Engineering Physics: From Nano-Electronics and Photonics to Renewable Energy

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Questions are welcome!
OUTLINE

• Introduction to Engineering Physics (EE)

• What do they do?

• What are the programs and how do we fit?

• Nano-technology
B.Eng. In Engineering Physics

• A fundamental education which is suitable for our rapidly-changing technological world

• Focus on the physics of optics, photonics and integrated circuits, which are fundamental to the infrastructure of modern society

• Careers in research and development
  • From pure physics to pure engineering.
B.Eng. In Electrical Engineering

• Broad field that provides graduates with a great deal of flexibility

• Our program generally reflects the technology-driven industry in the Ottawa area

• With a wide range of elective courses in integrated circuit design and fabrication, telecommunications systems, and computer hardware and software.
Electrical Engineering What does it do?

Analysis and design of systems, circuits and devices used to transmit, store, and process information/energy.

Hardware ➔ Software
ECE Programs – Carleton

The Hardware-Software Spectrum

Lead Department
Department of Electronics

The Programs
Engineering Physics
Electrical Engineering

Department of System and Computer Engineering
Computer Systems Engineering
Software Engineering

New
Sustainable and Renewable Energy Engineering

Communications Engineering
Biomedical and Electrical Engineering
Hierarchal Design – From small to big

System-level Design

Circuit-level Design

Device-level design

Software
From Idea to Reality

Design

Fabricate

Test
Technological Revolutions

- Electrical Engineers have been at the heart of a number of revolutions in technology.
- These paradigm shifts have radically changed the way Society functions.
- Two examples:
  - Electronic/communications 1950-1990
  - The Internet 1990-Now
A Paradigm Shift like the Internet

Pre-1980s

Centralized Mainframes

Paradigm Shift

Internet

Distributed Computing
- Shipping 250M pcs/yr.
- Ubiquitous ownership
- Ubiquitous use
- Ubiquitous sharing

Innovation & Industry Transformation

eBay
Google
YouTube
Nano Technology

nano- (nan'oh)

pref.
1. <unit> A prefix.
2. Used loosely to mean “extremely small”, e.g. nanotechnology.
3. One-billionth (10⁻⁹): nanosecond.
   [Greek nanos, nannos, little old man, dwarf, from nannas, uncle.]

tech·nol·o·gy (tech*nol'o*gy)
n. pl. tech·nol·o·gies

1. The application of science, especially to industrial or commercial objectives.
2. The scientific method and material used to achieve a commercial or industrial objective.
3. Electronic or digital products and systems considered as a group: a store specializing in office technology.
4. Anthropology. The body of knowledge available to a society that is of use in fashioning implements, practicing manual arts and skills, and extracting or collecting materials.
   [Greek tekhnologia, systematic treatment of an art or craft: tekne, skill; see teks- in Indo-European Roots + -logia, -logy.]
We already do it!
OR Something just as good!

Micromachines *NOT* Nanomachines
But this really is nano

Some IBM Molecular Manipulation

Carbon Monoxide Man
Carbon Monoxide on Platinum (111)

The Beginning
Xenon on Nickel (110)

Atom
Iron on Copper (111)
Photonic (light) and Nano
What can it do?

• Better communications
• More efficient solar cells
• Faster computers – artificial intelligence
• Stronger lighter materials
• Bio/medical engineering

• Who knows!