Nanophysics 2024

1. Basics of crystal structures, reciprocal space
2. Bloch wave functions, electronic energy bands: occupation, envelope functions
3. Electronic energy bands: effective mass, doping
4. Electronic surface states: general features
5. Semiconductor-metal interface
6. Semiconductor heterostructures
7. Field-effect transistors and quantum wells
8. Experimental techniques in Nanophysics: samples preparation
9. Experimental techniques in Nanophysics: low-temperature techniques
10. Experimental techniques in Nanophysics: SPM, AFM, STM
11. Two-dimensional electron gas: General properties
12. Two-dimensional electron gas: Magnetoconductance
13. Quantum Hall effect: Basic information
14. Graphene: Main properties and band structure
15. Diffusive and ballistic quantum wires
16. Quantum point contact: Conductance quantization
17. Ballistic quantum wires: Conductance quantization
18. Phase coherence, Aharonov-Bohm effect in nanostructures
19. Weak localization
20. Resonant tunneling
21. Coulomb blockage: principle and devices
22. Single-electron tunneling devices: Main principles
23. Single-electron tunneling devices: “Diamond” diagrams
24. Quantum dots: Energy spectrum
25. Quantum dots: Manifestation of magnetic field
26. Quantum dots: Conduction resonances
27. Nanomechanics
28. Nanophotonics
29. Mesoscopic superlattices
30. Magnetic superstructures. Physics of giant magnetoresistance
31. Spintronics
32. Superconductivity as nanoscale quantum phenomenon, applications of superconductors
33. Nanoscale superconductivity