n/a

Project

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Project	Research Exercise	2,3,4	20.00	n/a

Practical

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Practical/Skills Evaluation	Lab Reports – Formative Assessments.	1,2,3,4,5	20.00	Week 14

No End of Module Formal Examination

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	Every Week	3.00
Laboratory	Every Week	2.00
Independent Learning	Every Week	3.00
	Total Hours	8.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_EEBEE_B	Bachelor of Engineering (Honours) in Biomedical Electronics	4	Mandatory
CW_EEBEE_D	Bachelor of Engineering in Biomedical Electronics	4	Mandatory