Electronics (ELEC) Courses

ELEC 1908 [0.5 credit]
First Year Project
A practical introduction to engineering design. Students work in small teams to specify, design and implement a system, formally managing the project progress and submitting oral and written reports. Professionalism: engineering ethics; health and safety. Technology, society and the environment.
Prerequisite(s): registration in the Engineering Physics program.
Lectures and tutorials three hours a week, laboratory four hours a week.

ELEC 2501 [0.5 credit]
Circuits and Signals
Prerequisite(s): MATH 1005 and (PHYS 1004 or PHYS 1002).
Lectures three hours a week, laboratory and problem analysis three hours a week.

ELEC 2507 [0.5 credit]
Electronics I
Qualitative semiconductor physics, leading to the diode equation. Diode applications. Operational amplifiers and their application in feedback configurations including active filters. Introduction to bipolar transistors and MOSFETs, analysis of biasing circuits. Transistor applications including small signal amplifiers. Precludes additional credit for PLT 2006.
Prerequisite(s): ELEC 2501.
Lectures three hours a week, laboratory and problem analysis three hours a week.

ELEC 2607 [0.5 credit]
Switching Circuits
Precludes additional credit for SYSC 2310.
Prerequisite(s): PHYS 1004 or PHYS 1002.
Lectures three hours a week, laboratory three hours alternate weeks.

ELEC 3105 [0.5 credit]
Basic EM and Power Engineering
Prerequisite(s): MATH 2004 and (PHYS 1004 or PHYS 1002).
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

ELEC 3500 [0.5 credit]
Digital Electronics
Digital circuit design using verilog and logic synthesis, the electronic properties of logic gates, electrical interfacing between logic families, asynchronous to synchronous interfacing, clock distribution and timing, VLSI design options. Students implement substantial circuits with field-programmable gate arrays.
Prerequisite(s): ELEC 2507 and ELEC 2607.
Lectures three hours a week, laboratory three hours a week.

ELEC 3508 [0.5 credit]
Power Electronics
Power transformers. DC and AC motors. Power semiconductor devices: Thyristors, Triacs, MCTs, IGBTs). Converter circuits: controlled AC to DC rectifiers, choppers, DC to AC inverters, AC voltage controllers, cycloconverters. Protection of conversion circuits. Applications to high-efficiency control of electric machines and electromechanical energy conversion devices.
Prerequisite(s): ELEC 2501 and ELEC 2507.
Lectures three hours per week, laboratories/problem analysis three hours per week.

ELEC 3509 [0.5 credit]
Electronics II
Introduction to semiconductor devices and ICs. DC, AC and switching properties of BJTs. Linear amplifiers; bandwidth considerations; two-port analysis. Large signal amplifiers; power amplifiers; transformerless circuits. Feedback and operational amplifiers; gain, sensitivity, distortion and stability. Filter design. Oscillators.
Precludes additional credit for : ELEC 3509 may not be taken for credit by students in the Biomedical and Electrical Engineering or Biomedical and Mechanical Engineering programs.
Prerequisite(s): ELEC 2507.
Lectures three hours a week, laboratory three hours a week.
ELEC 3605 [0.5 credit]
Electrical Engineering
DC circuits: elements, sources, analysis. Single phase AC circuits: phasors, RLC circuits, real and reactive power, impedance, network analysis, three phase systems. Power transformers. DC motors: operation and characteristics. AC motors: single phase and three phase. Precludes additional credit for ELEC 2501. Prerequisite(s): MATH 1005 and (PHYS 1004 or PHYS 1002). Lectures three hours a week, problem analysis 1.5 hours a week.

ELEC 3907 [0.5 credit]
Engineering Project
Student teams work on open-ended projects based on previously acquired knowledge. Lectures are devoted to discussing project-related issues and student presentations. A project proposal, a series of project reports, and oral presentations, and a comprehensive final report are required. Prerequisite(s): ELEC 2607, ELEC 2507, and ECOR 2606, and enrolment in the Electrical Engineering program. Lecture two hours per week, laboratory six hours per week.

ELEC 3908 [0.5 credit]
Physical Electronics
Fundamentals of device physics and operation of the pn junction, bipolar transistor and MOSFET. Basic integrated circuit processing and application to diodes, BJTs and MOSFETs. Correlation between processing, structure, operation and modeling. Consideration of parasitic and small-geometry effects, reliability and process variation. Precludes additional credit for ELEC 4705. Prerequisite(s): ELEC 2507. Lectures three hours a week, problem analysis two hours a week.

ELEC 3909 [0.5 credit]
Electromagnetic Waves
Maxwell's equations and EM wave solutions. Polarization. Poynting vector. EM waves in dielectrics and conductors; skin depth. Reflection and refraction. Standing waves. Fresnel relations, Brewster angle. Transmission lines. Line termination, basic impedance matching and transformation. Smith charts. Introduction to guided waves; slab waveguide. Precludes additional credit for PHYS 3308. Prerequisite(s): ELEC 3105 or permission of the Department. Lectures three hours a week, problem analysis three hours alternate weeks.

ELEC 3999 [0.0 credit]
Co-operative Work Term

ELEC 4502 [0.5 credit]
Microwave Circuits
Introduction to microwave semiconductor devices, microwave passive components, microwave integrated circuit technology, and microwave circuit measurements. Basic network theory and scattering matrix description of circuits. Design of matching networks, filters, amplifiers and oscillators at microwave frequencies. Prerequisite(s): ELEC 4503; may be taken concurrently. Lectures three hours a week, laboratory three hours alternate weeks.

ELEC 4503 [0.5 credit]
Radio Frequency Lines and Antennas
Introduction to distributed circuits, travelling and standing waves, reflection coefficient, SWR, impedance transformation, Smith charts. Introduction to transmission lines; coaxial, rectangular waveguide, resonators, optical fibers. Introduction to antennas; gain, directivity, effective area. Introduction to linear arrays. Prerequisite(s): ELEC 3909. Lectures three hours a week, laboratory three hours alternate weeks.

ELEC 4504 [0.5 credit]
Avionics Systems

ELEC 4505 [0.5 credit]
Telecommunication Circuits
A course of study of the commonly used circuit components in modern telecommunication systems. Both analog and digital systems are included. The design of the hardware is emphasized. Examples are drawn from broadcasting, telephony and satellite systems. Prerequisite(s): ELEC 3509 and (SYSC 3501 or SYSC 3503). Lectures three hours a week, laboratory three hours alternate weeks.
ELEC 4506 [0.5 credit]
Computer-Aided Design of Circuits and Systems
Prerequisite(s): fourth-year status in Engineering.
Lectures three hours a week, laboratory three hours alternate weeks.

ELEC 4509 [0.5 credit]
Communication Links
Fundamentals; decibel, intermodulation, 1dB compression, dynamic range, SNR, noise figure, noise temperature, antenna gain, EIRP, G/T. Line-of-sight links; receiver, diversity, fade margin. Satellite links; link calculations, multiple accessing, earth stations. Fiber links, fiber types, sources, detectors, systems.
Prerequisite(s): fourth-year status in Engineering or permission of the Department.
Lectures three hours a week, problem analysis three hours alternate weeks.

ELEC 4600 [0.5 credit]
Radar and Navigation
Prerequisite(s): fourth-year status in Engineering or permission of the Department.
Lectures three hours a week, problem analysis 3 hours alternate weeks.

ELEC 4601 [0.5 credit]
Microprocessor Systems
Interfacing aspects in microprocessor systems. Microprocessors and bus structures, internal architecture, instruction set and pin functions. Memory interfacing, input-output, interrupts, direct memory accesses, special processors and multiprocessor systems.
Precludes additional credit for COMP 3006, SYSC 3320, SYSC 3601.
Prerequisite(s): ELEC 2607 and one of SYSC 2003 or SYSC 3003 or SYSC 3006 or permission of the Department.
Lectures three hours a week, laboratory three hours alternate weeks.

ELEC 4602 [0.5 credit]
Electrical Power Engineering
Prerequisite(s): ELEC 2501 or ELEC 3605.
Lectures three hours a week, problem analysis two hours every week.

ELEC 4609 [0.5 credit]
Integrated Circuit Design and Fabrication
Introduction to nMOS IC design: static logic gates, noise margin, transmission gates, factors influencing switching speed, dynamic logic, input protection, output buffers, circuit simulation with SPICE. Laboratory work includes design and layout of a simple nMOS IC that is fabricated and returned for testing.
Prerequisite(s): ELEC 3500 or ELEC 3908.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

ELEC 4700 [0.5 credit]
The Physics and Modeling of Advanced Devices and Technologies
Prerequisite(s): ELEC 3908.
Lectures three hours a week, problem analysis two hours alternate weeks.

ELEC 4702 [0.5 credit]
Fiber Optic Communications
Prerequisite(s): ELEC 3908 and ELEC 3909.
Lectures three hours a week, laboratory three hours alternate weeks.
**ELEC 4703 [0.5 credit]**

**Solar Cells**
Prerequisite(s): ELEC 2501 and ELEC 2507 and fourth-year status in Sustainable and Renewable Energy Engineering, or ELEC 2501 and ELEC 2507 and fourth-year status in Engineering with permission of the instructor.
Lectures three hours per week, laboratories/problem analysis three hours alternate weeks.

**ELEC 4704 [0.5 credit]**

**Nanoscale Technology and Devices**
Prerequisite(s): ELEC 3908.
Lectures three hours a week, problem analysis 1.5 hours a week.

**ELEC 4705 [0.5 credit]**

**Electronic Materials, Devices and Transmission Media**
Review of solid-state theory, conductors, semiconductors, superconductors, insulators, and optical and magnetic properties. Devices used in modern high speed electronic and communication systems: transistors, lasers, photodiodes, fiber optics, Josephson junctions. Implications of material properties on fabrication and operation of devices and circuits.
Precludes additional credit for ELEC 3908.
Prerequisite(s): fourth-year status in Engineering. Not available for credit to students in Electrical Engineering or Engineering Physics.
Lectures three hours a week.

**ELEC 4706 [0.5 credit]**

**Digital Integrated Electronics**
Lectures and hands-on experience introduce advanced concepts in digital interfacing and hardware simulation. Industry standard programmable ASIC design tools, interfacing techniques and System on a Chip are introduced along with hardware modeling and design flow. A modern laboratory includes software and hardware digital design tools.
Prerequisite(s): ELEC 3500.
Lectures two hours a week, laboratory three hours a week.

**ELEC 4707 [0.5 credit]**

**Analog Integrated Electronics**
Prerequisite(s): ELEC 3509.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

**ELEC 4708 [0.5 credit]**

**Advanced Digital Integrated Circuit Design**
Advanced Verilog, test benches. VLSI design based on CMOS technology, characteristics of CMOS logic circuits, cell libraries, building blocks, structured design, testing, Computer-Aided Design tools. Laboratory emphasis on design synthesis from Verilog.
Prerequisite(s): fourth-year status in Engineering and ELEC 3500) or permission of the department.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

**ELEC 4709 [0.5 credit]**

**Integrated Sensors**
Overview of sensor technologies with emphasis on devices suitable for integration with silicon integrated circuits. Sensor design and fabrication principles including signal conditioning; discussion of automotive, biomedical, and other instrumentation applications.
Prerequisite(s): fourth-year status in Engineering.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

**ELEC 4906 [0.5 credit]**

**Special Topics**
At the discretion of the Engineering Faculty Board, a course dealing with selected advanced topics of interest to students in Biomedical and Electrical, Communications, Computer Systems, Electrical and Software Engineering and Engineering Physics may be offered.
Prerequisite(s): fourth-year status in Engineering.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

**ELEC 4907 [1.0 credit]**

**Engineering Project**
Student teams develop professional-level experience by applying, honing, integrating, and extending previously acquired knowledge in a major design project. Lectures are devoted to discussing project-related issues and student presentations. A project proposal, interim report, oral presentations, and a comprehensive final report are required.
Prerequisite(s): ELEC 3907, ECOR 4995 (may be taken concurrently) and fourth-year status in Engineering.
Lecture one hour a week, ECOR 4995 seven hours a week.
ELEC 4908 [1.0 credit]
Engineering Physics Project
Student teams develop professional-level experience by applying, honing, integrating, and extending previously acquired knowledge in a major design project approved for Engineering Physics. Lectures devoted to discussing project-related issues and student presentations. A project proposal, interim report, oral presentations, and comprehensive final report are required.
Prerequisite(s): fourth-year status in Engineering and ECOR 4995 (may be taken concurrently). Certain projects may have additional prerequisites or corequisites.
Lecture one hour a week, laboratory seven hours a week.

Summer session: some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at central.carleton.ca

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at central.carleton.ca