

Course syllabus
Physics 451 –A Survey of Contemporary Physics
3 credit hrs.

SPRING 2018

Instructor: Prof. H.H. Weitering
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Time and place: Room 306 in the Nielsen Physics Bldg.
Meeting times: 2:10-3.25 PM on Tu/Tr
Office hours: Tu/Tr 3:30-5:00 PM or by appointment (ask Mrs. Showni Medlin in the Physics Office)

NB: **This course satisfies the General Education Oral Communication requirement.**
This course replaces PHYS 401.

Course Description and Learning Objectives:

This course is intended for senior physics majors as the capstone experience but it is also open to other students. The central objective of the course is to expose the student to modern physics research beyond the college textbook level and to convey the importance of basic and applied physics research to other science disciplines and the general public. You will learn to synthesize and apply appropriate concepts and methods from thermodynamics, electrodynamics, and quantum theory to selected topics of contemporary physics research. In addition, you will be trained in communicating and articulating the basic principles and broader significance of these topics to a non-expert audience. The latter is an essential component of a physicist's training as he or she will need to find a job, defend research proposals and expenditures to reviewers, funding agencies, politicians, and ultimately the tax payer. The course consists of a series of advanced topic lectures (including guest lectures), discussions, reading assignments, and six oral presentations, all in an informal setting. An important objective of the course is for students to learn how to give clear, scientific presentations, from preparing materials to executing impactful talks.

Degree level learning objectives: Physics majors will be able to synthesize and apply appropriate concepts and methods from different areas of physics to selected problems in current physics research.

Outline:

- Introduction to the course. Reading “More is Different” by P.W. Anderson, and “A Lesson in Humility” by Daniel Kleppner (first week).
- Introduction to giving scientific presentations. How to prepare engaging presentation materials.
- Read Science Magazine’s Breakthroughs of the Year (2017), along with two of your favorite Nobel lectures.
- Concurrently, “How to get your message across”. What is the point of your presentation? What do you want your audience to take away?
- Bosons, Fermions, and Fermi gases
- Hartree, Hartree-Fock, and Density Functional Theory approaches to the many-body problem (1/25 – 2/13)
- Failures of DFT: Mott insulators, Spontaneous symmetry breaking, Emergence (2/15 – 2/22)
- Concurrently, “Delivering a confident presentation”
- Superconductivity Part I: Phenomenological Theory
- Superconductivity Part II: Microscopic Theory
- Guest lectures on Nuclear Emergence, the Higgs boson, general relativity and the Universe
- Quantized conductance, Quantum Hall Effects, Topological Insulators
- Final presentations on the next Nobel prize

Each student will give four fifteen-minute presentations. Oral presentation dates will be announced two weeks ahead of time.

Prerequisites: One semester of quantum mechanics (PHYS 411).

Textbook: There will be handouts on the physics content of the course. For the oral communication aspects, we will use “When the Scientist presents” by Jean-Luc Lebrun (costs around \$28 on Amazon or World Scientific).

Grading: Based on class participation (60%) and presentations (40%). There will be no exams.

Attendance policy: Because your grade will be based on class participation, I expect you to be present. In case you cannot make it, please discuss this with me before class. More than two unexcused absences will lower your course grade by one or several units (e.g. A becomes an A- or B+).

Disability statement: Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact Student Disability Services at <https://sds.utk.edu> to coordinate reasonable accommodations for students with documented disabilities.