SYLLABUS

Physics 751
Advanced Solid State Physics
Fall, 2001

Instructor:	Prof. Andrey V. Chubukov
Address:	B307 Sterling
Office hours	Any time, but please be reasonable
Phone	263-3919

Text 1: E.M. Lifshitz, L.P. Pitaevskii Statistical Physics, v.2, Pergamon Press, 1980; This book is available for purchase in the University Bookstore and is on reserve at the Physics Library.

Text 2: A. L. Fetter and J.D. Walecka Quantum Theory of Many Body Systems, McGrow-Hill, 1971;

Text 3: G. Mahan Many-Particle Physics, Plenum Press, 1990.

Tentative Schedule of Topics

9/5	Introduction, Fermi-gas of free particles

Normal Fermi-liquid

9/7-9/14	Hartree-Fock approximation, Lindhard screening, weakly-nonideal Fermi-gas.
9/17-9/24	Landau theory of a Fermi liquid: excitations, zero-sound, Landau $f-$function, effective mass.

9/26-10/1	Green functions of a Fermi system: definitions, analytic properties, relation to quasiparticle excitations, Green function of an ideal Fermi gas.
10/3-10/10	Diagammatic technique for Fermi systems at $T = 0$: how to do calculations.
10/12-10/22	Self-energy and a two-particle Green function: definitions, diagrammatic representation, relation to the scattering amplitude and Landau $f-$function, zero-sound.
10/24-10/29	Ward identities.
10/31-11/7	Diagammatic solution for weakly nonideal Fermi gas.
11/9-11/14	Diagmmatic technique at $T \neq 0$: retarded and advanced Green functions, Matsubara frequencies.

Electrons in a crystal

11/16	Luttinger theorem.
11/19-11/23	Hubbard model, spin-density-wave and charge-density-wave instabilities.
11/26-11/28	Electron-phonon interaction.

Superconductivity

11/30-12/3	Gap equation, thermodynamics, normal and superfluid densities.
12/5	Fermi-systems with repulsive interaction: Kohn-Luttinger effect.
12/7-12/10	Green functions of a superconductor: normal and anomalous Green functions.
12/12-12/14	Meissner effect.

Exam schedule

9/21-10/1	Homeset #1

10/5-10/15	Mid-Term Exam.
10/26-11/5	Homeset #2
11/9-11/19	Mid-Term exam
11/30-12/10	Homeset #3
12/14-12/21	FINAL EXAM

Three credit students

1. Exams. Each three-credit student will take a total of three exams (including the final exam). Each mid-term exam will have 3 questions, final exam will have 5 questions. Exam dates are listed on the Schedule of Topics. The dates are tentative and are subject to change. Exams will cover the assigned lectures. Approximately 2/3 of the questions will be drawn from the textbook, others will be drawn from lectures.

2. Problem Sets. There will be 3 problem sets, each set will have 6-10 problems and will be due in 10 days.

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** - 15-13 points, **AB** - 12-11 points, **B** - 10-9 points, **BC** - 8-7 points, **C** - below 7 points. For the final exam, the total grades will be as follows **A** - 25-21 points, **AB** - 20-18 points, **B** - 17-15 points, **BC** - 14-12 points, **C** - below 12 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.