Module Code	**EEU22E06**
Module Name	Electronics
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Dr Justin King (Section A) Dr Friedrich Wetterling (Section B)
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students will be able to LO 1) Analyse circuits with dynamic elements [PO1(i,ii), PO2(ii,iii)] LO 2) Design circuits with a specific frequency response [PO4(ii)] LO 3) Analyse and design circuits with nonlinear elements [PO1(ii), PO2(ii)] LO 4) Classify analogue signals and quantify signal parameters [PO1(iii), PO4(i, ii)] LO 5) Analyse and design electronic circuits for biomedical applications [PO1(iv), PO3(ii, iii), PO4(iii)] **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Attained To develop continuously - Enhanced To communicate effectively - Introduced
Module Content	**Section A** Up to this point, students will have learned simple yet powerful techniques to analyse basic circuits. The term 'basic' is used here to denote circuits that consist of only ideal power sources i.e. voltage and current sources, and ideal linear resistors. Such circuits are completely described by linear algebraic equations. Therefore, all voltages and currents in the circuit are scaled replicas of the input signal; if the input is doubled, all other voltages and currents are likewise doubled. Such circuits are of limited practical use. This module introduces dynamic elements, namely the capacitor and inductor. These elements can change the shape of the input waveform, providing for more complicated outputs and hence more useful functionalities. For example, energy storage is now possible, as are oscillations – a fundamental requirement for circuits that are used in wireless data transmission.

[1] TEP Glossary

Frequency response is introduced, allowing the analysis of circuits that may be used to filter out unwanted signals, leaving only the signal of interest.

Section B
This section aims to introduce non-linear circuit elements such as the diode and the operational amplifier. Practical rule-based models, such as the piecewise linear diode models, are covered, and their limitations. The use of these nonlinear circuits is explained using the example of ultrasound transducers, wireless sensor technology, and Magnetic Resonance Imaging (MRI) sensors.

Listing of course content

----- Section A -----

1. Introduction to dynamic circuit elements
    - Introduction to the capacitor and inductor
    - Energy storage

2. Transient analysis
    - Transient response of first order linear circuits
    - Transient and steady-state response

3. Introduction to phasor analysis
    - Complex numbers and sinusoids
    - Phasor analysis and impedance
    - Applications of phasor analysis

4. Power in the sinusoidal steady-state
    - Derivation of power under sinusoidal conditions
    - Maximum power transfer
    - Power factor correction

5. Frequency response and filters
    - Frequency response and transfer functions
    - Graphical transfer functions interpretation
    - Electronic filters

----- Section B -----

6. Introduction to circuits containing nonlinear elements
    - Examples of circuits that cannot be solved via elementary functions; numerical solutions; graphical solutions.
    - Piecewise linear models for diodes; analysis techniques.

	• Analysis and classification of analogue electrical signals • Deterministic vs information-bearing; energy vs power; periodicity • Calculation of energy, power, rms and dc quantities 7. The operational amplifier • Ideal amplifier versus practical amplifier; input and output resistance; gain; decibels; voltage-controlled voltage source. • Ideal op amps operating in the linear region; simplified analysis technique; nonlinear operation; comparator. • Example op amps circuits: buffer; inverting / noninverting amplifiers; summing amplifier; difference amplifier; instrumentation amplifier; Schmitt trigger 8. Electronic circuits used in biomedical systems • Obtaining useful information and signals from sensors using analogue circuits; shape modulation; amplification; filtering; • Circuits used in biomedical systems to interrogate implantable sensors
Teaching and Learning Methods	This module will be taught via lectures, laboratory sessions, and weekly tutorial and/or weekly office hours sessions. Homework sessions provide students with regular feedback.
Assessment Details[2] **Please include the following:** • **Assessment Component** • **Assessment description** • **Learning Outcome(s) addressed** • **% of total** • **Assessment due date**	(see table below)

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Section A (50% of total grade)				
Homework	Blackboard (Numerical)	1,2	10	Weeks 1 – 6
Laboratory A	Practical	1	10	See schedule
Mid-Section Exam	Blackboard (MCQ)	1	10	Week 4
End-of-Term Exam	Written Exam (MCQ)	1,2	20	Semester 1 Exam Session
Section B (50% of total grade)				
Laboratory B	Practical	3	10	See schedule
End-of-Term Exam	Written Exam	3,4,5	40	Semester 1 Exam Session

[2] TEP Guidelines on Workload and Assessment

Reassessment Requirements	Exam (100 %)
Contact Hours and Indicative Student Workload[2]	**Contact hours:** The component breakdown is approximately: • 3 hours/week lectures (total of 33 hours) • 1-hour tutorials (total of 4 hours) • 2 x 2-hour labs (total of 4 hours) • 6 x 1-hour office hours (total of 6 hours) **Independent Study (preparation for course and review of materials):** 20 **Independent Study (preparation for assessment, incl. completion of assessment):** 50
Recommended Reading List	**Section A (any of the following):** A. R. Hambley, *Electrical Engineering: Principles & Applications*, 7th Edition, Pearson, 2018. J. W. Nilson and S. Riedel, Electric Circuits, Pearson, 10th Edition, 2019. G. Rizzoni and J. Kearns, *Principles and Applications of Electrical Engineering*, 6th ed., McGraw-Hill, 2015. **Section B:** A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th edition, Oxford University Press, 2014
Module Pre-requisite	1E6 Electronics or equivalent (KVL, KCL, Voltage/Current Sources, Power, Resistive Circuits including voltage/current dividers, Thévenin’s and Norton’s Theorem, Maximum Power Transfer).
Module Co-requisite	None
Module Website	Blackboard
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No
Module Approval Date	
Approved by	Prof. Naomi Harte
Academic Start Year	September 2025

Academic Year of Date	2025/2026