Physics 6555– Advanced Solid State Physics I

Syllabus – Fall 2002

Instructor: Massimiliano Di Ventra
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Office hours: by appointment

Recommended Texts: No single book will be followed. Different sources will be used for different subjects. The following sources are the most used:

- G. Mahan, "Many-Particle Physics"
- R.D. Mattuck, "A Guide to Feynman Diagrams in the Many-Body Problem"
- E. Fradkin, "Field Theories of Condensed Matter Systems"
- A.L. Fetter and J.D. Walecka, "Quantum Theory of Many-Particle Systems"
- Ph. A. Martin and F. Rothen, "Many-Body Problems and Quantum Field Theory"
- E.K.U. Gross, E. Runge, O. Heinonen, "Many-Particle Theory"
- P.L. Taylor and O. Heinonen, "A Quantum Approach to Condensed Matter Physics"
- A.M. Zagoskin, "Quantum Theory of Many-Body Systems"
- J.W. Negele and H. Orland, "Quantum Many-Particle Systems"
- S. Doniach and E.H. Sondheimer, "Green's Functions for Solid State Physics"
- R.P. Feynman, "Statistical Mechanics, A Set of Lectures"

Prerequisites: Statistical Mechanics, Quantum Mechanics, Solid State Physics (5555 and 5556 level). It is particularly required the knowledge of the adiabatic approximation, band theory, mean-field and Hartree-Fock approximation, screening, and phonons.

Lectures: Monday, Wednesday 4:00 PM – 5:15 PM, Robeson Hall 101.

Grading: On average, one exercise per week will be assigned that will count 70% of the final grade. At the end of the semester the students will have to pass an exam that will count 30% of the final grade.

List of Topics:

Second quantization for fermions and bosons, field operators
Green's functions, Wick's theorem, Dyson's equation, Feynman diagrams
Renormalization
Quasiparticles, Self Energies, Spectral functions
Quantum liquids: Fermi and Luttinger liquids
Strongly-interacting electrons
Kondo effect
Quantum phase transistions and metal-insulator transistion
Quantum Hall Effects