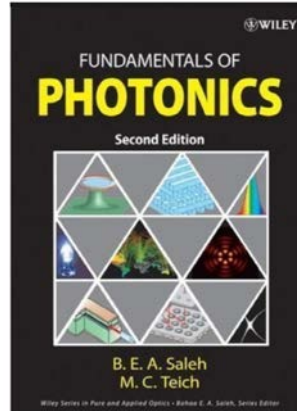
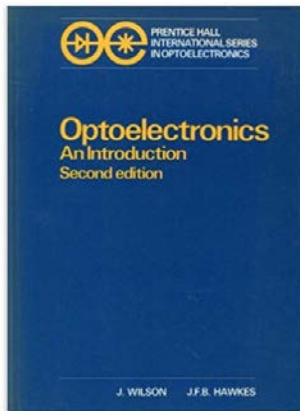
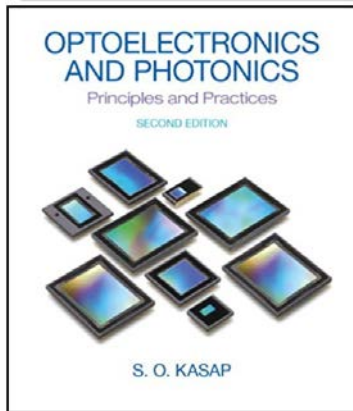


Optoelectronics-I

Assoc. Prof. Dr. Isa NAVRUZ

Lecture Notes - 2018

Recommended books



Department of Electrical and Electronics
Engineering, Ankara University
Golbasi, ANKARA

Optoelectronics-I

CONTENT

Week-1: Introduction to Optoelectronics

Week-2: Fundamentals of Optics

Week-3: Wave Nature of Light

Week-4: Light Propagation in the Free Space

Week-5: Light Propagation in the Material

Week-6: Polarization Optics

Week-7: Reflection and Refraction

Week-8: Reflection and Refraction-2

Optoelectronics-I

CONTENT

Week-9: Tutorial-1

Week-10: Tutorial-2

Week-11: Interference & Diffraction

Week-12: Optical Resonators Interferometers

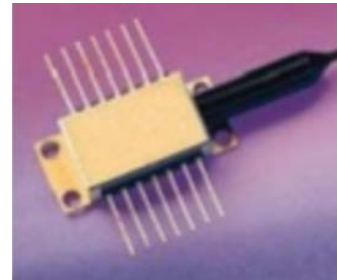
Week-13: Radiometry and Photometry

Week-14: Tutorial-3

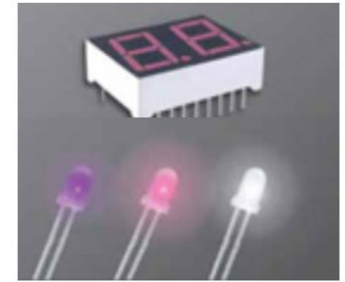
What is the meaning of “Optoelectronics”

Optoelectronics is a word combining optics and electronics. In the literature, "optronics" and "electro-optics" are used in the same meaning.

This term covers broad concepts involving light emitting devices and elements, information displays, image pickup devices, optical storages, optical communications, remote sensing systems.



Telecommunication laser

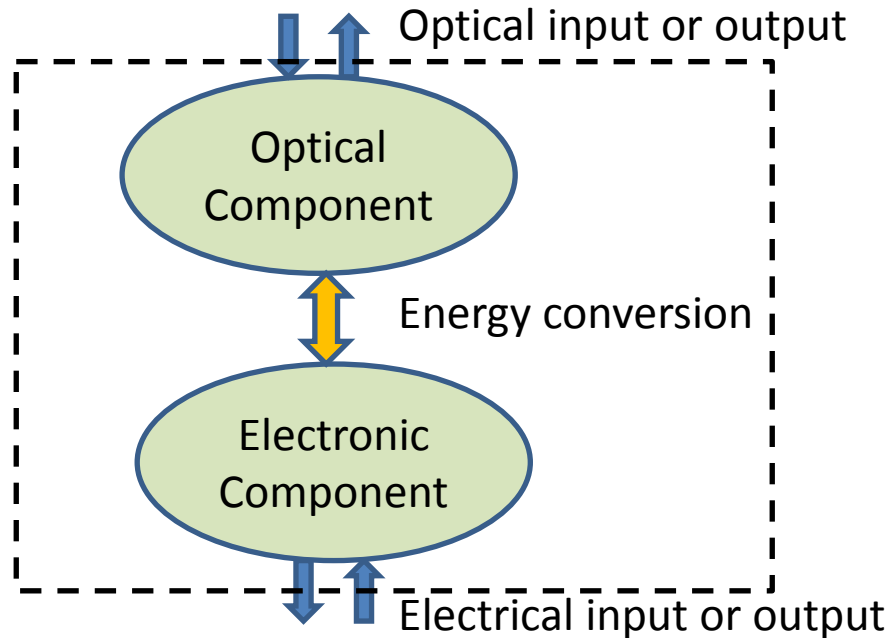


Leds

INTRODUCTION

Optoelectronics is the scientific field that deals with the operation and application of light controlled electronic devices and systems.

Optoelectronics is usually considered a sub-field of **photonics**. Photonics is the physical science of photon generation, detection, transmission and amplification. Photonics is closely related to optics.



An optoelectronics device

Optoelectronics devices

- Lasers
- Leds
- Photodiodes, Phototransistors
- Photovoltaic cells (Solar cells)
- Optical fiber
- CCD (Charge Coupled Device)
- Photon detectors

INTRODUCTION

Optoelectronics materials are produced using direct bandgap compounds or alloy semiconductors made from elements of different groups such as periodic table III-V, IV-IV, II-VI.

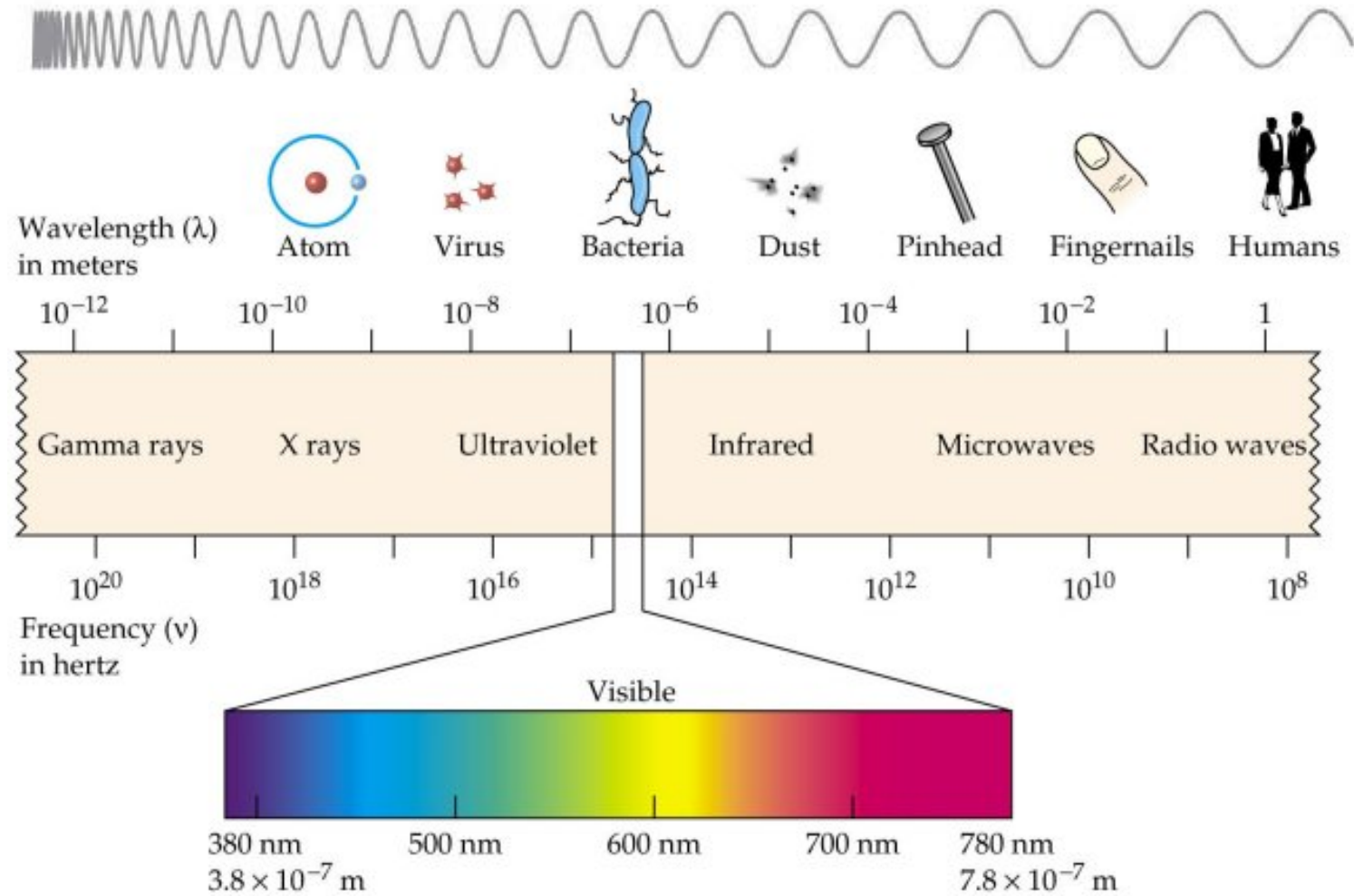
Germanium (Ge) and **silicon (Si)** are the two most commonly used elements in the semi-conductor construction. However, these elemental semiconductors (like Si and Ge) have indirect type bandgap that show poor light emission as well as light absorption. Therefore, optoelectronic devices made out of elemental semiconductors are not energy efficient.

Some compound semiconductors

GaAs is suitable for high speed microwave devices such as Gunn diode also efficient optoelectronic devices like LED, laser, photodetector.

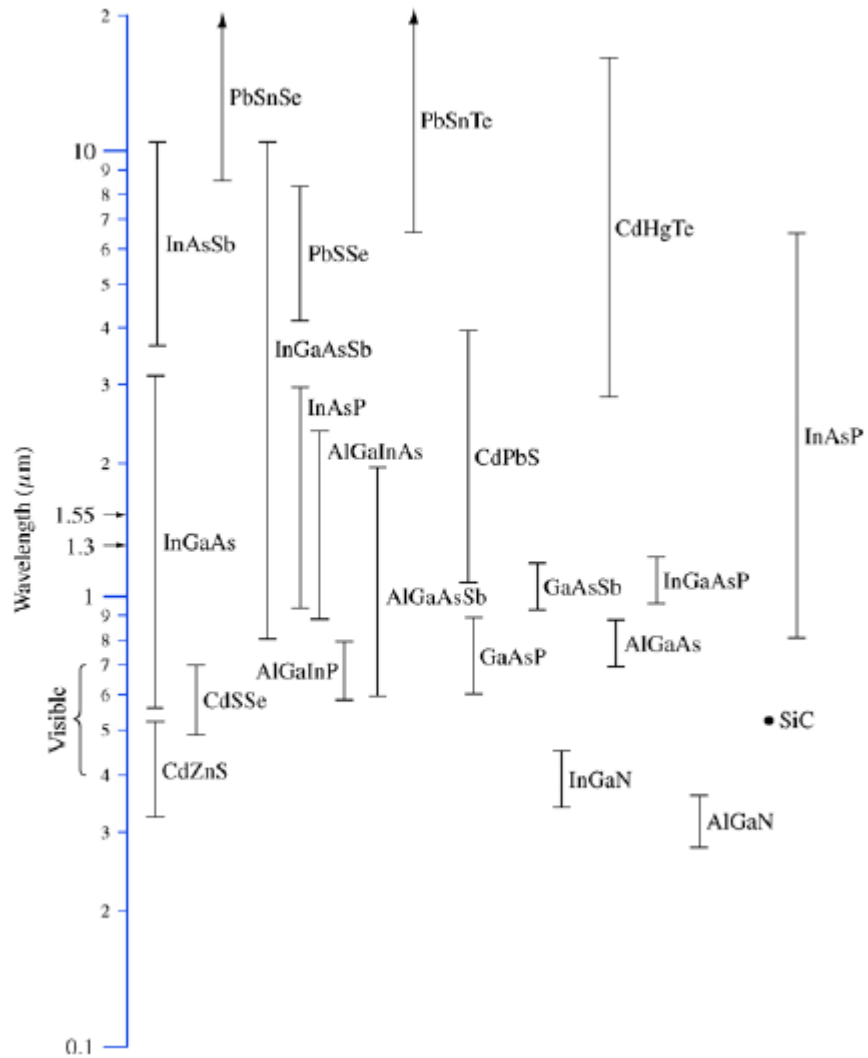
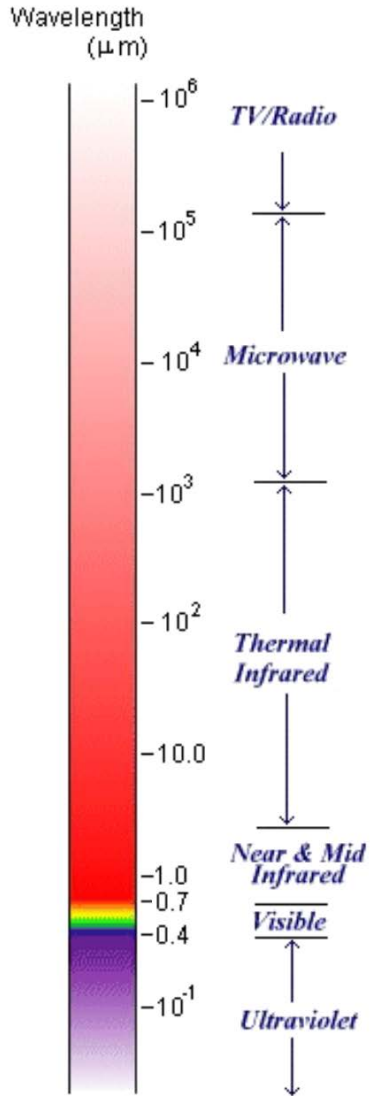
AlGaAs, InGaAs and InGaAsP are suitable for LEDs and Lasers operating at $\lambda \sim 1.3 \mu\text{m}$ used in optical fiber communication.

INTRODUCTION



Electromagnetic Spectrum

INTRODUCTION



Some semiconductor materials and their wavelength ranges.

INTRODUCTION

Optoelectronics devices and their applications

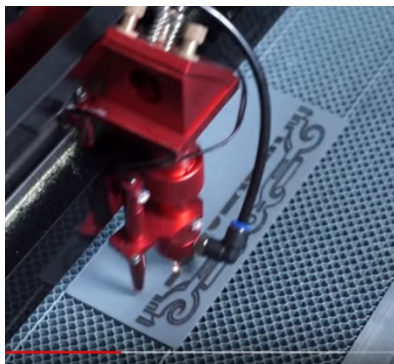
Optoelectronic devices are used in many applications such as in telecommunications, military services, medical field, and automatic control systems .

Laser applications

- laser cutting
- laser welding
- laser engraving
- Laser drilling
- Laser brazing
- laser range finder
- Lidar (likes Radar)
- Lasers in medicine
- Lasers in telecommunication
- Lasers in military devices
- other applications



Cutting



Engraving



Laser Engraving device

We have this device and the device uses CO2 laser

INTRODUCTION

Optoelectronics devices and their applications

Displays



Leds



LCD screen



Touch screens

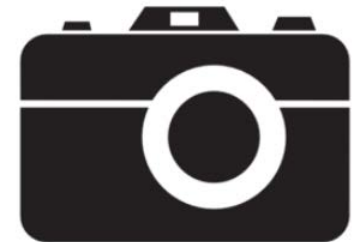
Lighting



Sensing



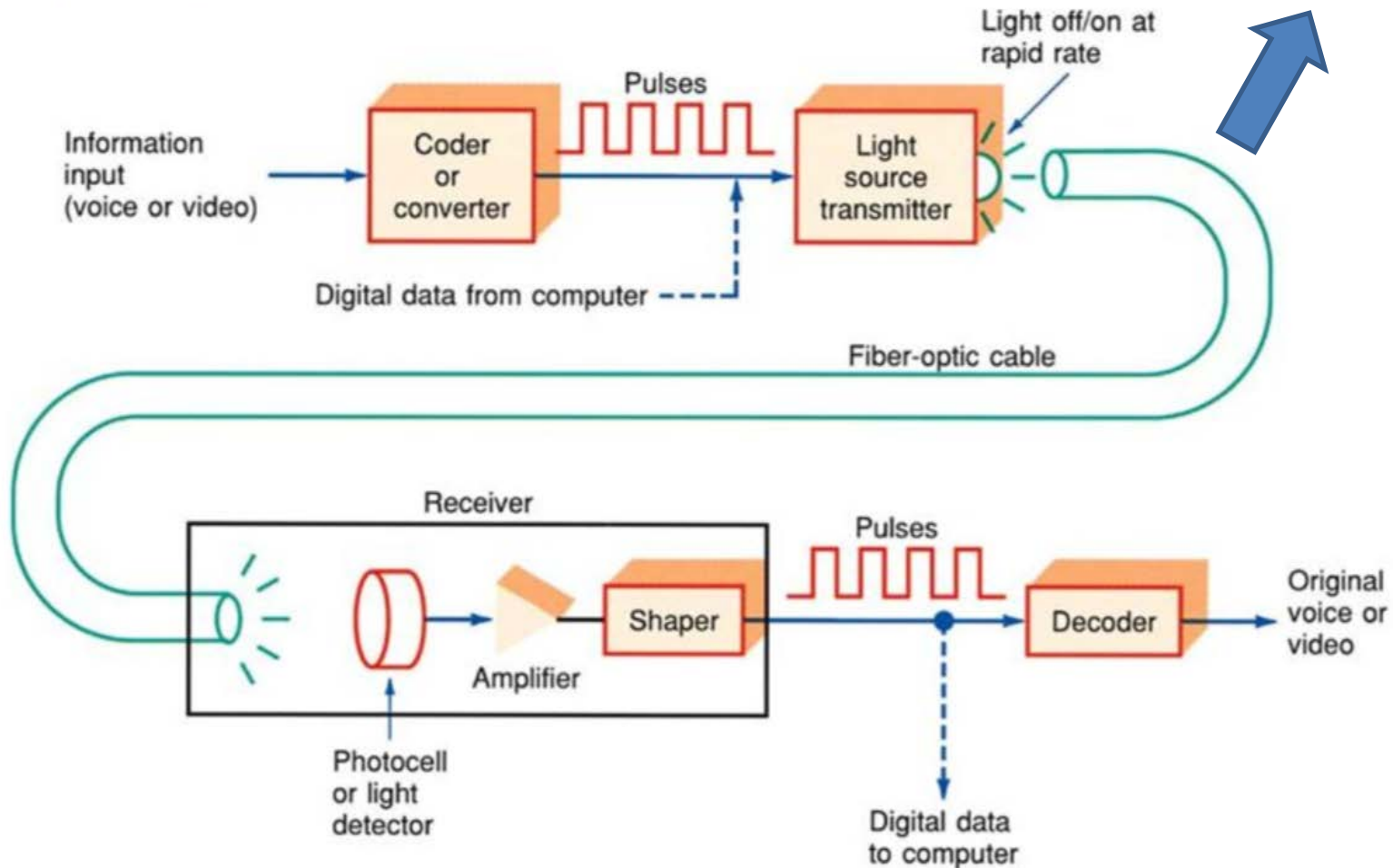
Camera



INTRODUCTION

Optoelectronics devices and their applications

Are there other applications?



Basic elements of a fiber optical communication system

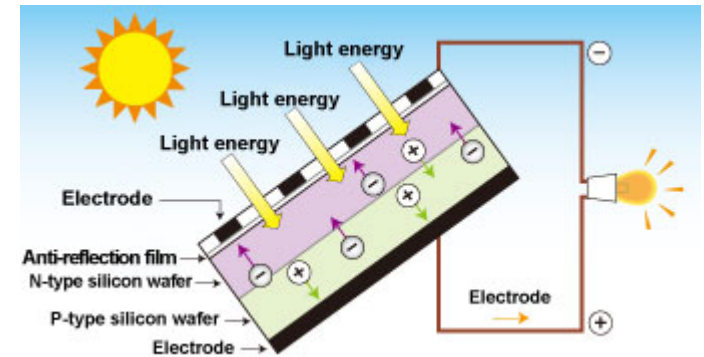
INTRODUCTION

Optoelectronics devices and their applications

Are there other applications?



A photo image of solar energy central



Operating Principle of a Solar Cell

http://www.kitagawaseiki.co.jp/en/ji_gyo_pv.html

INTRODUCTION

Optoelectronics devices and their applications

Are there other applications?

1- CD, DVD, Blu-Ray Disk Drivers

2- Lazer Printers

3- Barcode Readers

4- Fingerprint sensors

5- Infrared Thermometers

6-LCD screens

7-Touch Screen

8- Scanner

9-CCD camera

10-X-ray monitoring

.....

Each student must choose a subject. Each week, a group of two students will present their presentations.