TOPICS OF THE LECTURES OF CONDENSED MATTER PHYSICS

[AM X = Ashcroft Mermin Chapter X; LL X Y Z = Landau Lifshits vol X chap Y sec Z; HM X = Hansen McDonald Chapter X]

L1,2	23 sep 2022	2h Introduction. The condensed phases of matter. The liquid phase. The van der Waals equation.
L3,4	27 sep 2022	2h Correlation functions. Structure factor [HM 1]. The solid phase: amorphous and crystalline solids. Crystal lattices. Bravais Lattices in 1 and 2 dimensions
L5	28 sep 2022	1h Bravais Lattices in three dimensions
L6,7	30 sep 2022	2h Primitive vectors. Primitive cell. Conventional cell. Wigner-Seitz primitive cell. Lattices with a basis. The example of the honeycomb lattice. Reciprocal lattice and its properties [AM 4, see also AM 7].
L8,9	4 oct 2022	2h Exercises on Bravais lattices and reciprocal lattices.
L10	5 oct 2022	1h Lattice planes. Miller indices [AM 5].
L11,12	7 oct 2022	2h X-ray diffraction from a crystal: Bragg's formulation. [AM 6].von Laue's formulation and its equivalence with Bragg's formulation. Ewald's construction. Ewald's sphere. von Laue's method. The rotating crystal method.
L13,14	11 oct 2022	2h The Debye-Scherrer method. The structure factor. The atomic form factor. Exercises on X-ray scattering from crystals with the simple cubic, bcc, fcc and diamond structure.
L15	12 oct 2022	1h Exercise on X-ray diffraction [AM problem 1 page 108]
L16,17	14 oct 2022	2h Exercises on X-ray diffraction with the Debye-Scherrer method.
L18,19	18 oct 2022	2h Exercises on X-ray diffraction with the Debye-Scherrer method. The Born-Oppenheimer approximation.
L20	19 oct 2022	1h The harmonic approximation for lattice vibrations.
L21,22	21 oct 2022	2h Normal modes of a one-dimensional Bravais lattice. Born-von Karman periodic boundary conditions. [AM 22]. Normal modes of a one-dimensional Bravais lattice with basis [AM 22]. Acoustic and optical modes.
L23,24	25 oct 2022	General formulation of the theory of harmonic lattice vibrations. [AM 22: see also LL V VI 69]. Acoustic and optical modes. Born-von Karman periodic boundary conditions in a three-dimensional crystal.
L25	26 oct 2022	The quantum theory of the harmonic crystal. Phonons. [AM 23].
L26,27	28 oct 2022	The thermodynamics of phonons. Free energy and internal energy

L 28	2 nov 2022	The specific heat of solids. Einstein theory. Specific heath of optical modes. [AM 23].
L29,30	4 nov 2022	Debye theory of the specific heath. Debye's interpolating formula. [AM 23].
L31,32	8 nov 2022	Exercise on the phonon mode of a linear crystal with basis
L33	9 nov 2022	Exercise on the phonon contribution to the specific heath at high and low temperatures.
L34,35	11 nov 2022	Exercises on phonons.
L36,37	15 nov 2022	Electron states in a periodic potential. Bloch's theorem. [AM 8]. Periodic boundary conditions.
L38	16 nov 2022	Second proof of Bloch's theorem.
L39,40	18 nov 2022	Quasimomentum. Energy bands. Metals and insulators. Density of states of Bloch electrons. The Fermi surface.
L41,42	22 nov 2022	Exercises on Bravais lattices, x-ray scattering, and phonons.
L43	23 nov 2022	Exercises on Bravais lattices, x-ray scattering, and phonons.
L44,45	25 nov 2022	First mid term assessment test.
L46,47	29 nov 2022	Thermodynamic properties of Bloch electrons. Sommerfeld expansion. [AM 8, see also AM 2]. Chemical potential and specific heat of Bloch electrons.
L48	30 nov 2022	Electrons in a weak periodic potential [AM 9].
L49,50	2 dec 2022	The tight-binding method to calculate the electron bands in solids [AM 10]. Examples of applications of the tight-binding method.
L51,52	6 dec 2022	The semiclassical model of Bloch electron dynamics. Group velocity. Effective mass. Motion in a uniform electric field. Motion in a uniform magnetic field. Closed and open orbits. [AM 12]. The Drude formula.
L53	7 dec 2022	Exercises on the tight-binding method.
L54,55	9 dec 2022	Exercises on the tight-binding method.
L56,57	13 dec 2022	Homogeneous semiconductors [AM 28].
L58	14 dec 2022	Exercises on homogeneous semiconductors.
L59,60	16 dec 2022	Doped semiconductors. Predominantly extrinsic regime. The electrical conductivity of semiconductors.
L61,62	20 dec 2022	Exercises on doped semiconductors.
L63	21 dec 2022	Exercises on doped semiconductors.
L64,65	10 jan 2023	Exercises on Bloch electrons and tight binding.
L66	11 jan 2023	Exercises on tight binding.
L67,68	13 jan 2023	Exercises on tight binding.