EE 2E06 Electronics [5 credits]

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Module organisation
The module runs for the first twelve-week term of the twenty-four week academic 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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<th>Engineering Term</th>
<th>Start Week</th>
<th>Hours of Associated Practical Sessions</th>
<th>End Week</th>
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Total Contact Hours: 48

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 module covers the basic characterization of analogue signals and systems. The analysis of linear circuits driven by ideal and real sources is covered. Frequency selectivity in RC-circuits is studied, with characterization based on Bode plots. Amplifiers are introduced, in particular the ideal operational amplifier. Basic op-amp applications are covered and the student is introduced to the effects of non-ideal performance characteristics such as finite open loop gain. The basic characterization and implementation of circuits for analogue-digital conversion are covered.

The module is intended to give students an understanding of the information-bearing nature of analogue signals and the concept of the electronic circuit as a signal processing system with particular reference to the information content. The idea of modelling amplifier functionality by means of a controlled voltage source together with input and output resistance is treated, and many practical examples are given. The ideal operational amplifier is selected as an illustrative electronic subsystem of considerable application importance. The methodology for analysing a linear application circuit is regarded as a major objective of the course.
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. Compute the power factor of a complex load;
5. Understand the basic principles of operation of DC motors and generators;
6. Distinguish between ideal and real amplifier performance;
7. Calculate the closed loop gain and carry out design manipulations for basic ideal op-amp applications;
8. Quantify the effects of key op-amp non-idealities on the performance of op-amp circuits;
9. Characterize the input-output behaviour of analogue-digital conversion systems;
10. Design electronic circuits to meet ideal analogue-digital conversion specifications.

Module content
1. AC Network Analysis
   - Time-dependent signal sources
   - Circuits excited by sinusoidal voltages
   - Phasor analysis
   - Electrical impedance
   - Analysis of electric filters
   - Bode plots

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

3. AC Power
   - AC average and complex power
   - Power factor correction
   - Ideal transformer
   - Maximum power transfer

4. DC Motors and Generators
   - Analyse DC generators at steady state
   - Analyse DC motors under steady state and dynamic operation
5. Amplifiers and their equivalent circuits
   - Equivalent circuit of ideal and real amplifiers
   - Cascades of amplifiers

6. Operational amplifiers (op-amps)
   - The ideal op-amp
   - The inverting, non-inverting, differential, and integrating configurations
   - Effect of finite open-loop gain and input resistance

7. Introduction to analogue-digital conversion
   - Input-output characterization of analogue-digital conversion systems
   - Introduction to electrical circuit implementations of ADCs and DACs

**Teaching strategies**
The module is taught using a combination of lectures, tutorials and two associated laboratories.

**Assessment**
70% of the assessment of 2E6 is derived from a two-hour examination held at the end of the academic year. 10% of the marks are derived from the laboratory programme, and 10% each from a mid-term test and an end-of-term test.

**Required textbook**


**Further information**