1E6 (EE1E06) ELECTRICAL ENGINEERING [5 credits]

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Module organisation
The module runs for Semester 2 of the academic year and comprises of three lectures plus a one-hour tutorial per week together with two two-hour laboratories (total contact time of 48 hours).

Module description, aims and contribution to programme
This is a one semester module which intends to impart a basic understanding of the concepts and laws of electricity and magnetism, and concepts in combinational logic to Junior Freshman Engineering students. Fundamental laws will be established from physical principles and then used to define the nature of primitive circuit elements. Elementary DC and transient circuit analysis will be carried out using these elements. The interaction of electricity and magnetism and the basic operating principles of such components as solenoids, relays, motors, and generators will be introduced, with illustrations of their use in everyday applications. The module also introduces the foundational concepts of the digital signal and system, and progresses through standard combinational logic design, with particular reference to arithmetic processing. Complexity, speed and power consumption are considered as the main parameters of system performance.

Learning outcomes
Upon completion of this module, students will be able to:
1. explain the fundamental concepts of electricity and magnetism and their importance;
2. apply fundamental circuit theory and laws to dc resistive circuits;
3. analyse the operation of simple circuits in RC and RL combinations;
4. outline the construction and mechanism of operation of the DC motor and generator.
5. convert between binary and decimal representations and carry out binary addition, subtraction and multiplication;
6. manipulate Boolean expressions so as to minimise the number of literals using algebra or Karnaugh maps;
7. design standard and iterative combinational logic circuits;
8. evaluate the complexity and speed of combinational designs;
Module content

**Simple DC circuits**
- Resistors in series and parallel; Kirchhoff’s voltage and current laws; power dissipation; the ideal voltage source and current source; maximum power transfer; the ideal capacitor, permittivity; the multi-plate capacitor, variable capacitor; capacitor charging and discharging, current-voltage relationship, time-constant, rise-time, fall-time; inductor energisation and de-energisation, inductance current-voltage relationship, time-constant

**Electromagnetism**
- Electromagnetic induction, Fundamental relations, Faraday’s law, Lenz’s Law, simple applications: solenoids and relays

**Motors and Generators**
- The simple DC motor, construction, energy transfer, applications, the simple DC generator, reversal of energy transfer, emf-speed relationship, applications

**Digital Systems and Binary Numbers**
- Digital signals and systems
- Number systems
- Positive/negative representation
- Binary arithmetic

**Boolean Algebra**
- Definitions and basic theorems
- Algebraic simplification
- Sum of products and product of sums formulations
- Gate primitives
- Karnaugh maps

**Combinational Logic**
- Combinational design
- Assessment of complexity and speed
- Code converters, multiplexors, decoders
- Addition circuits, priority encoder

**Teaching strategies**
The module is taught using a combination of lectures, tutorials and two supporting laboratories. The tutorials will develop students problem-solving skills by tackling problems based on the lecture material.

**Associated laboratory/project programme**
- Lab 1 TBA
- Lab 2 TBA
Assessment
The formal written end-of-year two-hour examination will contribute 80% and the continuous assessment with quizzes and laboratory work will contribute 20% of the overall module mark at the Annual Examination. For the Supplemental (Repeat) Examination, in August, the mark is based solely on a written two-hour examination.

Recommended textbook

Further information