

Univ. of Winnipeg Dept. of Physics  
Fall 2013-14

## PHYS-3103 Special Topics: String Theory

Lecture Times: W 1:30-3:00PM

Room: 3C33

Instructor: Dr. Andrew Frey

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Office: 2L26

Office Phone: 786-9215

WWW: <http://ion.uwinnipeg.ca/~afrey/FW1314/strings/>

Office Hours: by appointment

### Course Description

This advanced course will present an introduction to string theory, including quantization of the string and extra dimensions. This will primarily be a reading course with minimal lectures.

**Office Hours:** Due to the nature of the course and use of the lecture period to answer and address questions, additional office hours will be by appointment.

### Textbooks

There is one required text.

- **Required:** *A First Course in String Theory* by B. Zwiebach, 2nd ed.

In addition, some extra reading (from other texts, journal articles, etc) may be assigned.

### Topics

We will discuss

- Relativity in extra dimensions — Light-cone — Compactification — Electromagnetism in general dimensions — Gravity in general dimensions
- Lagrangian mechanics of relativistic particles and strings
- Quantization of the point particle — Introductory field theory — Light-cone quantization
- Symmetries and gauge fixing
- Light-cone string quantization — Closure of Lorentz algebra — Open and closed strings
- D-branes — Worldvolume theory — Charges
- Dualities — T-duality — S-duality and the web of string theories — AdS/CFT
- String and black hole thermodynamics
- String phenomenology and cosmology

Not all topics above will be covered equally or necessarily in the order listed. Also, some topics may be skipped due to time constraints.

### Assignment Policies

**Reading & Summaries:** Reading assignments will be posted on the course web page each week. You are responsible for keeping up with the reading since the responsibility for learning in this class is your own. *In addition, you must submit a reading summary each week.* This summary will be due Wednesday at 9AM prior to the course meeting for the week (for example, the summary for reading to be discussed at 1:30PM Sept 18 is due at 9AM Sept 18). The summary should be one to two pages and typed or legibly written. In content, it should explain what you learned from the reading and indicate your questions. Those questions should be indicated clearly, either by font choice (bold, underlining, or italics) or in a list at the end.

**Homework:** There will be 2 homework assignments, the first due in October and the second during exam period. Assignments will be posted on the course web page (see above) in PDF format. They will **NOT** be handed out in class, so you must tell me if you cannot access the assignments! Homework solutions will be posted on the course web page as soon as possible after the homework is due. Collaboration on the problems is allowed, but each student must write up the solutions independently. Late assignments will **not** be accepted without prior permission from the instructor.

**Final Project:** Students will work in pairs to review an advanced or contemporary topic not covered in the main course reading. Topic selection will be coordinated with and approved by the instructor. Then the pair of students will give a short (approximately 10 minute) presentation to the class during exam period.

**Organization:** Your summaries and homework solutions should be written (or typed) neatly with steps explained *as if you were writing a research paper*. Not all algebra need be shown if the steps are explained in words; however, showing your work may improve your credit if you make a mistake. Multiple pages must be stapled together. Assignments should be turned in to the labeled dropbox outside room 2L26 marked with your name and “Strings.”

**Regrading:** If you feel that there is a mistake in grading, I will regrade each problem in question completely. It is possible that newly discovered mistakes will reduce your credit. Please also see the section on appeals.

## Evaluation

**Grades:** Grading will be done on a Standing (S)/Failing (F) basis. A student will receive a grade of Standing if he/she

- turns in all or all but one of assigned reading summaries,
- achieves at least 50% marks on each homework assignment, and
- participates satisfactorily in the final project.

The instructor will take feedback from each student’s partner about participation in the final project.

**Important Dates:** Dates to note include

- Voluntary Withdrawal Date: Oct 24, 2013
- Final Assignment Due: Dec 13, 2013

## Miscellaneous

**Appeals and Misconduct:** See the **Academic Regulations and Policies** section of the **Course Calendar** regarding appeals and academic misconduct. The minimum penalty for **cheating** on any course work will be a failing course grade.

**Services for Students with Disabilities:** Students with documented disabilities, temporary or chronic medical conditions requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., access to volunteer note-takers) are encouraged to contact Accessibility Services (AS) at 786-9771 or email [accessibilityservices@uwinnipeg.ca](mailto:accessibilityservices@uwinnipeg.ca) to discuss appropriate options. Specific information about AS is available on-line at <http://www.uwinnipeg.ca/accessibility>. All information about a student’s disability or medical condition remains confidential.

The University of Winnipeg promotes a scent-free environment. Please be respectful of the needs of your fellow classmates and your instructor by avoiding the use of scented products while attending lectures. Exposure to perfumes and other scented products (such as lotion) can trigger serious health reactions in persons with asthma, allergies, migraines or chemical sensitivities.