**The electron microscope**

Basic design of the electron microscope / Electron sources / Magnetic lenses (properties and their aberrations) / Illumination of the specimen: transmission and/or scanning electron microscopy / Sample thinning techniques: chemical/mechanical polishing, ion milling, focused ion beam.

**Electron diffraction**

Scattering of electrons from atoms / Scattering of electrons from unit cell / Scattering of electrons from perfect crystal: the reciprocal lattice, reflecting sphere construction, Laue zones, effects due to structure factor, diffraction from various crystal shapes / Diffraction geometry of twinned structure / Kikuchi lines / Extinction distance / Refraction / Diffraction from amorphous specimens.

**Kinematical theory of image contrast**

Dark–field and bright–field imaging / Column approximation / Amplitude–phase diagram / Effect of two beams reaching the image / Contrast from crystal defects: stacking faults, Moiré patterns, dislocations, inclusions, and coherency strains / Limits of validity of the kinematical theory.

**Dynamical theory of image contrast**

Wave–optical formulation of the dynamical theory of contrast / Pendellösung effect / Wave–mechanical formulation of the dynamical theory of contrast / The dispersion surface / Equivalence of wave–optical and wave–mechanical formulations / Symmetry of Bloch waves and anomalous absorption effects / Dynamical theory in a crystal containing defects.

**Direct structure imaging in electron microscopy**

Propagation in an optical system / Wave–optics treatment of spherical aberration and defocus / Ultimate resolution / The weak phase object / Optimal “Scherzer defocus” / Effects due to chromatic aberrations and beam divergence / The projected charge density approximation / Many beam diffraction formulations.

**Electron energy loss spectroscopy and energy filtered imaging**

The electron energy loss spectrum / Energy–analyzing and energy–selecting instrumentations / Inelastic scattering: Bohr and Bethe theory / Dielectric formulation / Excitation of Outer–Shell Electrons / Volume plasmons / Surface plasmons / Plasmons in nanostrucutres / Inner–Shell excitations.

**Scanning transmission electron microscopy**

The principle of reciprocity / Probe formation and aberration / Interference of overlapping disks / Bright–field and annular dark–field imaging / Coherent and incoherent imaging / The effect of thermal diffuse scattering / Z–contrast / Contrast from crystal defects / Atomic resolved X–ray energy dispersion and/or electron energy loss spectroscopy.