

SCIENCE

An Introduction to Laser Technology and Its Applications

- I. LIGHT 15%
 - A. Properties of Light
 - 1. Waves
 - 2. Wave Properties
 - 3. Electromagnetic Waves
 - 4. The Speed of Light
 - 5. The Electromagnetic Spectrum
 - 6. Antennas and Radio Waves
 - 7. Transparent vs. Opaque Materials
 - B. Visible Light and Color
 - 1. The Visible Spectrum
 - 2. Selective Absorption and Reflection
 - 3. Selective Transmission
 - 4. Blue Skies and Red Sunsets

- II. OPTICS 30%
 - A. Geometric Optics
 - 1. The Ray Approximation
 - 2. Reflection
 - 3. The Law of Reflection
 - a. Specular and diffuse reflection
 - 4. Refraction
 - a. The law of refraction
 - 5. Mirages
 - 6. Dispersion
 - 7. Rainbows
 - 8. Total internal reflection
 - a. Fiber-optics
 - B. Mirrors and Lenses
 - 1. Plane Mirrors
 - 2. Concave and Convex Mirrors
 - a. Concave mirrors
 - b. Convex mirrors
 - 3. Lenses
 - a. Converging lenses
 - b. Diverging lenses
 - c. Spherical and chromatic aberration
 - C. Wave Optics
 - 1. Huygens' Principle
 - 2. Diffraction
 - 3. Interference
 - a. Superposition

- b. Double slit interference
- c. Diffraction gratings
- d. Thin-film interference
- 4. Polarization
- D. Optical Instruments
 - 1. Simple Magnifier
 - 2. Microscopes
 - 3. Telescopes

III. LASERS 35%

- A. Light Emission and Absorption
 - 1. The Atom
 - 2. Quantization
 - 3. Photons
 - 4. The Bohr Model
 - 5. Atomic Excitation and Emission
 - 6. Emission Spectra
 - 7. Incandescence
 - 8. Absorption Spectra
 - 9. Fluorescence
 - 10. Phosphorescence
 - 11. Lamps
 - a. Incandescent lamps
 - b. Fluorescent lamps and CFLs
 - c. Light-emitting diodes
- B. Lasers
 - 1. Laser Operation
 - a. Stimulated emission
 - b. Population inversion
 - c. Energy levels
 - d. Optical cavity
 - 2. Properties of Laser Light
 - a. Monochromatic
 - b. Directional
 - c. Coherent
 - 3. Types of Lasers
 - a. Gas lasers
 - b. Solid-state lasers
 - c. Semiconductor diode lasers
- C. History of the Laser
 - 1. 1900–50: Early Foundations
 - 2. Early 1950s: Charles Townes and the Maser
 - 3. Late 1950s: Laser Conceived
 - 4. 1960s: The Race to Build the Laser
 - 5. 1970s–Present

IV. APPLICATIONS OF LASERS 20%

A. Scientific Applications

1. Laser Spectroscopy
2. Confocal Laser Scanning Microscopy
3. Manipulating Tiny Objects
 - a. Optical tweezers
 - b. Laser cooling
 - c. Atomic clocks
4. Nuclear Fusion

B. Medical Applications

1. Laser Surgery
 - a. Refractive eye surgery
2. Laser Dermatology
3. Laser Dentistry

C. Industrial Applications

1. Laser Drilling
2. Laser Cutting
3. Laser Beam Welding
4. Laser Marking, Engraving, and Etching
5. Photolithography
6. Stereolithography

D. Other Applications

1. Barcode Readers
2. Laser Pointers
3. Laser Printers
4. Optical Discs: CDs, DVDs, and Others
5. Holography