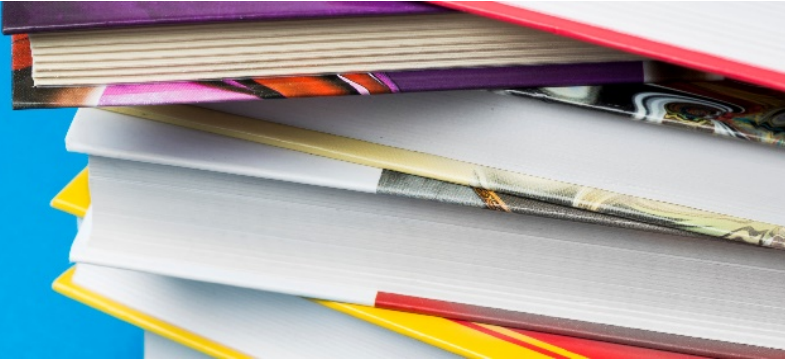
TEL AVIV UNIVERSITY אוניברסיטת תל אביב

Full Syllabus



Course Title

ADVANCED QUANTUM FIELD THEORY IN CONDENSED MATTER

Lecturer

Eran Sela

Semester

2

Course requirements

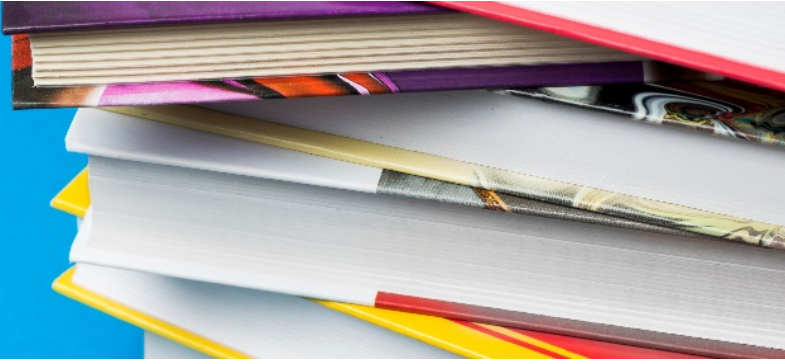
Submission of exercises, short presentation in the last week, final exam.

Final grade components

Exercises 10%, presentation 20%, exam 70%

Course schedule

Class no. / Date	Subject and Requirements (assignments, reading materials, tasks, etc.)
1	From particles to fields, Classical harmonic chain: phonons, Quantum chain
2	Second quantization: Applications, Electrons in a periodic potential, Interaction effects in the tight-binding system, Interaction effects in the tight-binding system, Hubbard model, Heisenberg Hamiltonian
3	Interacting fermions in one dimension, Quantum spin chains, Anderson impurity Hamiltonian
4	Feynman path integral, Construction of the path integral, Semiclassics from the path integral, Applications, Path integral for spin
5	Functional field integral, Coherent states, Field integral for the quantum partition function, Matsubara frequencies
6	Field theoretical bosonization
7	Symmetry breaking, mean field theory, long range order, effective theory and Goldstone modes. Superfluidity versus superconductivity. Anderson-Higgs mechanism
8	Low dimensional systems, Mermin-Wagner theorem, the xy model, Kosterlitz-Thouless transition.
9	Kondo effect and the renormalization group, strong coupling theory, Local Fermi liquid theory, multichannel Kondo effect.
10	Exact solution of Luttinger model, Sine-Gordon model, renormalization group analysis, semiclassical interpretation of strong coupling theory.
11	Quantum Magnetism: Jordan-Wigner transformation, spin chains, Lieb-Shultz-Mattis theorem, the Haldane gap.



12	Topological phases and Quantum Hall effect: Topological field theory, Chern-Simons theory Berry phase,topological band insulators, topological superconductors, Majorana fermions
13	Aharonov-Bohm effect and fractional statistics in 2D, quasiparticle excitations in fractional quantum Hall effect, ground state degeneracy, quantum gauge theories. Topological terms in spin systems

Required course reading

Optional course reading

Quantum Field Theory of Many Body Systems: Xiao-Gang Wen
Condensed Matter Field theory: Alexander Altland and Ben Simons
Quantum Physics in One dimension: Tierry Giamarchy

Comments