Photonics and Electro-Optical Engineering

The science and technology of light. Photonics encompasses the generation of light, the detection of light, the management of light through guidance, manipulation, and amplification, and most importantly, the utilization of light as a tool for the benefit of mankind.

Electro-optics
(interaction between light and electrical fields)

Subfields:
Biomedical Optics
Remote Sensing
Nanophotonics
Photonics for Energy
Neurophotonics

Optoelectronics
(study and application of electronic devices that source, detect, and control light)

Quantum optics

Lightwave technology
Photonics and Electro-Optical Engineering

Photonics is an enabling technology\(^1\) with general-purpose characteristics applications in:
- Communications, information processing and data storage
- Health and medicine
- Energy
- Defense and homeland security
- Advanced manufacturing
- Advanced metrology

\(^1\) enabling general-purpose technology – technology that advances foster innovations across a broad spectrum of applications in a diverse array of economic sectors. Other examples of general-purpose enabling technologies are the transistor and the integrated circuit.
Photonics engineering – an enabling technology

Not always seen but it is ubiquitous.
Consider for example using a smartphone to perform an Internet search. Where is the optics?

High resolution display

Microprocessor fabricated using optical lithographic techniques

Chips inspected with photonics techniques

more than 1 million lasers involved in the data signaling 20 km of fibers

Efficient Flash light

cell tower

fiber optic network

Data center
The term of **photonics** was coined in analogy with **electronics**:  
- Electronics involves the control of electric-charge flow (in vacuum or matter);  
- Photonics involves the control of photons (in free space and matter)

It is expected that the 21st century will depend as much on photonics as the 20th century depended on electronics\(^1\).

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Photonics—the enabling technology of the 21st century

- **Immersive reality**
- **Memory storage**: Hundreds of TB memory on cm² with unlimited lifetime
- **Solar energy harvesting**