Module Code	**EEU22E06**
Module Name	Electronics
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof. Justin King (Section A) Prof. Shreejith Shanker (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: Understand the importance and use of dynamic circuit elements and their distinction from resistive elements LO 2: Obtain the transient response of linear circuits excited by switched DC sources. LO 3: Analyse linear circuits excited by sinusoidal voltages LO 4: Understand the concept of power in the sinusoidal steady-state LO 5: Analyse circuits contain ideal transformers LO 6: Analyse basic filter circuits and determine their transfer functions and qualitative behaviour LO 7: Calculate key electrical quantities and use them to classify analogue electrical signals. LO 8: Diagnose nonlinearity in electrical systems, and linearize such systems using the small-signal condition. LO 9: Analyse the input-output behaviour of ideal and real diodes in various regimes and circuits, notably in rectifier circuits. LO 10: Design and characterize linear amplifier circuits and cascades, taking into account their non-ideal input and output behaviours, and meeting practical gain (decibel) and buffering specifications. LO 11: Configure ideal and near-ideal operational amplifiers (op-amps) for tasks in analogue computing. LO 12: Design electronic circuits to meet ideal analogue-digital conversion specifications.

[1] TEP Glossary

Graduate Attributes: levels of attainment
To act responsibly - Enhanced
To think independently - Enhanced
To develop continuously - Enhanced
To communicate effectively - Introduced

Module Content

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 have the ability to 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.

Frequency response is introduced - a very important concept that shows how circuits can be used to filter out unwanted signals, leaving only the signal of interest (consider the task of filtering out the thousands of unwanted phone conversations from the myriad of signals transmitted across the airwaves, leaving only the desired conversation signal).

Nonlinear components add even more types of behaviour allowing applications such as ac to dc conversion. Unfortunately, the powerful analysis methods of linear algebra are no longer applicable - methods to deal with this issue are introduced.
The important task of amplification - to ensure those aforementioned phone conversations can reach their destination - is also introduced.

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

5. Frequency Response and Filters
   - Frequency response and transfer functions
   - Graphical transfer functions interpretation
   - Electronic Filters

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

1. Analysis and classification of analogue electrical signals
   - Deterministic vs information-bearing; energy vs power; periodicity
   - Calculation of energy, power, rms and dc quantities

2. Introduction to classification and analysis of analogue electrical systems:
   - Memorylessness, nonlinearity
   - Small-signal excitation and linearization
   - Ideal vs real diodes, and applications in rectification

3. The linear amplifier
   - Modelling via voltage- controlled voltage source

- The decibel unit of gain
- Accumulation of gain via cascades
- Buffering

4. Operational amplifiers (op-amps)
   - The ideal op-amp in open-loop and closed-loop configurations
   - The inverting, non-inverting, summing, differencing configurations
   - The integrating and differentiating configurations
   - Analysis of near-ideal (i.e. finite open-loop gain) op-amp circuits
   - Introductory application in analogue-digital conversion (ADC)

Teaching and Learning Methods

For 2021/2022, this module will be taught via online lectures, with face to face laboratory sessions, and weekly online tutorial sessions.

There are homework sessions to 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**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Section A (50% of total grade)				
Online Term Test 1	Blackboard MCQs	1, 2	15	Week 10/11
Online Term Test 2	Blackboard MCQs	3, 4 and 5	15	Week 10/11
Homework	Blackboard Qs	1 – 5	10	Weeks 8-11
Laboratory A	In-person labs	2	10	See schedule
Section B (50% of total grade)				
Online Term Test 3	Blackboard MCQs	6 – 11	20	Week 6
End of Term Test	In-person exams	6 – 11	20	End-of-term
Laboratory B	In-person labs	10	10	See schedule

[2] TEP Guidelines on Workload and Assessment

Reassessment Requirements	In-person Exam (100 %)
Contact Hours and Indicative Student Workload[2]	**Contact hours:** This module will be taught online for the 2021/2022 academic year. The component breakdown is approximately: • 3 hours/week online video lectures (total of 33 hours) • 8 x 1-hour online tutorials (total of 8 hours) • 2 x 2-hour in-person labs (total of 4 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 Alan V. Oppenheim, Alan S. Willsky, Signals and Systems, Prentice Hall, 2nd Ed.
Module Pre-requisite	1E6 Electronics or equivalent
Module Co-requisite	None
Module Website	See Blackboard
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No
Module Approval Date	

Approved by	
Academic Start Year	13 September 2021
Academic Year of Date	2021/2022