



Quantum Theory Of The Optical And Electronic Properties Of Semiconductors

Hartmut Haug, Stephan W Koch

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This invaluable textbook presents the basic elements needed to understand and research into semiconductor physics. It deals with elementary excitations in bulk and low-dimensional semiconductors, including quantum wells, quantum wires and quantum dots. The basic principles underlying optical nonlinearities are developed, including excitonic and many-body plasma effects. Fundamentals of optical bistability, semiconductor lasers, femtosecond excitation, the optical Stark effect, the semiconductor photon echo, magneto-optic effects, as well as bulk and quantum-confined Franz Keldysh effects, are covered. The material is presented in sufficient detail for graduate students and researchers with a general background in quantum mechanics. This fifth edition includes an additional chapter on Quantum Optical Effects where the theory of quantum optical effects in semiconductors is detailed. Besides deriving the semiconductor luminescence equations and the expression for the stationary luminescence spectrum, results are presented to show the importance of Coulombic effects on the semiconductor luminescence and to elucidate the role of excitonic populations.

Contents: Oscillator Model; Atoms in a Classical Light Field; Periodic Lattice of Atoms; Mesoscopic Semiconductor Structures; Free Carrier Transitions; Ideal Quantum Gases; Interacting Electron Gas; Plasmons and Plasma Screening; Retarded Green's Function for Electrons; Excitons; Polaritons; Semiconductor Bloch Equations; Excitonic Optical Stark Effect; Wave-Mixing Spectroscopy; Optical Properties of a Quasi-Equilibrium Electron Hole Plasma; Optical Bistability; Semiconductor Laser; Electroabsorption; Magneto-Optics; Quantum Dots; Coulomb Quantum Kinetics; Quantum Optical Effects.

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