a spontaneous emission spectrum determined by its temperature; this feature can be measured in the infrared by instruments such as the atmospheric emitted radiance interferometer. Emission can also be induced by other sources of energy such as flames or sparks or electromagnetic radiation in the case of fluorescence.

Elastic scattering and reflection spectroscopies determine how incident radiation is reflected or scattered by a material. Crystallography employs the scattering of high-energy radiation, such as x-rays and electrons, to examine the arrangement of atoms in proteins and solid crystals.

Impedance spectroscopy studies the ability of a medium to impede or slow the transmittance of energy. For optical applications, this is characterized by the index of refraction.

Inelastic scattering phenomena involve an exchange of energy between the radiation and the matter that shifts the wavelength of the scattered radiation. These include Raman and Compton scatterings.

Coherent or resonance spectroscopy is a technique where the radiative energy couples two quantum states of the material in a coherent interaction that is sustained by the radiating field. The coherence can be disrupted by other interactions, such as particle collisions and energy transfer, and so often requires high-intensity radiation to be sustained. NMR spectroscopy is a widely used resonance method, and ultrafast laser methods are also now possible in the infrared and visible spectral regions.

The combination of atoms into molecules leads to the creation of unique types of energetic states and, therefore, unique spectra of the transitions between these states. Molecular spectra can be obtained due to electron spin states (electron paramagnetic resonance), molecular rotations, molecular vibrations, and electronic states. Rotations are collective motions of the atomic nuclei and typically lead to spectra in the microwave and millimeter-wave spectral regions; rotational spectroscopy and microwave spectroscopy are synonymous. Vibrations are relative motions of the atomic nuclei and are studied by both infrared and Raman spectroscopies. Electronic excitations are studied using visible and UV spectroscopies as well as fluorescence spectroscopy.

Nuclei also have distinct energy states that are widely separated and lead to gamma ray spectra. Distinct nuclear spin states can have their energy separated by a magnetic field, and this allows for NMR spectroscopy.

5.2.3 Chromatography

5.2.3.1 Ion-exchange chromatography (IEXC) IEXC is a process that enables the separation of ions and polar molecules based on their affinity to the ion exchanger. It can be used for almost any kind of charged molecule including large proteins, small nucleotides, and amino acids. IEXC retains analyte molecules on the column based on coulombic (ionic)