## Physics 503: Elementary Particle Physics Fall 2022

Instructor: Dr. Jake Bennett (jvbennet@olemiss.edu) Web: https://physics.olemiss.edu/bennett/ Office: Lewis 105 Office Hours: MW 1:00-2:00 pm, Th 11:00 am-noon and by appointment

Class Time: MWF 12:00-12:50 pm

Class Location: Lewis 104

## **Course Description**

This one-semester course on elementary particle physics will include an introduction to fundamental particles, their interactions, and the techniques used to detect them.

#### **Course Objectives**

At the end of this course, students should be able to

- describe the fundamental particles and interactions;
- identify the substructure of composite particles and classify them according to quantum numbers;
- articulate fundamental symmetries and their implications for particle decays;
- explain how common particle detectors operate and identify their limitations; and
- perform simple programming tasks related to data analysis.

#### Texts

There is no required text for this class. Reading assignments will be made available as needed. I will draw from several texts and other resources for lecture material, including, but not limited to

- *University Physics, Vol 3*, by OpenStax. Available online at the OpenStax page. Covers some of the basics.
- *Introduction to Elementary Particles, 2nd Ed.*, by David Griffiths (2008). A simple and straightforward review of fundamental particles. A bit dated, but a very nice introduction to the content.
- *Introduction to High Energy Physics, 4th Ed.,* by Donald H. Perkins (2000). A standard review of particles and interactions. A bit more advanced than Griffiths.
- *Quarks and Leptons: An Introductory Course in Modern Particle Physics,* by F. Halzen and A. D. Martin (1991). Somewhat dated regarding experiment, but good presentation of theory, including Feynman diagrams, cross sections, etc.
- *Introduction to Elementary Particle Physics,* by A. Bettini (2008). Covers the basics of elementary particles without theoretical rigor.
- *Modern Particle Physics*, by M. Thomson (2013). A bit more recent and nice figures, doesn't assume a lot of QFT knowledge.

- *Phenomenology of Particle Physics*, by A. Rubbia (2022). An up to date and very thorough review of the field, including both theory and experiment.
- *Particle Data Group: Review of Particle Physics,* available online at pdglive.lbl.gov. An important complement to any text to get present-time information in an often rapidly changing field. Includes some very good reviews and collections of useful information.
- *Published research articles* will be used occasionally.

#### Assessments

- Homework (30%) Homework sets will be assigned weekly. It is very important to start early and finish homework on time.
  - As scientists and engineers normally work in groups, students are encouraged to work together on homework to teach and learn from each other. However, each student is responsible for understanding all details of each solution.
  - Homework help sites such as Chegg are a liability, not a resource. Depending on sites like these are a sure way to do poorly on a quiz or exam. It is also cheating and a great way to fail the course. Instead, work with peers or the instructor. Teaching peers is a great way to solidify your understanding!
  - As is true for most physics classes, you must show your work to get full credit. Solutions alone will receive no credit. You work must be clear and include text notations as needed.
  - There is no penalty for extensions past the due date during the first two weeks of class. After the first two weeks, there will be a 10% penalty per day the assignment is late.
- In-class activities (20%) In-class activities will include whiteboard activities and group problem solving work. If insufficient time is available to complete an in-class activity, it will be extended, as announced by the instructor. Students are expected to attend all classes. **Every three unexcused absences will result in a drop of one letter grade for the course, according to the grading scale below.**
- Quizzes (20%) Short quizzes will be given regularly. These quizzes are intended primarily to show students where their understanding is weakest and help to focus their study. All quizzes are closed book (no books, notes, or "cheat-sheets"), individual assignments.
- Final exam (30%) The comprehensive final exam will be held on Friday, December 9, at noon.

## **Grading Scale**

- 92%  $\leq A \leq 100\%$
- 88% ≤ A- < 92%
- $84\% \le B+ < 88\%$
- $80\% \le B < 84\%$
- 76% ≤ B- < 80%
- $72\% \le C + < 76\%$
- $68\% \leq C < 72\%$
- $64\% \le C < 68\%$
- $50\% \le D < 64\%$
- F < 50%

#### Policies

#### Academic Integrity

Every student of the University of Mississippi, by virtue of choosing to be part of the university community agrees to abide by the University of Mississippi Creed and the UM Academic Integrity Policy which covers academic integrity. Please consult the M-Book, Academic Integrity document for details on university policy and the academic creed.

# Cheating is forbidden and will result in a zero grade on the assignment. If a second case of cheating occurs, this will result in an F for the entire course.

*UM Creed* The University of Mississippi is a community of learning dedicated to nurturing excellence in intellectual inquiry and personal character in an open and diverse environment. As a voluntary member of this community:

- I believe in respect for the dignity of each person
- I believe in fairness and civility
- I believe in personal and professional integrity
- I believe in academic honesty
- I believe in academic freedom
- I believe in good stewardship of our resources
- I pledge to uphold these values and encourage others to follow my example

All materials distributed electronically and in hard copy in this class are protected under intellectual copyright. Any attempt to upload these documents onto the Internet (or to distribute them by some other means) or to profit from the distribution (by Internet or other means) of these documents constitutes theft and will be in violation of intellectual property law and the UM Academic Conduct Code unless expressly permitted for by the instructor. Accessing such materials for your own use is also in violation of the UM Academic Conduct Code.

#### Disability Access and Inclusion:

The University of Mississippi is committed to the creation of inclusive learning environments for all students. If there are aspects of the instruction or design of this course that result in barriers to your full inclusion and participation, or to accurate assessment of your achievement, please contact the course instructor as soon as possible. Barriers may include, but are not necessarily limited to, timed exams and in-class assignments, difficulty with the acquisition of lecture content, inaccessible web content, and the use of non-captioned or non-transcribed video and audio files. If you are approved through SDS, you must log in to your Rebel Access portal at https://sds.olemiss.edu to request approved accommodations. If you are NOT approved through SDS, you must contact Student Disability Services at 662-915-7128 so the office can: 1. determine your eligibility for accommodations, 2. disseminate to your instructors a Faculty Notification Letter, 3. facilitate the removal of barriers, and 4. ensure you have equal access to the same opportunities for success that are available to all students.

#### Audio and video recording

Audio and/or video recording of class lectures is not allowed unless explicit permission is given by the instructor. Permission will only be given if the student has a Student Disability Services request. In such cases, recordings may only be used by the student to whom permission is given and all recordings must be deleted at the end of the semester. Recordings may not be distributed online or elsewhere.

### **Important Dates**

See the academic calendar (http://registrar.olemiss.edu/spring-2021)