

The background features a large, light blue watermark of the Yonsei University logo. The logo is circular with the text 'YONSEI UNIVERSITY' around the top and '연세대학교' around the bottom. In the center is a shield with a book, a lamp, and the year '1885'.

# **Opto-Electronics and Photonics**

## **Lecture 1: Introduction**

**Woo-Young Choi**

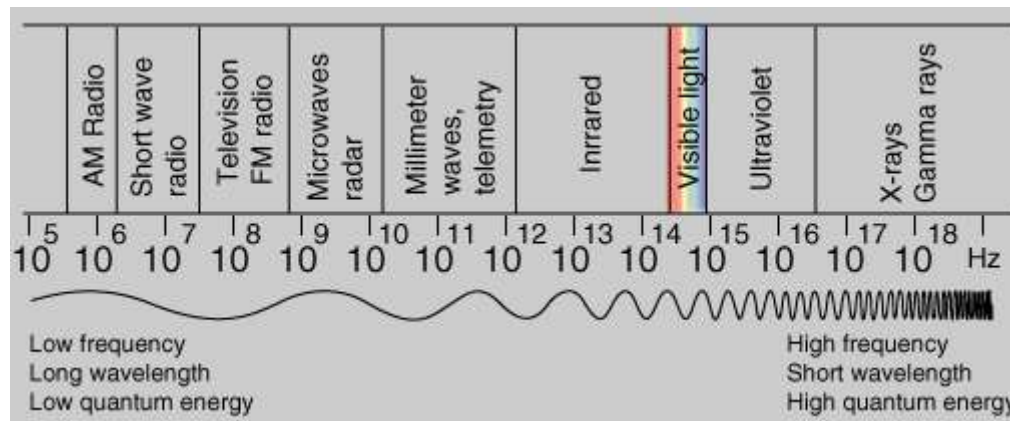
**Dept. of Electrical and Electronic Engineering**

**Yonsei University**

# Lect. 1: Introduction

- *What is light?*

- EM radiation visible to human eyes



- What is EM radiation?

Visible EM radiation: Wavelength: 400-700 nm

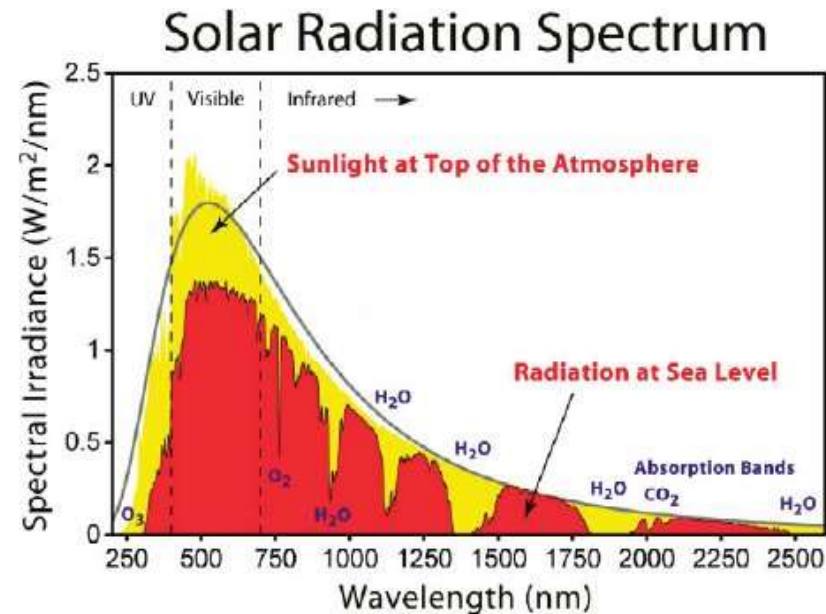
Frequency: 430 - 750 THz

Photon energy: 1.65 - 3.1 eV

Why do we see only what we see?

# Lect. 1: Introduction

Why do we see only what we see?



- Light from the sun has been the most abundant EM waves for very very long time!
- Why does the sun light have above spectrum?  
Temperature of sun at the surface: about 5,500 deg C → Blackbody radiation
- Why is the sun so hot?

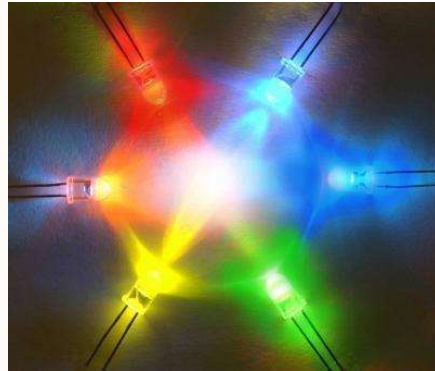
# Lect. 1: Introduction

---

- *Why study light in EE Engineering?* Many applications



LED  
(Light Emitting Diode)



LED Lighting



LED Display



OLED

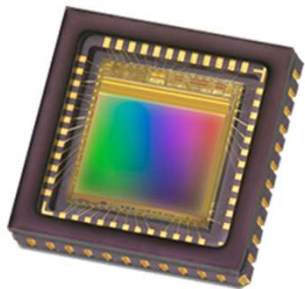
# Lect. 1: Introduction

---

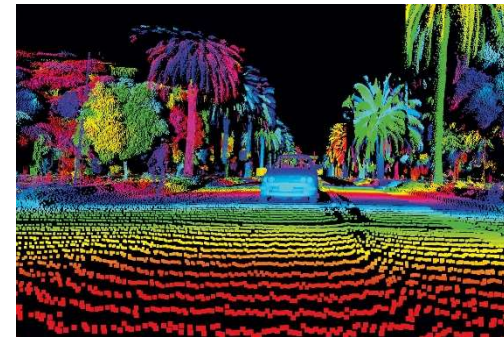
- *Why study light in EE Engineering?* Many applications



Lidar  
(Light Detection and Ranging)



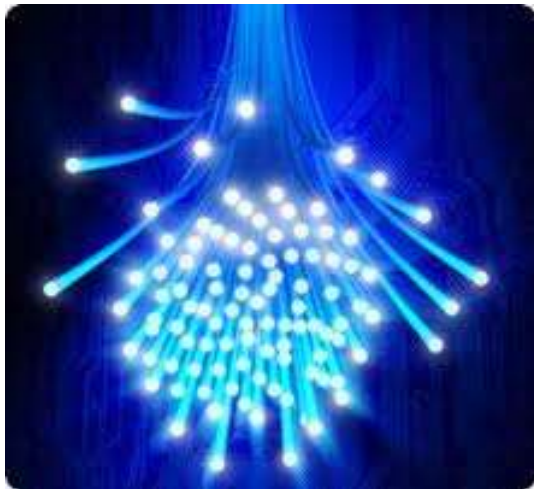
CIS  
(CMOS Image Sensor)  
→ Photodetectors



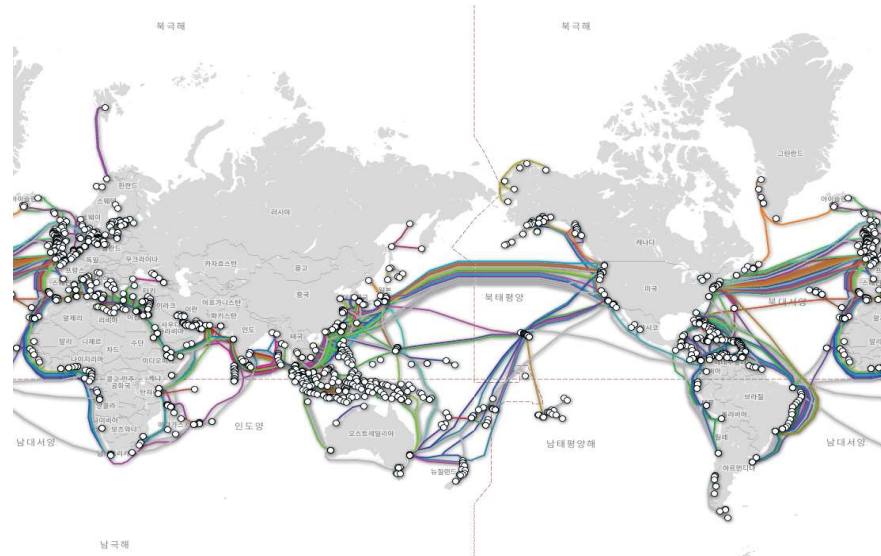
# Lect. 1: Introduction

- *Why study light in EE Engineerig?* Many applications

## Optical Communication



Light travels inside fiber without diffraction and with very small loss



([www.submarinecablemap.com](http://www.submarinecablemap.com))

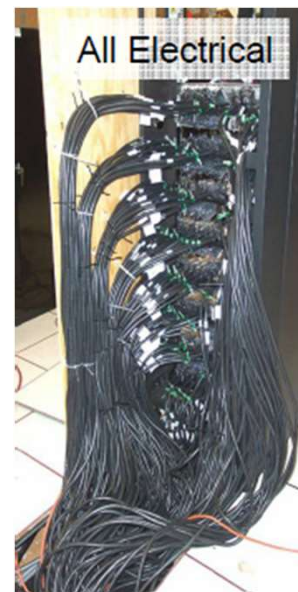
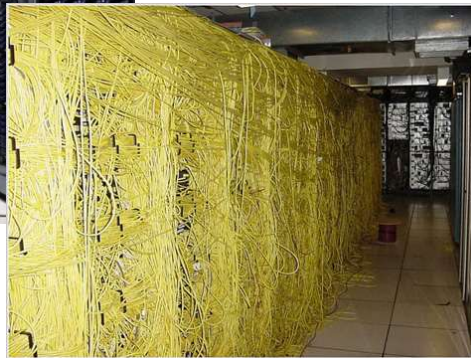
Total undersea fiber length: ~0.5 billion km  
(~725 round trips between earth and moon)  
Internet revolution!

# Lect. 1: Introduction

---

- *Why study light in EE Engineerig?* Many applications

Data Centers for Cloud Service



Optical Interconnect

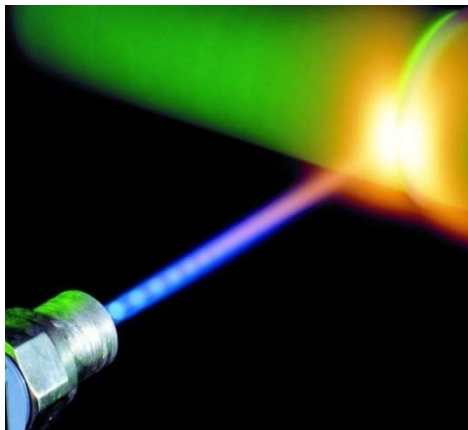
➔ Larger data throughput over longer distance with smaller size

# Lect. 1: Introduction

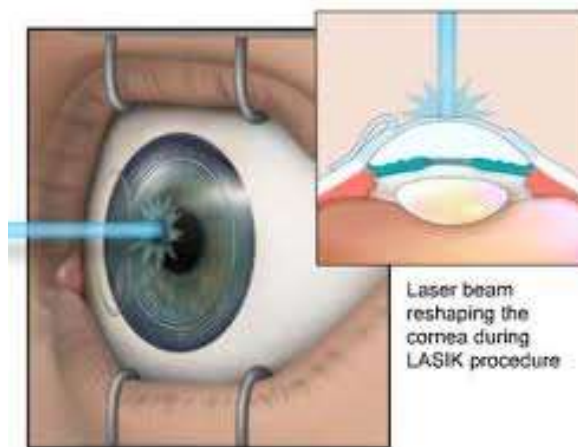
---

- *Why study light in EE Engineerig?* Many applications

LASER: Light Amplification by *Stimulated Emission* Radiation



Machining



Laser Surgery



Display/  
Information Storage  
(Hologram)

# Lect. 1: Introduction

---

Many applications in Information Technology

Information Transmission: Optical Communication/Interconnect

Information Display: LCD, LED, Hologram

Information Storage/Recovery: CD, DVD, Hologram

Medical Applications: Surgery, Imaging

What are we going to do in this course?

# Lect. 1: Introduction

---

- Goals:

  - Learn basic properties of light

  - Learn how to control the light property for useful applications

- Teaching Staffs

  - Lecturer: Prof. Woo-Young Choi (최우영)  
Room: C525, Tel: 02-2123-2874  
Email: wchoi@yonsei.ac.kr,  
Web: [tera.yonsei.ac.kr](http://tera.yonsei.ac.kr)

    - (Past years' lecture notes and test problems available)

  - T.A.'s: Min-Hyeok Seong (성민혁)  
Room: C531, Tel: 02-2123-7709  
Email: [alsguree@gmail.com](mailto:alsguree@gmail.com)

# Lect. 1: Introduction

---

- Class Style: Blended Learning

- Lecture: Recording of two-hour ppt presentation uploaded on YSCEC on Wed.  
(Starting today for Lecture 2)

Attendance check replaced by homework due Sunday 24:00

- Discussion Session: Mon. 10:00-10:50 on Zoom (starting next Monday)

Attendance check during the class

Q&A, homework problem solution, additional exercise problems

**Active Zoom participation is required for interactive learning**

- Post questions on YSCEC Q&A

→ Class-participation points awarded if question is selected for discussion

- Be ready to show and explain your homework answers
- Secure a place where you can talk and use tablet/mouse
- Use your webcam, if possible

# Lect. 1: Introduction

---

## ● Textbook:

Class notes (Available in PDF at yscec)

## References:

- *Field and Wave Electromagnetics* by Cheng
- *Optoelectronics and Photonics* by Kasap
- *Fundamentals of Photonics* by Saleh and Teich

## ● Grades

- Attendance (Homework): 30%

Equal weight for each class, 3 late attendance (Mon.) = 1 absence

- Mid-term Exam: 30% (10-12 am, Oct. 21, Wed., Open book)
  - Final Exam: 30% (10-12 am, Dec. 9, Wed.)
  - Class Participation: 10%
- 0.25 point for each question selected and discussed during Zoom session  
(Max. 0.5 point for one person for one session)
- Evaluation of student participation

# Lect. 1: Introduction

---

## ● Final Letter Grade

Mostly A's and B's

If students actively participate and show the minimum understanding of the subject

(This is not an easy subject especially if you do not have sufficient background or are not interested in the subject)

## ● Prerequisite

- Basic understanding of E&M (전자기1)

- Usually best appreciated by students having strong interest in physics

## ● Zoom Meeting

Informal zoom meeting with the professor and fellow students. Wednesdays from 10:00 - 10:30 am. Schedule will be posted in YSCEC. Will start next week.

# Lect. 1: Introduction

---

## ● Topics (Tentative and subject to changes)

- Introduction
- Review of basic E&M
- Time-varying fields
- Wave equations and plan-wave solutions
- Polarization
- Plane waves in lossy media
- EM waves incident at conductor
- Oblique incidence at conductor
- Normal incidence at dielectric interface
- Oblique incidence at dielectric interface
- Total internal reflection
- Interference
- Multiple dielectric interference
- Interferometers
- Diffraction
- Diffraction Gratings

# Lect. 1: Introduction

---

## ● Topics (Tentative and subject to changes)

- Dielectric waveguides
- Optical fiber
- Planar waveguide devices
- Photons
- Interaction between light and matter
- Optical pumping
- Lasers
- Optical gain in semiconductors
- Semiconductor lasers
- Single-mode semiconductor laser
- Photodetectors