

# Department of Physics University of Maryland

Physics 851 Syllabus

FALL 2003

**Course Title:** Advanced Quantum Field Theory

**Course Description:** An introduction to advanced topics in relativistic quantum field theory is presented, with an emphasis on the use of this formalism to describe the fundamental physics of matter and energy.

**Instructor:** Sylvester J. Gates, Jr., Room 4121 (Physics Building),  
telephone: 301-405-6025,  
e-mail: gatess@wam.umd.edu

**Text Required:** Ramond, *Field Theory : A Modern Primer, Revised*,  
(Addison-Wesley, 1995).

**Text Recommended:** Ramond, *Journeys Beyond the Standard Model*,  
(Perseus Books, 1999).

**Recitation Section:** Under normal circumstances this class will meet on Tuesday and Thursday, 11:00 - 12:15 in the Physics Bldg., Rm. 1304.

## Office Hours:

The course instructor is available for scheduled office hours between 12:30 a.m. - 1:30 p.m. every Monday and Tuesday under ordinary circumstances. However, students are encouraged to contact Prof. Gates for meetings at other times as so desired.

For students with access to electronic mail, inquiries may be sent to the instructor at any time via e-mail.

## Grading:

The final grade for the course will be determined by the following formula;

$$\text{F.G.} = \frac{1}{2}(\text{H. W.}) + \frac{1}{2}(\text{XAM}) \quad ,$$

where H. W.  $\equiv$  (Score on homework) and XAM  $\equiv$  (Score on final exam).

**Examination:**

There will be a take-home final examination for the course. The examination will be handed out on **Nov. 22**, and is due **Dec. 13**.

**Homework:**

\* Homework will normally be assigned at two week intervals and collected one week later.

\* Graded homework will be returned one week after submission.

\* **ABSOLUTELY NO LATE HOMEWORK WILL BE ACCEPTED.**

Please staple papers and write your name on front page.

**Tutorial Assistance:**

Any student seeking additional assistance is urged to contact the course instructor as desired.

**Adjustments to Course Schedule**

The last day of scheduled adjustment is November 10.

**Academic Dishonesty**

Academic dishonesty is a serious offense which may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of “XF” denoting “failure due to dishonesty” that will normally be recorded on the official transcript of the offending student.

**Course Outline of Topics**

We will cover the following material.

## 1: Introduction

Symmetries

Spin Statistics, CPT

Group Theory and Quark Model

Scattering Theory

## 2: Quantization

Path Integrals

Field Quantization – Klein-Gordon & Dirac

Feynman Rules

- 3: Abelian Gauge Theories
  - QED
  - Green's Functions, propagators & BRST
  - Ward identity
  
- 4: Non Abelian Gauge Theories
  - BRST
  - Renormalization Methods
  - Renormalization Groups
  
- 5: Nonperturbative Issues
  - Instantons
  - Monopoles
  
- 6: Anomalies

Time allowing, I shall discuss other topics to be accompanied by notes to be handed out. These are

- (a.) Gauge Theory and the Standard Model
- (b.) The Gauge Theory Basis for Gravitational Theories
- (c.) Operator Product Expansion
- (d.)  $\frac{1}{N}$  Expansion