

MANY-BODY PHYSICS: 12 lectures

Syllabus (2017)

Alexander Nersesyan

August 10, 2016

1 PHONONS: 4 lectures

1. Lattice dynamics in one dimension

- Classical harmonic chain. Continuum limit and sound waves in elastic string
- Quantum approach: acoustic phonons
- Lattice with a basis: optical phonons

2. Lattice dynamics in three dimension

3. Thermodynamics: Debye model

4. Lattice stability; role of dimensionality

2 MAGNONS: 4 lectures

1. Exchange Hamiltonian

2. Spin waves in ferromagnets

- Holstein-Primakoff transformation
- Equations of motion

3. Spin waves in antiferromagnets

4. Broken symmetry and Goldstone modes

3 ELECTRONS ON A LATTICE: 4 lectures

1. **Tight-binding model. Band spectrum**
2. **Electrons on a diatomic chain: band insulator with a charge density wave**
3. **Types of band spectrum in two and three dimensions**
4. **Electron-phonon interaction; Peierls insulators; soliton excitations**
5. **Hubbard model: Mott insulators**