SYLLABUS

Physics 8750.001
Advanced Topics in Condensed Matter Physics
Spring, 2016

Instructor: Prof. Andrey V. Chubukov
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Office hours Any time, but please be reasonable
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Tentative Schedule of Topics

Theory of interacting fermions


2/3-2/8 Perturbation theory, diagrammatic technique.

2/10-2/15 Fermi liquid theory via diagrammatics, effective mass.
2/17 Luttinger theorem.
2/22 Beyond Landau Fermi liquid theory.

Superconductivity
2/24 BCS theory, gap equation, universal relations.
2/29-3/2 Diagrammatics, normal and anomalous Green’s functions.
3/7-3/9 Response functions, conductivity, neutron and Raman scattering.

Density-wave orders
4/4 Charge-density-wave order. Examples.
4/6-4/11 Hubbard-Stratonovich transformation. Landau theory for density-wave (and superconducting) orders.

Boson-Fermion models
4/13 Spin-fermion model, derivation.
4/18-4/20 Quantum-critical behavior, non-Fermi liquid.
5/2-5/4 Interplay between magnetism and superconductivity, parquet renormalization group.

Exam schedule
2/3-2/10 Homeset #1
2/17-2/24 Mid-Term Exam
3/2-3/9 Homeset #2
3/16-3/23 Homeset #3
3/30-4/6 Mid-Term exam
3. **Grades** Each solution will be graded on the conventional (A-F) grading system. Valid grades are $A$ -5 points, $AB$ - 4 points, $B$ - 3 points, $BC$ - 2 points, $C$ - 1 points $D$ - 0.5 points, and $F$ -0 points. The total grades for mid-term exams will be based on the following scheme: $A$ - 15-14 points, $AB$ - 13-12 points, $B$ - 11-10 points, $BC$ - 9-8 points, $C$ - below 8 points. For the final exam, the total grades will be as follows $A$ - 25-22 points, $AB$ - 21-19 points, $B$ - 18-16 points, $BC$ - 15-13 points, $C$ - below 13 points. The final grade for the course will be based on the mid-term exams (30% each), and on the final exam (40%). Besides, to get $A$ or $AB$, one should present solutions for all four home sets and collect more than 66% of the maximum total number of points graded on the same system. To get $B$, one should collect more than 50% of the maximum total number of points.

4. Class attendance is required.