Introduction to Photonics

Note Title

Why Photonics ? – Human Vision

↓

Science of Light

Imaging

Optical Communications

Material processing

Augmented Reality

Gesture Recognition

Quantum Computing

EE5500 - Introduction to Photonics

Identify the fundamental principles of photonics and light-matter interactions

Develop the ability to formulate problems related to photonic structures/processes and analyze them

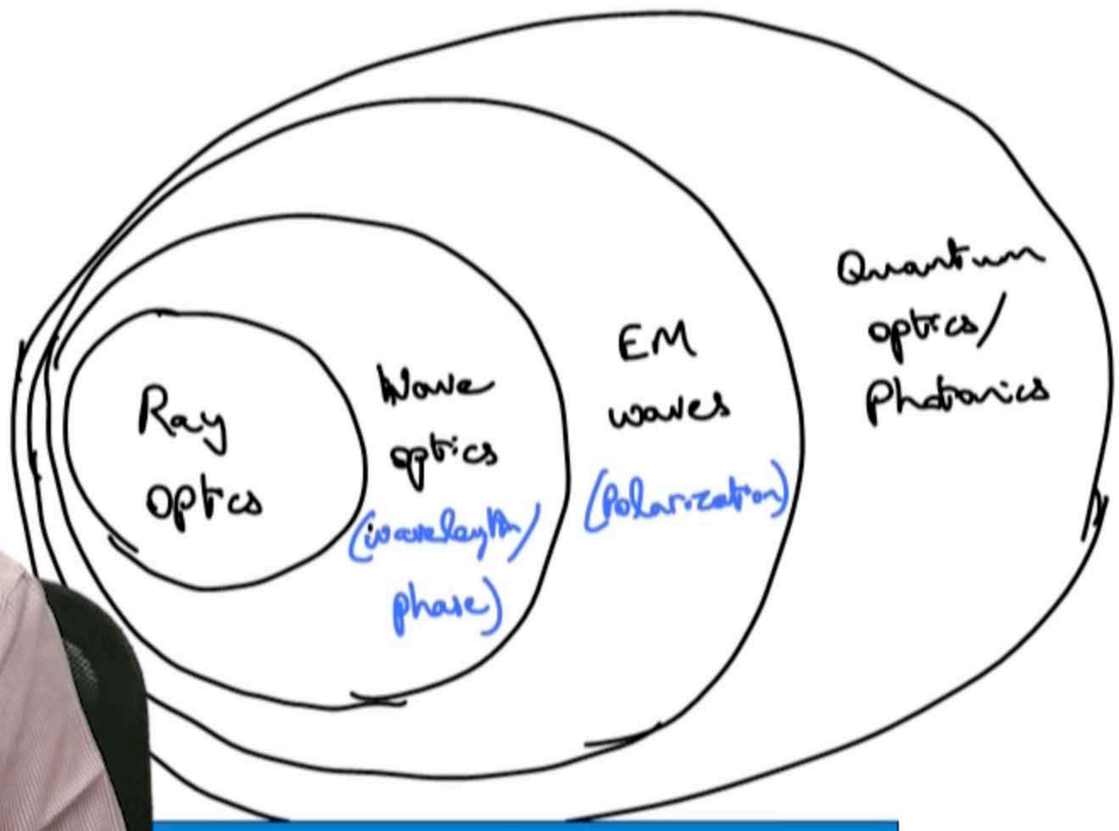
Identify processes that help to manipulate the fundamental properties of light

I. Photonics - Fundamentals	**Schedule**	**Lab Session**
1. Wave/particle duality	Week 1	Diffraction of light
2. Statistical properties of light, Coherence	Week 2	Michelson interferometer
3. Photon properties - energy, flux, statistics	Week 3	Coupling laser light into optical fiber
4. Interaction of photons with atoms	Week 4	Light absorption & filtering
5. Light amplification	Week 5	Optical amplifiers (EDFA)
Quiz I (20%)		
II. Semiconductor light sources & detectors		
1. Laser Fundamentals	Week 6	
2. Junction devices	Week 7	Fiber ring laser
3. Semiconductor light sources	Week 8	Optical sources
4. Semiconductor light detectors	Week 9	Optical detectors
Quiz II (20%)		
III. Manipulation of photons		
1. Interaction with RF and acoustic waves	Week 10	Malus law

Photonics → Properties of photons/light

→ Generation/detection of photons

→ Manipulation of photons



Fermat, 1600s → light travels in straight lines

Huygens, mid-1600s → light travels as waves

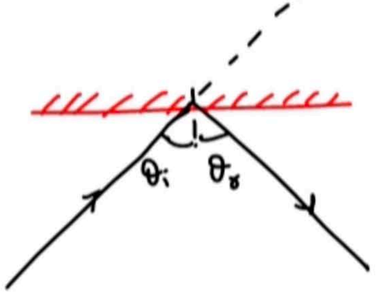
Maxwell, mid-1800s → light travels as EM waves

Planck, 1885 → light emission/ absorption is quantized

Einstein, 1915 → light comprises of quanta of energy (photons)

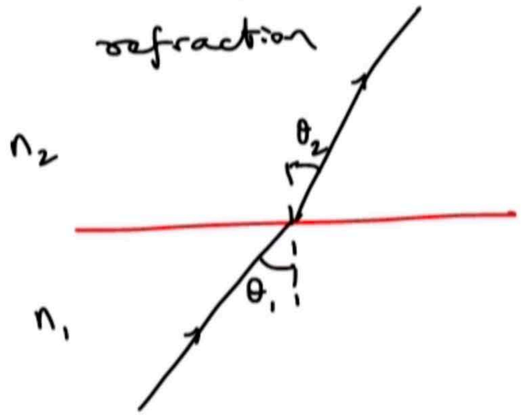
Endoscopy → optical probe

Law of reflection



$$\theta_r = \theta_i$$

Law of refraction



Snell's law

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$n_1 > n_2 \Rightarrow \theta_2 > \theta_1$

$\theta_1 = \theta_c \rightarrow \theta_2 = \pi/2$

$n_1 \sin\theta_c = n_2 \sin(\pi/2)$

$= n_2$

$$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

If $\theta_1 > \theta_c$ → Total Internal Reflection