

PHYSICAL KINETICS

12 Lectures

Lecture 1.

Liouville theorem, distribution function and the Boltzmann equation. Hypothesis of molecular chaos and collision integral. Examples of electron collisions in solids. Detailed balance. Maxwell, Bose-Einstein and Fermi-Dirac distributions. 5

Lecture 2.

τ - approximation for collision integral. Diffusion equation, linear response, conductivity and the Einstein relations. Magneto-resistance, the Hall effect and thermo-power for electrons in metals. 10

Lecture 3.

Derivation of Hydrodynamics from Kinetics. Kinetic coefficients of atomic gases 15

Lecture 4.

Self-consistent field and collision-less dynamics for plasma. Plasma oscillations and the Landau damping. 20

Lecture 5.	
	<i>Diffusion approximation for the Boltzmann equation. Fokker-Planck equation for heavy particle in a gas of light particles. Hot electrons in semiconductors and weakly ionized plasma. Electron temperature, current-voltage characteristics. Energy relaxation rate.</i>
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Lecture 6	
	<i>Coulomb collisions in plasma. Landau collision integral for the Coulomb scattering. Heat transport from electrons to ions. Running away.</i>
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Lecture 7.	
	<i>Boundary problem for kinetic equation. Normal and anomalous skin-effect.</i>
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Lecture 8.	
	<i>Kinetics of cascade processes. An example: ‘ballistic’ phonons in dielectrics. Non-local phonon thermo-conductivity.</i>
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Lecture 9.	
	<i>BBGKY hierarchy of kinetic equations. Fluctuation of the distribution function. Equilibrium and non-equilibrium noises. Example: Noise of hot electrons in semiconductors.</i>
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Lecture 10.	

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Lecture 11.	
	<i>Quantum kinetics. Wigner function and kinetic equation. Magnetic resonance. Bloch equation. Longitudinal and transverse relaxation rates. Examples. Non-linearity, saturation. Hyperfine interaction of Overhauser effect.</i>
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Lecture 12.

Non-equilibrium superconductivity. Kinetic equations. Charge imbalance. Penetration of electric field in superconductors. Collective excitations. . . 60

Appendices

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Gases of rotating molecules. 68

Appendix 3.

Plasma in Magnetic Field. Collision-less Hydrodynamics. Waves and Instabilities. Modification of Collision Integral in Magnetic Field 71

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Sound attenuation in metals. Non-linear attenuation. 74

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Kinetics of spin magnetization in metals 77

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Kramers' Problem of Escape from a Trap 80

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