**EEU22E06 Electronics (2E6) [5 credits]**

**Lecturer(s):**  
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**Module organization**  
The module runs for the first twelve-week (Michaelmas) term of the twenty-four week academic teaching year, and comprises three lectures and one tutorial every week. There are two two-hour scheduled laboratory sessions during the twelve weeks, so that the total number of contact hours is forty-eight.

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<tr>
<th>Engineering Term</th>
<th>Start Week</th>
<th>Lectures</th>
<th>Tutorials</th>
<th>Total Contact Hours: 48</th>
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**Module description, aims and contribution to programme**  
2E6 Electronics is taken during the first term by the full complement of Senior Freshman BAI students and comprises a signals-and-systems-oriented foundation in the principles of analogue electronics suitable for students intending to follow any of the sophister engineering streams.

The first half of the module focuses on the analysis of circuits excited by sinusoidal voltages and currents. The phasor analysis method is introduced along with the related concept of impedance. AC circuit analysis methods are used to study the frequency response of electric circuits. This section ends with a discussion of complex power and power factor correction.

In the second half of the module, fundamental characterizations of analogue signals and systems are studied. System nonlinearity is introduced, as is linearization via small-signal analysis, with the diode providing a particular focus. Linear amplifiers and their cascades are introduced, as is the ideal operational amplifier (op-amp). The key op-amp configurations are covered, and the student is introduced to the effects of non-ideal performance characteristics such as finite open-loop gain. The relevance of all these principles and methods in practical electronic design – such as in rectification, buffering, analogue-digital conversion and analogue computing – is mentioned throughout.
Learning outcomes

On completion of this module the student will be able to:

1. Analyse linear circuits excited by sinusoidal voltages.
2. Obtain the transient response of linear circuits excited by switched DC sources.
3. Obtain the sinusoidal frequency response of an electric circuit.
4. Correct the power factor of an inductive load.
5. Understand the basic principles of operation of DC motors and generators.
6. Calculate key electrical quantities and use them to classify analogue electrical signals.
7. Diagnose nonlinearity in electrical systems, and linearize such systems using the small-signal condition.
8. Analyze the input-output behaviour of ideal and real diodes in various regimes and circuits, notably in rectifier circuits.
9. 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.
10. Configure ideal and near-ideal operational amplifiers (op-amps) for tasks in analogue computing.

Module content

1. AC Network Analysis
   - Circuits excited by sinusoidal voltages
   - Phasor analysis
   - Electrical impedance
   - Analysis of electric filters

2. Transient Analysis
   - Transient response of linear circuits excited by switched DC sources

3. AC Power
   - AC average and complex power
   - Power factor correction

4. DC Motors and Generators
   - Analyse DC generators at steady state
   - Analyse DC motors under steady state and dynamic operation
5. Analysis and classification of analogue electrical signals:
   • Deterministic vs information-bearing; energy vs power; periodicity, etc.
   • Calculation of energy, power, rms and dc quantities

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

7. The linear amplifier:
   • Modelling via input and output voltage division and a voltage-controlled voltage source
   • The decibel unit of gain
   • Accumulation of gain via cascades
   • Buffering

8. Operational amplifiers (op-amps):
   • The ideal op-amp in open-loop and closed-loop configurations
   • The inverting, non-inverting, summing, differentiating, 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 strategies**
The module is taught using a combination of lectures, tutorials and two laboratories.

**Assessment**
70% of the assessment of 2E6 is derived from a two-hour examination held at the end of the Term. 10% of the marks are derived from the laboratory programme, and 10% from each of the two in-class tests which will take place during the Term.

**Recommended textbooks**


**Further information**