



# Laser Safety

Diploma program

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# COURSE CONTENTS

- Basics of Lasers and Laser Light
- Laser Beam Injuries
- Laser Hazard Classes
- Laser Safety Standards
- Laser Hazard Evaluation
- Laser Control Measures

# BASICS OF LASERS AND LASER LIGHT

L ight

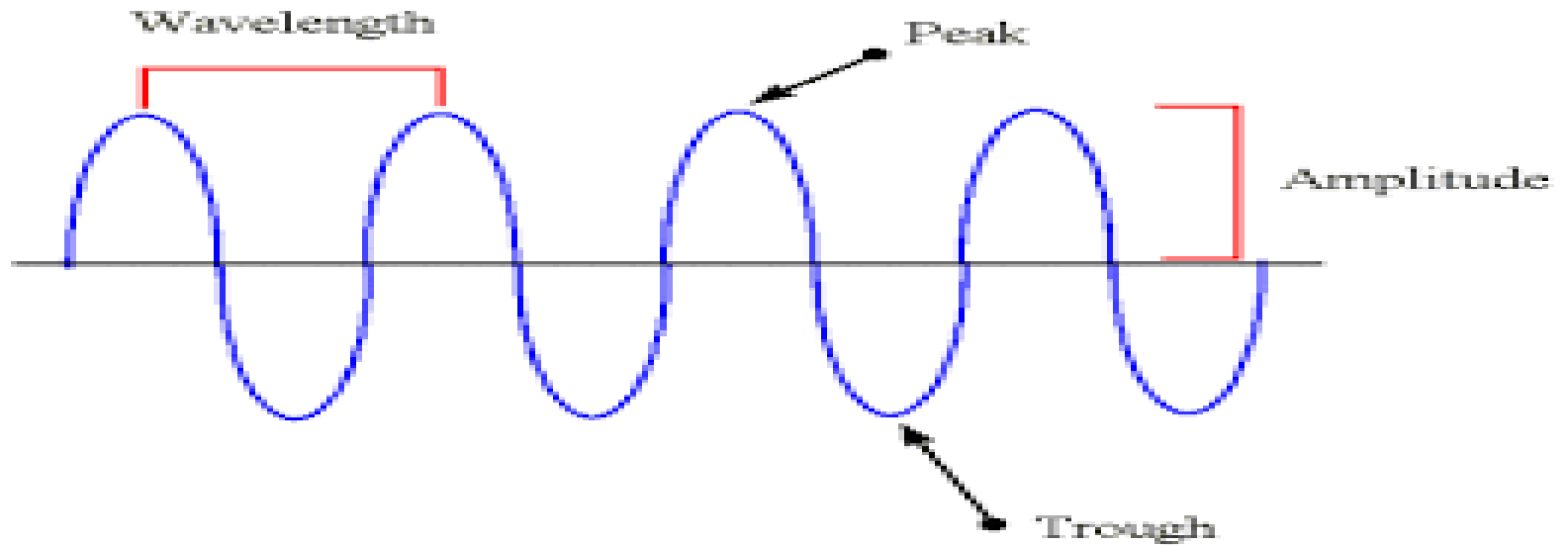
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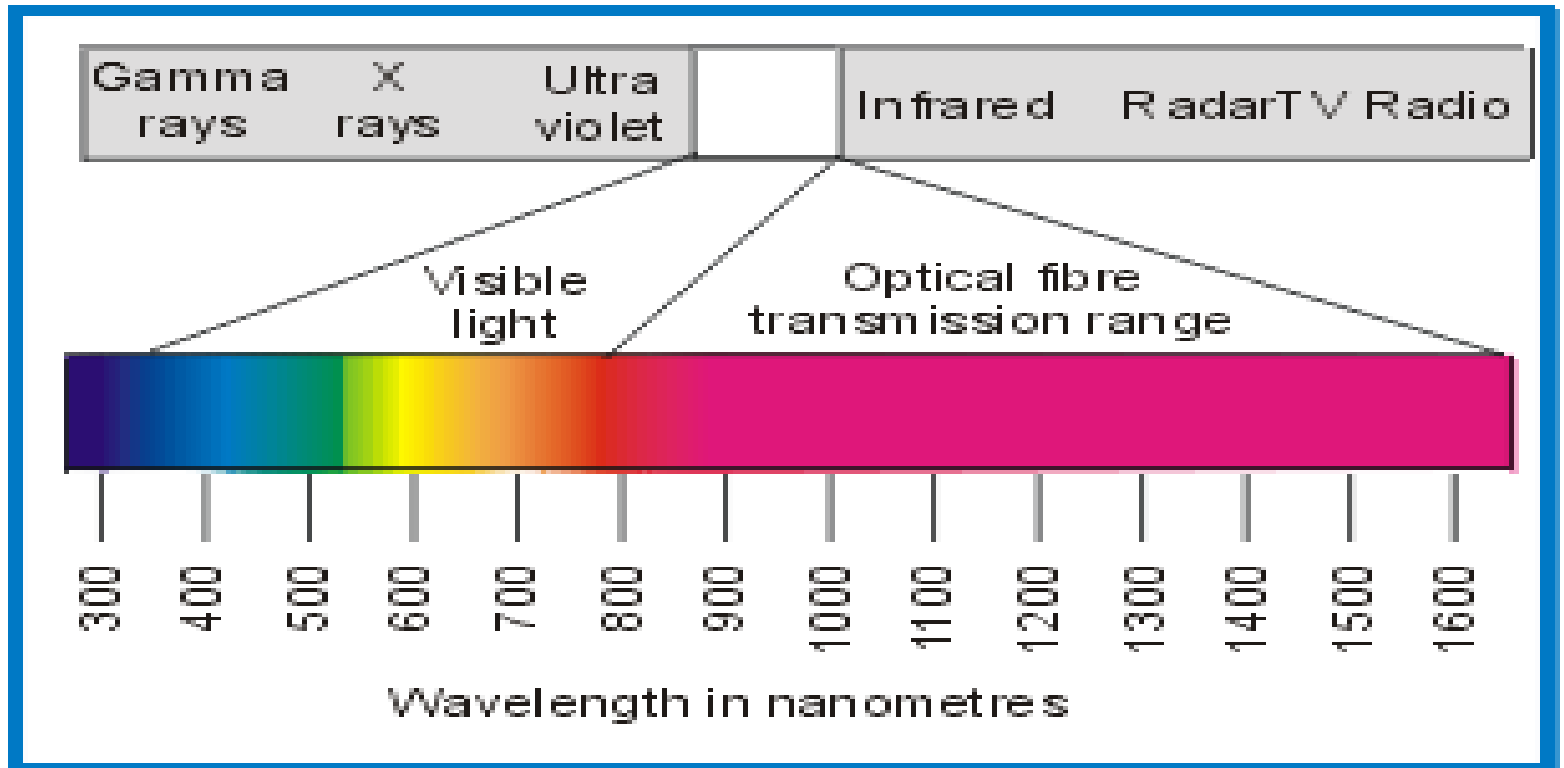
R adiation

# WAVE NATURE OF LIGHT



Light is an electromagnetic wave.  
Different wavelengths in the  
visible spectrum are seen by the  
eye as different colors.

# ELECTROMAGNETIC SPECTRUM



Lasers operate in the ultraviolet, visible, and infrared.

# Common Visible Light Lasers

Violet	Helium cadmium	441 nm
Blue	Krypton	476 nm
	Argon	488 nm
Green	Copper vapor	510 nm
	Argon	514 nm
	Krypton	528 nm
	Frequency doubled Nd YAG	532 nm
	Helium neon	543 nm
Yellow	Krypton	568 nm
	Copper vapor	570 nm
	Rhodamine 6G dye (tunable)	570 nm
	Helium neon	594 nm
Orange	Helium neon	610 nm
Red	Gold vapor	627 nm
	Helium neon	633 nm
	Krypton	647 nm
	Rhodamine 6G dye	650 nm
	Ruby ( $\text{CrAlO}_3$ )	694 nm

The wavelength range for light that is visible to the eye ranges from 400-760 nm

# CHARACTERISTICS OF LASER LIGHT

***MONOCHROMATIC***

***DIRECTIONAL***

***COHERENT***

- The combination of these three properties makes laser light focus 100 times better than ordinary light

# LASER COMPONENTS

## ACTIVE MEDIUM

Solid (Crystal)

Gas

Semiconductor (Diode)

Liquid (Dye)

## EXCITATION MECHANISM

Optical

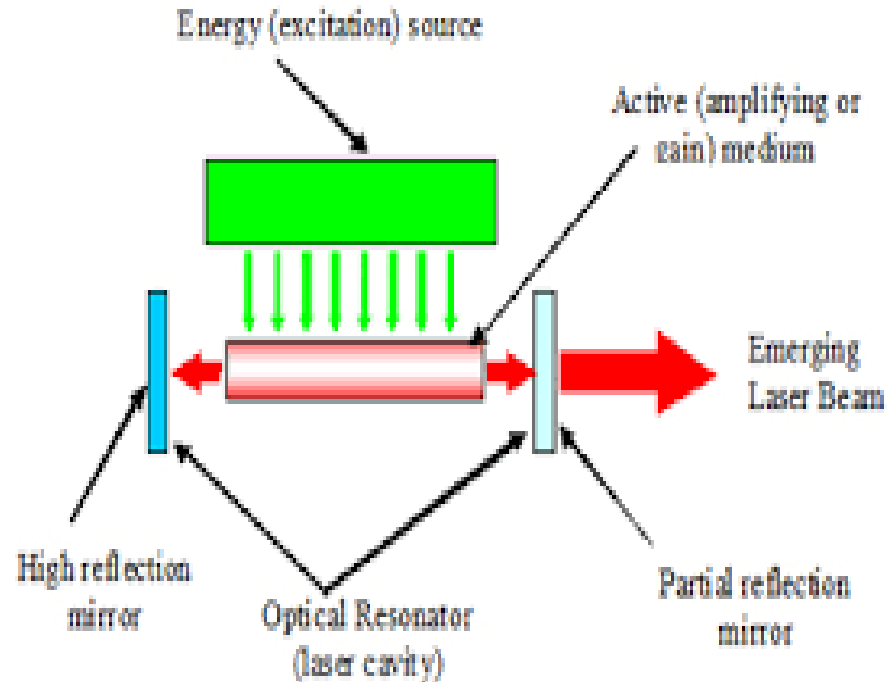
Electrical

Chemical


## OPTICAL

## RESONATOR

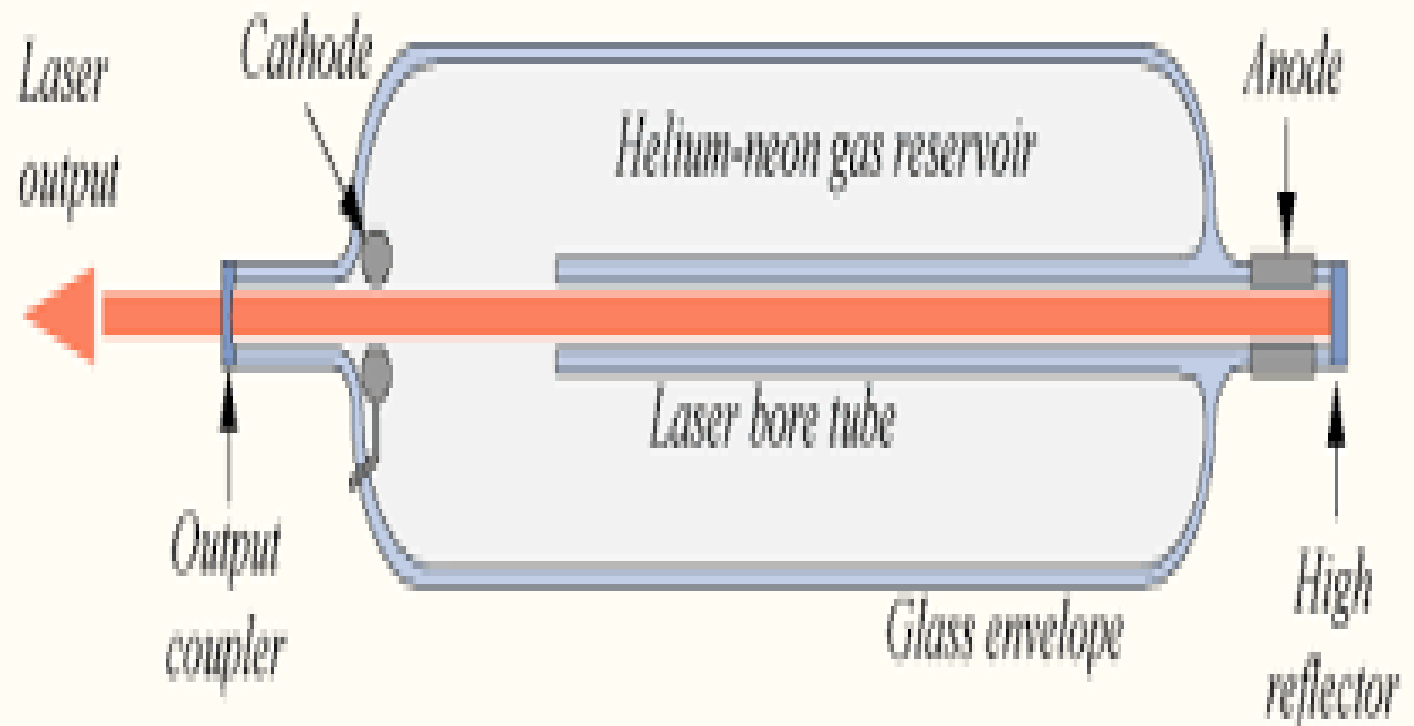
HR Mirror and  
Output Coupler



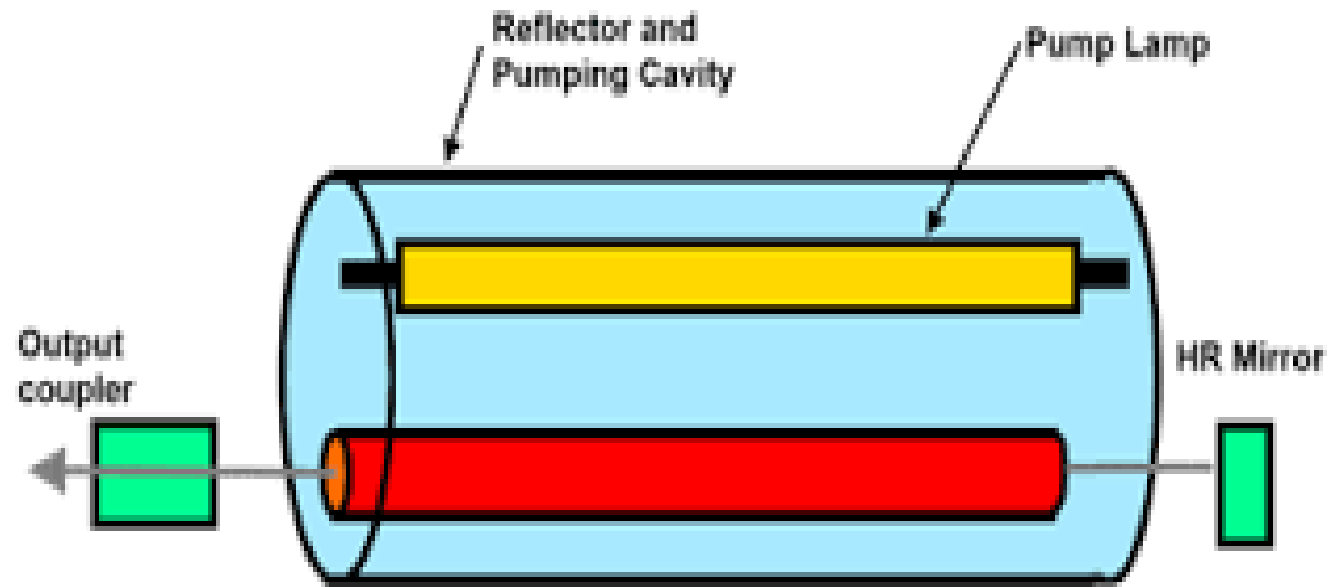


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- The Active Medium contains atoms which can emit light by stimulated emission.
  - The Excitation Mechanism is a source of energy to excite the atoms to the proper energy state.
  - The Optical Resonator reflects the laser beam through the active medium for amplification.

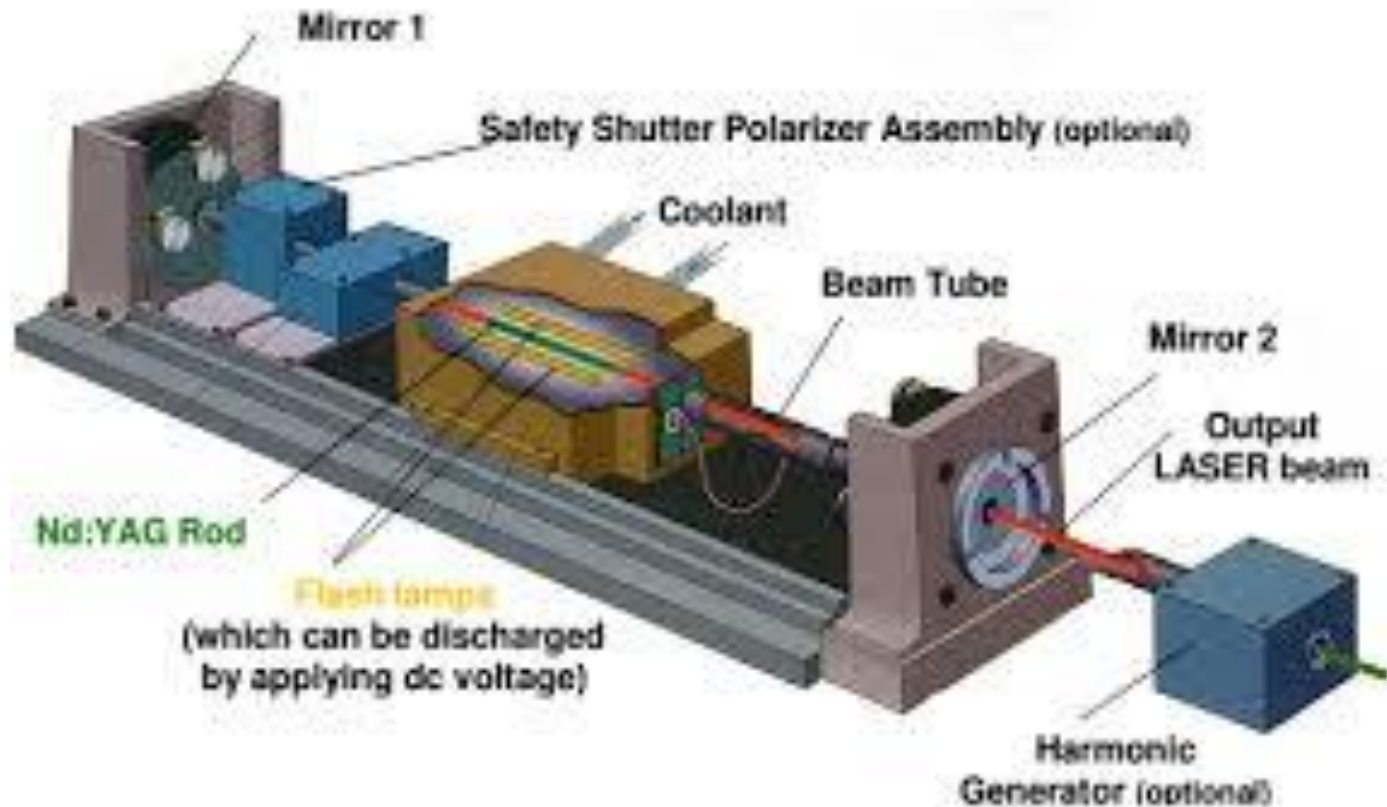
# HELIUM-NEON(HeNe) GAS LASER



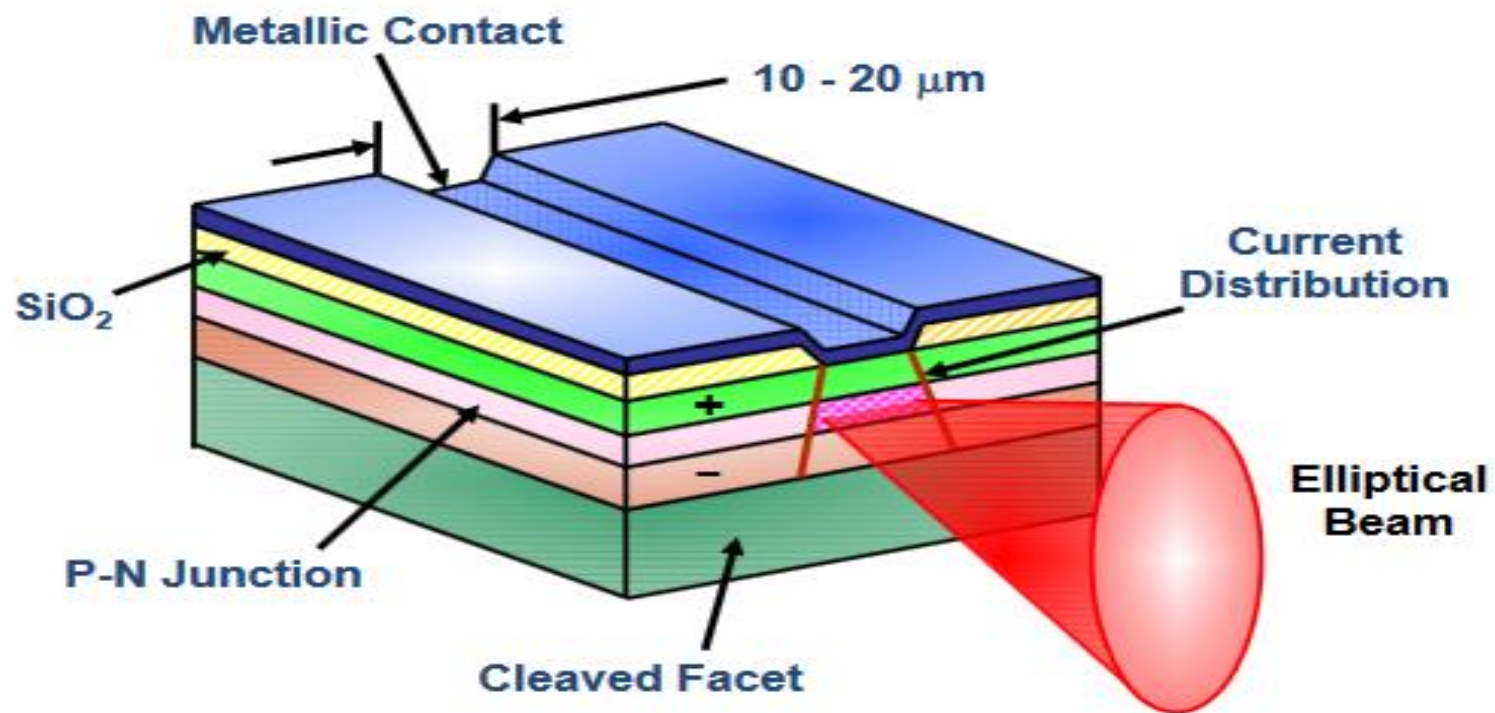
# SOLID STATE LASER



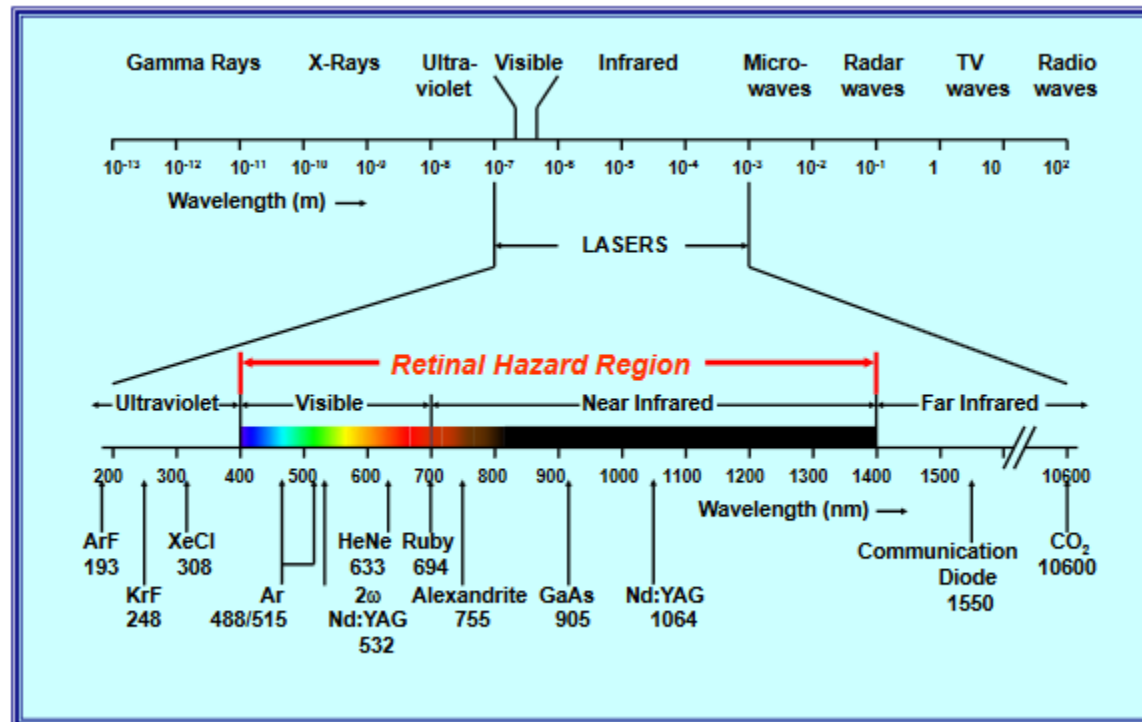
# NEODYMIUM YAG LASER



# DIODE LASER



# LASER SPECTRUM



# CHARACTERISTICS OF LASERS AND THEIR EFFECTS ON LASER HAZARDS

- Spectral characteristic – Wavelength

In general, shorter wavelengths are more hazardous in any spectral

region, but Near Infrared lasers are the most hazardous because they are invisible retinal hazards.

- Temporal characteristic – Pulse Duration

In general, pulsed lasers are more hazardous than CW lasers.

The shorter the pulse duration, the higher the peak power and the greater the hazard.

- Spatial characteristic – Beam Divergence

Low beam divergence results in a large intrabeam hazard distance.

- Focusing characteristic

High retinal irradiance of focused beam creates extreme retinal hazard for visible and near infrared lasers