AM 529b, Winter 2004

INTRODUCTION TO SUPERSYMMETRY

Time & Place: To be determined.

Instructor: Dr. Alex Buchel , office WSC 115 , Ext: 88794 , E-mail: **abuchel@uwo.ca**

Office hours: To be determined.

Course webpage: **http://abuchel.apmaths.uwo.ca/∼public/susy2004/**

Prerequisites:

On the physics side: Lagrangian formulation of classical mechanics, Maxwell equations, Lorentz invariance (special relativity), Quantum Mechanics.

On the math side: analysis on the complex plane (holomorphy, analytical continuation), rudimentary group theory ($SU(2)$, Lorentz group).

Course outline:

I. Qualitative supersymmetry:

a. Coleman-Mandula theorem (Why supersymmetry?).

b. Supersymmetric quantum mechanics: vacuum properties, superfields, instantons.

II. Perturbative supersymmetry:

a. Representations of the Lorentz group and supersymmetry algebra.

b. $\mathcal{N}=1$ superspace and chiral superfields.

c. Effective actions, nonrenormalization theorems, $nl\sigma m$.

d. Moduli space, "integrating out", and singularities in effective actions.

e. Supersymmetry breaking in the $nl\sigma m$.

f. Vector superfields and superQED.

g. Spontaneous symmetry breaking (supersymmetry and/or gauge symmetry).

III. Nonabelian gauge theories:

a. Quantum gauge theories.

b. Θ-angles and instantons.

c. Anomalies.

d. SuperQCD.

e. Non-renormalization in supersymmetric gauge theories.

IV. Nonperturbative supersymmetry:

a. Supersymmetric Yang-Mills theory.

b. Supersymmetric QCD.

c. Phases of $\mathcal{N} = 1$ gauge theories.

V. Supersymmetric theories with low-energy photons (Seiberg-Witten model)

a. Monopoles.

b. Electric-magnetic duality.

c. Exact solution of $\mathcal{N} = 1$ $SU(2)$ gauge theory with adjoint χsf.

d. Dual Higgs mechanism and confinement.

Text:

The primary text are lecture notes "Introduction to Global Supersymmetry" by Philip Argyres, available at **http://www.physics.uc.edu/∼argyres/661/index.html**. Addition resources will be posted on the course webpage.

Course evaluation:

Course grade will be based on 2 homework assignments. There will be no final exam. For people really interested in learning the subject, there will be additional 'suggested exercises' at the end of each lecture. I will not post solutions to these additional problems, but will be happy to discuss them during my office hours.

Feedback to the instructor regarding the quality, speed, and content of presentation is especially appreciated during the semester!