

SEMICONDUCTOR PHYSICS, TRANSPORT AND SPINTRONICS

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First part:

Band structure and relativistic effects in solids. Spin-orbit coupling, spin relaxation and spin transport.

Two-dimensional structures and integer quantum Hall effect. Graphene as a single-layer two-dimensional material.

Quantum wires: conductance and conductivity, Landauer theory of one-dimensional quantum transport.

Quantum dots: zero-dimensional quantum systems and as spin-based qubits.

Electric dipole spins resonance and spin manipulation by electric field.

Second Part:

Review of electronic structure theory: We will review the main features of band theory that we will apply for topological characterization.

Adiabatic perturbation theory.

Introduction to topology: Berry and Zak phase and the Chern theorem.

Chiral anomaly and magnetoelectric response