Physics 217 Introduction to Quantum Field Theory I Fall 2010

Instructor:	Stefano Profumo
Office:	ISB, Room 325
Phone Number:	831-459-3039
Office Hours:	Thursdays 1:00-2:00 PM (or by appointment)
E-mail:	`profumo@scipp.ucsc.edu`
Course Web Page:	`http://scipp.ucsc.edu/~profumo/teaching/phys217_10/phys217.html`
Lectures:	Tuesdays and Thursdays, 10:00 AM – 11:45 AM
Lecture Room:	ISB, Room 231

Course Description

This course is the first quarter of a 2-quarter graduate-level introduction to relativistic quantum field theory (QFT). The focus is on introducing QFT and on learning the theoretical background and computational tools to carry out elementary QFT calculations, with a few examples from tree-level quantum electrodynamics processes. The course will be broadly based on the first 5 chapters of the Peskin and Schroeder book.

Course Outline

1. Quantum Mechanics, Special Relativity and their “marital issues”
2. Elements of Classical Field Theory
3. The Klein-Gordon Field
4. The Dirac Field
5. Discrete Symmetries of the Dirac Theory
6. Perturbation Theory
7. Feynman Diagrams
8. Elementary Processes in QED
9. Schwinger-Dyson Equations and Functional Integrals

Required Textbook

- *An Introduction to Quantum Field Theory* by Peskin and Schroeder (1 day reserve)

Other Reference Textbooks

- *Modern Quantum Field Theory* by Banks (1 day reserve)
- *Quantum Field Theory* by Srednicki (1 day reserve)
- *Quantum Field Theory* by Mandl and Shaw (1 day reserve)
- *The Quantum Theory of Fields: Foundations* by Weinberg (3 days reserve)
- *Quantum Electrodynamics* by Berestetskii, Lifshitz and Pitaevskii (3 days reserve)
- *Quantum Field Theory* by Itzykson and Zuber (3 days reserve)
- *Relativistic Quantum Mechanics* by Bjorken and Drell (3 days reserve)
- *A Modern Introduction to Quantum Field Theory* by Maggiore
- *Fields* by Siegal

Homeworks and Grading Policy

Grading will be based on weekly or bi-weekly homework exercises. Each homework will consist of typically 1-2 exercises on the material discussed in class, or on complements to that material. The homework problems will be posted on the course web page during the quarter. After attempting each problem by yourself, you are encouraged to discuss the problems with the Instructor and with each other.

One week after the homework is handed out, during the first half hour at the beginning of class 1-2 "*volunteers*" will either spontaneously step forward or (in the absence of volunteers) will be drafted by the Instructor to solve the assigned problems, or to sketch the solution on the blackboard. Volunteers will rotate throughout the class participants, and will be required to write full solutions to the problems in LaTeX by the following week. Grading will be given according to the quality of (i) the oral presentations, (ii) the timeliness and quality of the LaTeX-ed solutions (a LaTeX skeleton template is provided on the Course webpage) and (iii) the interaction/suggestions given to the volunteer when one is not at the blackboard (i.e. participation will be an important component).

The idea behind this homework and grading policy is to familiarize you with presenting orally your work and in producing a written account of what you learnt. Doing this effectively is a fundamental skill for your current and future research career. Presenting orally, in particular, both at the informal level of group meetings and at the more formal level of conference talks or job interviews is of crucial importance to the successful scholar. Interaction with those presenting their research is also a fundamental aspect of doing research. Further, this will give everybody an opportunity to discuss and re-think the assigned homework material, and to try to conceptualize and digest it in order to present it to others. Finally, writing up the solutions will help you familiarize with writing scientific-style papers and with the gymnastics related to learning to use LaTeX, and will help others by providing clearly written solutions and complements to the homework.