PHY 8850 – Quantum Field Theory – Syllabus

Semester: Winter 2012

Lecturer:

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Lecture Time/Room:

Lecture **Monday, Wednesday, Friday 11.45 am - 12.40 pm**, 185 Physics Building

Suggested Texts:

D. Bailin and A. Love, **Introduction to Gauge Field Theory**, (IOP Publishing, Graduate Student Series in Physics);
M. E. Peskin, D. V. Schroeder, **An Introduction to Quantum Field Theory**, (Addison-Wesley Publishing Company);
L. H. Ryder, **Quantum Field Theory**, (Cambridge University Press).

Office Hours: anytime by appointment.

Grading: Your course grade will be determined by your performance in homework assignments and a Final Project on the basis of the following distribution:

Homework Projects (typically every 10 days)	80%
Final Project	20%

The overall course grade will be determined on the basis of the following curve:

Grade	Cumulated Score	Grade	Cumulated Score
A	91-100	C	60-64
A-	85-90	C-	55-59
B+	80-84	D+	50-54
B	75-79	D	45-49
B-	70-74	D-	40-44
C+	65-69	E	0-39

The completed homework assignments are due at 5 pm on the date specified, typically 10 days after the assignment is given. Late submissions are accepted, but maximum possible score for the late assignment will be linearly decreased according to the formula $N = N_{\max}\left(1 - 0.2n\right)$, where n is the number of days.

Course description and objectives:

This course provides an introduction to modern methods of quantum field theory, including renormalization, regularization, path integrals, Feynman diagrams, applications to scattering process and bound states, QED and QCD. It is suitable for students of theory and experiment in the fields of nuclear, particle, and solid-state physics.

Topics to be covered:

1. **Lagrange formalism.** Symmetries and conservation laws.
2. **Classical field theory.** Scalar fields. Spinor fields. Massless vector fields. Supersymmetry and superfields.
3. **Path integrals.** Path integrals in quantum mechanics.
4. **Quantum field theory of a scalar field.** The generating functional. Green functions. Effective action. Scattering amplitudes and Feynman rules. Scattering cross-sections.
5. **Interactions.** Scalar φ^4 theory as the simplest example. Momentum space. Green functions.
6. **Quantum field theory with fermions.** Gauge field theories.
7. **Quantum electrodynamics (QED) and quantum chromodynamics (QCD).** Feynman rules. Quantization of QCD. Scattering amplitudes with gauge fields.
8. **Renormalization** of φ^4 theory. Renormalization of QED and QCD at one loop.
9. **Standard Model and examples.** Calculations of experimentally observed processes.

Depending on how much time we have left, we will discuss other related topics, such as spontaneous symmetry breaking.

Website: http://www.physics.wayne.edu/~apetrov/PHY8850/