MANY-BODY PHYSICS: 12 lectures
Syllabus (2017)

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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**