Lecture2

1. Which Limitations of Classica physics were at the end of XIX, beginning in the XX century? Why is quantum physics important?
2. What are matter waves? Derive wave equation for the plane wave.
3. Schrödinger equation for free particle in 1D/3D space, general view.
4. Difference between particle and wave nature.
5. Uncertainty (Heisenberg) principle.
6. Compare the behavior of particle in a 1D box and in a harmonic oscillator.
7.

Lecture3

8. Free particle in 3D box. The density of states of a particle in 3D box.
9. Fermi-Dirac distribution.
10. Free particle in quantum well. DOS
11. Free particle in quantum wire
12. Free particle in quantum dot
13. Compare the behaviour of the free particle in 3D, 2D, 1D, 0D

Lecture4

14. Hydrogen atom in quantum mechanics (main conclusion, spectral lines)
15. H2 molecular ion
16. H2 molecule
17. Schrödinger equation at the Solid state

Lecture5

18. Types of bonds, range with binding energies
19. Difference between covalent and ionic bonding
20. Madelung constant for 1D chain and for 2D plane

Lecture 6

21. Models of electrons in solids (Drude theory, Sommerfeld theory, Jellium model)
22. Van der Waals bonding (nature, examples)
23. Lennard-Jones potential (between atoms, for fcc crystal)
24. VdW forces between macroscopic bodies: ball and surface, two surfaces, two balls
25. Hydrogen bond

Lecture 7

26. Dispersion relation for vibrations of the one-dimensional monoatomic harmonic chain. Comparison with sound waves
27. Reciprocal and direct lattice
28. Dispersion relation for vibrations of the one-dimensional diatomic harmonic chain.
29. Monoatomic vs diatomic chains with k1=k2

Lecture 8

30. Dispersion relation of the tight binding chain. What does it describe?
31. Effective mass

Writing exam (Professor Cuniberti): 17/02/2025 HSZ/E05/U, 09:20-10:50.

Location for the oral exam (Professor Helm): Nöthnitzer Str. 61, 1.0G on the right.