Kent State University - Physics Department

PHY 46301/56301 – Introduction to Nuclear and Particle Physics

Course Syllabus – Spring Semester 2014

Course Objective (4 credit hours): To learn basic concepts of nuclear-particle physics, including particle detectors and accelerators, experimental techniques, nuclear fission/fusion and associated reactors, medical applications, nuclear astrophysics and particle cosmology**.**

Class Hours: 2:15 pm - 3:30 pm, Monday, Wednesday and Friday, Math. Bldg. 276

Instructor: Dr. Gerassimos G. Petratos, Professor of Physics
Office/Phone: 314 Smith Physics Hall, (330) 672-5408
Email/Bio info: gpetrato@kent.edu, http://www.kent.edu/CAS/Physics/people/~gpetrato/
Office Hours: 3:45 pm - 5:30 pm, Monday, Wednesday and Friday

Teaching Assistant/Grader: Mr. Tyler Hague, Graduate Student

Recommended Textbooks (on reserve at the Kent State Library):

1) The ideas of Particle Physics: an Introduction for Scientists**.** By Guy Coughlan, James Dodd, and Ben Gripaios, 3rd edition, Cambridge University Press, 2006.

2) Quarks, Leptons and the Big Bang. By Jonathan Allday, 2nd edition, Institute of Physics Publishing, 2002.

3) An Introduction to the Physics of Nuclei and Particles. By Richard Dunlap, Thomson Brooks/Cole, 2004.

4) Introduction to Nuclear Particle Physics. By Ashok Das and Thomas Ferbel, 2nd edition, World Scientific, 2003.

5) Nuclear and Particle Physics, an Introduction. By Brian Martin, 2nd edition, John Wiley, 2009.

6) Subatomic Physics. By Ernest M. Henley and Alejandro García, 3rd edition, World Scientific, 2007.

7) Particles and Fundamental Interactions: an Introduction to Particle Physics. By Sylvie Braibant, Giorgio Giacomelli, and Maurizio Spurio, 2nd edition, Springer, 2012. Available as electronic book.

Exams: Exam I: Monday, February 17
Exam II: Monday, March 31
Exam III: Wednesday, May 7, 12:45 pm

Final Grade Components:

Exam I:	24 %
Exam II:	24 %
Exam III:	24 %
Quizzes - Attendance:	5 %
Homework:	15 %
Project:	8 %

Final Grade Scale: A: >= 90 (90-92: A-, 93-96: A, 97-100: A+)
B: >= 80 (80-82: B-, 83-86: B, 87-89: B+)
C: >= 70 (70-72: C-, 73-76: C, 77-79: C+)
D: >= 60 (60-62: D-, 63-66: D, 67-69: D+)
F: < 60

Important Notes

- Previous course work requirements: Intro Modern Physics (36001) is prerequisite and Math for Physical Science (32052) is pre/corequisite for this course (or permission).
- Attendance is absolutely mandatory and will be monitored. Students must notify instructor (by email) for the reason of a class absence.
- There will be absolutely zero tolerance on cheating or other academic dishonesty (see relevant University Policy section).
- No sleeping, eating or drinking during the class.
- No texting or web surfing during the class. All cell phones, iPads, laptops and other gadgets must be turned off.
- Homework will be assigned each week. It must be worked out during the week after the assignment, or as noted by the instructor.
- All exams and quizzes will be closed-books-and-notes ones.
- There will not be review sessions conducted before the exams.
- There will not be a "cheat sheet" handout with Physics or Mathematics formulas available in the exams.
- No curving or other dubious grading schemes will be applied in the final grade determination.
- If necessary (for a fully justified/documented reason), one make-up exam can be taken, together with Exam III at the end of the course.

Course Content Outline

- **Kent State University Catalog Description:**

  Introduction to nuclear and particle physics including particle detectors and accelerators, experimental techniques, nuclear fission/fusion and reactors, medical applications, and connections to astrophysics and cosmology.

Topics to be covered include:

- Radioactivity
- Interaction of radiation with matter
- Particle detectors
- Particle accelerators
- Basic experimental techniques
- Nuclear counting statistics
- Scattering cross section
- Rutherford scattering and findings
- Electron-nucleus scattering
- Liquid drop model of nucleus
- Shell model of nucleus
- Nucleon-nucleon force and scattering
- The deuteron
- Nuclear decays and reactions
- Fission
- Fusion
- Nuclear reactors
- Baryons
- Mesons
- Leptons
- Quark and gluons
- Electromagnetic interactions
- Weak interactions
- Strong interactions
- Symmetries and conservation laws
- Neutrino oscillations
- Grand unification
- Supersymmetry and strings
- Nuclear astrophysics
- Particle cosmology
- Medical and industrial applications

Learning Outcomes (per official Departmental guidelines)

Upon successful completion of this course, the student will be able to:

1. Demonstrate a satisfactory level of familiarity with basic concepts of Nuclear-Particle Physics, including particle detectors and accelerators, experimental techniques, nuclear fission and fusion and reactors, medical applications, and connections to astrophysics and cosmology.
2. Solve quantitative fundamental problems of subatomic physics, including radioactivity, experimental techniques, nuclear structure, particle interactions, and particle collisions and decays.

In-class Activities:

1. Students will take notes, be responsible for asking questions when clarification is needed, and participate in discussion topics posed by the instructor.
2. There is no laboratory activity in this course.
3. The course credit is based mostly on student performance on a midterm and a final exam.

Out-of-class Activities:

1. Students are required to read the class notes and sections of mandatory or recommended textbooks, and consult other reference material.
2. Students are assigned homework problem sets weekly, which mostly consist of quantitative problems.
3. Students are expected to meet out of class with the instructor for clarification on course material and assistance with homework or test preparation, as necessary and appropriate.

Additional Information

For important dates see: **http://www.kent.edu/registrar/calendars/stu_important_fall.cfm**

*The official registration **add/drop deadline** for this course is **January 26**. The course **withdrawal deadline** is **March 23**. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashLine) prior to the deadline indicated. Registration errors must be corrected prior to the deadline.*

University policy 3-01.8 deals with the problem of academic dishonesty, cheating, and plagiarism. None of these will be tolerated in this class. The sanctions provided in this policy will be used to deal with any violations. Should you have any questions, please read the KSU policy at **http://www.kent.edu/policyreg/policydetails.cfm?customel_datapageid_1976529=2037779**.

University policy 3342-3-18 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (visit **http://www.kent.edu/sas** *or call 330-672-3391 for more information on registration procedures).*