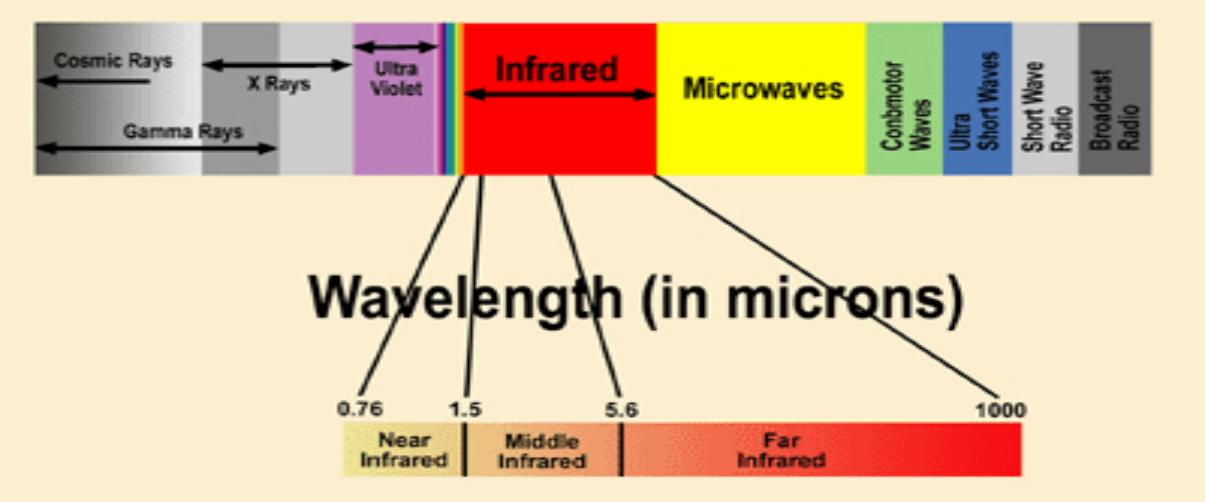
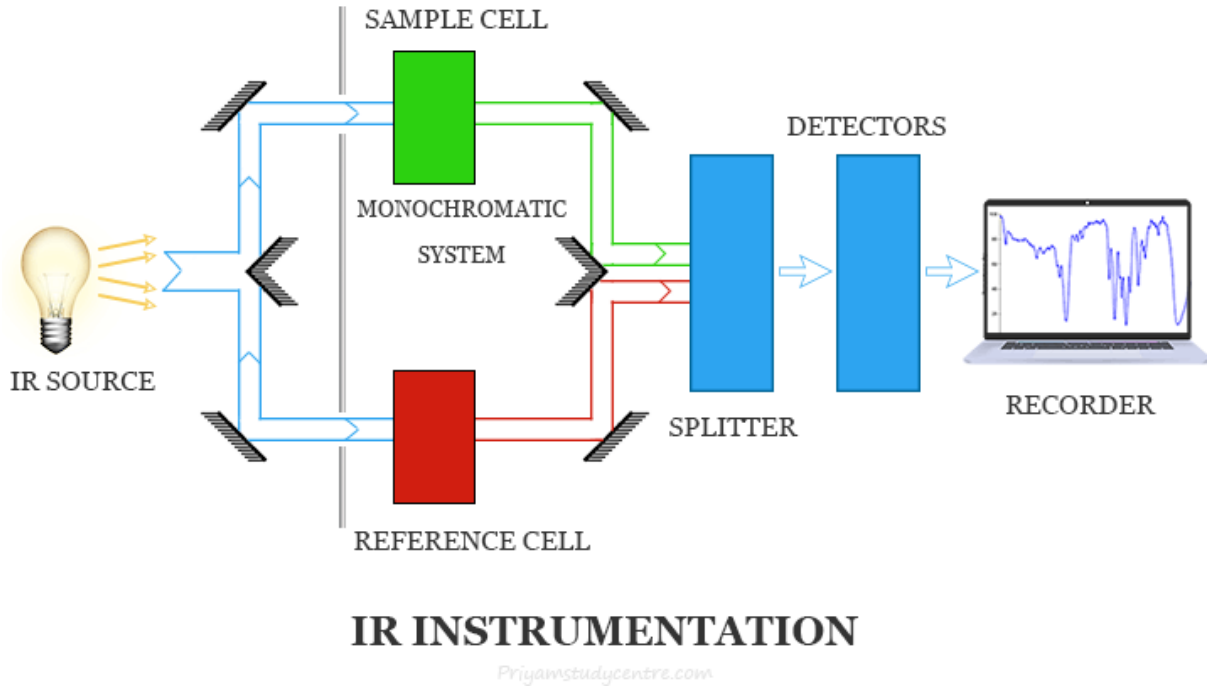
IR Spectroscopy:

Infrared (IR) spectroscopy instrumentation is designed to analyze the interaction between infrared radiation and a sample, providing information about molecular vibrations and chemical bonds.



IR Instrumentation:



IR INSTRUMENTATION

The main components of IR spectroscopy instrumentation include:

1. IR Radiation Source

- Produces infrared light, typically in the range of 4000–400 cm^{-1} (mid-IR region).
- **Common IR sources include:**
    - Nernst Glower: A ceramic rod that emits IR radiation when heated.
    - Globar Source: A silicon carbide rod that emits a continuous spectrum of IR light.
    - Incandescent Lamps: Used in simpler instruments for near-IR spectroscopy.

2. Sample Holder

- Holds the sample in solid, liquid, or gaseous form.
    - **Solid samples**: Prepared as KBr pellets or thin films.
    - **Liquid samples**: Placed in liquid cells with IR-transparent windows like NaCl or KBr.
    - **Gas samples**: Contained in gas cells with a long path length to allow adequate absorption.

3. Monochromator

- Separates IR radiation into individual wavelengths or a narrow band.
    - **Gratings**: Use diffraction to disperse wavelengths.
    - **Prisms**: Made from materials like NaCl or KBr, suitable for IR light.
    - Filters may also be used for simpler instruments.

4. Detectors

- Measure the intensity of IR radiation after it passes through the sample.
    - **Thermal Detectors**: Measure changes in temperature due to absorbed IR radiation (e.g., thermocouples).
    - **Pyroelectric Detectors**: Use materials like lithium tantalate to detect changes in polarization.
    - **Photoconductive Detectors**: Respond to changes in electrical conductivity caused by IR light (e.g., HgCdTe detectors).

5. Interferometer (in FTIR Instruments)

- Replaces the monochromator in modern Fourier Transform IR (FTIR) instruments.
    - Uses a **Michelson Interferometer** to modulate IR light into an interferogram.
    - A mathematical algorithm (Fourier Transform) converts the interferogram into a spectrum.

6. Data Processing System

- Converts the detector signal into a readable spectrum.
    - Modern instruments include advanced software for spectral analysis, peak identification, and comparison with libraries.

Working Principle

1. Infrared light from the source passes through the sample.
2. The sample absorbs specific frequencies corresponding to its molecular vibrations.

3. The transmitted or reflected light is measured by the detector.
4. The resulting spectrum displays absorbance (or transmittance) as a function of wavelength or wavenumber.

Types of IR Spectrometers

1. **Dispersive IR Spectrometers**: Use monochromators for wavelength selection.
2. **Fourier Transform IR (FTIR) Spectrometers**: Provide high-resolution spectra using interferometry.

Applications:

- Identifying functional groups in organic compounds.
- Studying molecular structures and conformations.
- Quality control in pharmaceuticals and polymers.