SYLLABUS

Course Information:

PHYS 222 Section 1 [CRN# 74575] — Comprehensive Physics II — Spring 2019
Lecture: M, W & F 10:00-10:50 [Workman 109]
Recitation: W: 14:00-15:55 [Workman 109]

|**Professor:**.....Dr. David Meier, Workman 359
| Tel: 835-5340, email: david.meier@nmt.edu (preferred,
|**Office Hours:**.....M: 11:00-12:00, T: 14:00-15:30, Th: 14:00-15:30; or by appointment
|**Class Webpage:**.....kestrel.nmt.edu/∼dmeier/phys222/phys222.html

Learning Outcomes:

|**Program Learning Outcomes:** Program mission / learning outcomes are available at the top of the main NMT physics webpage. Upon successful completion of this course you will be prepared to meet your next milestones in your undergraduate study of physics.

|**Course Learning Outcomes:** Upon successful completion of this course students will be able to solve basic problems in gravitation, electromagnetism and particle physics. The central outcome of this unique course is to go beyond Newtonian thinking to understand the world view from the perspective of a modern (20/21st century) physicist. Its main focus is to understand the specific particles and forces that Nature uses. Students will be able to explain what are the four fundamental forces and the particles they interact with (the "standard model of particle physics"). The student will be able to describe and compare the different ways of explaining the concept of forces. In addition, students will be able to apply mathematical reasoning, particularly (4-)vector analysis and calculus, to solve real world physics problems and from that develop spatial reasoning and visualization as applied to both relativistic and non-relativistic systems. Also the student will show that they can read the textbook *and* peer-reviewed literature with comprehension and communicate (oral and written) about them in a coherent fashion.

Course Requirements:

|**Required Text:**.....*A Radically Modern Approach to Introductory Physics — Volume II; 2nd edition* — D. J. Raymond
|**Pre-requisites:**.....*PHYS 221, MATH 131*
|**Co-requisites:**.....*PHYS 122, PHYS 222 L, MATH 132*

|**General Course Policy / Expectations:** Welcome to the sophomore-level comprehensive physics course, part II. The following class policy is designed to make your learning as effective and pleasant as possible. If a particular aspect of the class policy is not working, I reserve the right to change it as we go along. However, I will do my best to be fair and give advanced notice. You are urged to communicate with me if you need to discuss class material or policy. An email is the quickest way to get ahold of me outside office hours.

You will be expected to actively participate in all aspects of the course. Significant interaction between student/instructor and student/student is expected (especially in the Recitation). Utmost effort should be made by all to handle such interactions in a respectful, supportive and friendly manner.

|**Attendance / Participation:** Attendance is required for all class sessions. This includes both Lectures and Recitation. New (and required) material may be presented in any class session. Participation grades will be evaluated based on regularity of attendance and level of in class participation (both Lectures and Recitation).

|**Exams:** There will be three exams throughout the term. It is anticipated that exams will occur in Recitation or the finals period. All requests for make up exams must be associated with an excused absence *requested ahead of time* and require acceptable documentary proof of said excuse. The nature of the accommodation is at the discretion of the instructor and may be different in format/material from the in-class exam. The exams will cover material from the previous test up to the current point. Exams will test your *independent* mastery of the course material so you must do the work alone. You will be permitted use of notes and a calculator (exact amount and form to be determined). No "smart" devices (those that can connect to the internet or to other devices) are permitted in exams.

|**Homework:** The homework (HW) problems and due dates will nominally be announced at the beginning of class (and on the class webpage) on the day a chapter is begun in Lecture. The HW will include mostly end of chapter textbook problems, each of equal weight, but may be supplemented by additional problems. Nominally, HW turned in late will lose 5% per day up to a maximum of 30%. Credit will be given up until the exam that covers that material occurs. [If you are late on an assignment please go back and do it, you can still obtain up to 70% credit.] This late policy may be modified, based on class discussion. Working in groups to set up the problems is permitted (encouraged during Recitation) but all turned in assignments must be your own work written up individually (see the academic honest policy below). HW must be written legibly and show all work in clear and followable narrative. If the grader cannot follow the train-of-thought credit will be lost.

|**Textbook / Chapter Summaries:** Material covered will follow the textbook topically, however the relative focus will not be weighted the same and not all chapters may be covered. The material covered is novel and likely is not the way you've seen it presented elsewhere (if you have seen it at all). Therefore it is vital that you have read and considered the chapter material ahead of time. To motivate this, chapter summaries will be required to be completed by the time we begin the material in Lecture. The chapter summaries should be approximately 250 words in length and describe: i) a brief summary of the material presented in the chapter at the level of detail necessary to make it clear that the chapter was read, ii) **a brief description of the parts of the chapter you found most interesting, and perhaps most importantly**, iii) **identify** *specific* **sub-topics that you did not understand in reading the chapter**. Grading of chapter summaries will be on a 0 (low) - 5 (high) scale. The grading is based on the carefulness with which i) - iii) are addressed and **not** on your level of mastery of the material. I am not particular about specific formatting of the chapter summaries as long as they are legible and match the above length and topic requirements. Chapter summaries **cannot** be made up (there will be no excused absences for these!).

|**Reports:** This class will also include a report. You can never get too much experience writing and speaking. As budding physicists it is also key to begin to develop experience reading, understanding and explaining clearly the physics literature. The report will serve to give you practice with both of these. You will select a *peer-reviewed* paper of historical significance (see below), read it, generate a detailed outline of what you plan to present and then, upon approval, develop a report on it. The report will be in the form of a ∼15 minute oral presentation at the end of the semester. The report should introduce the paper's basic physics (including background information), discuss its key discovery/result, place its significance to the field in context. Paper choices will be allocated on a first-come first-served basis with overlap minimized. Report outlines will be due ∼1 month after the topic choice deadline. Grading will be based on both scientific content and clarity of presentation.

|**Lab:**
Officially the Lab is a separate course from the Lecture. All grading issues for the Lab are entirely the providence of the Lab instructor. I cannot guarantee any direct association between the Lecture presentation and the Lab material.

|**Grading:**

Exams (x3)	45 %
Homework	30 %
Chp. Summaries	5 %
Report Outline	5 %
Report	10 %
Participation/Effort	5 %

Grading Scale — A: 90 - 100 %, B: 80 - 89 %, C: 70 - 79 %, etc.
(I reserve the right to curve the grades [up only] if necessary)

Counseling and Disability Statement:

Reasonable Accommodations: New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office of Counseling and Disability Services (OCDS) as soon as possible. To schedule an appointment, please call 835-6619.

Counseling Services: New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. The confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

Academic Honesty: New Mexico Tech's Academic Honesty Policy for undergraduate students is found in the NMT Undergraduate Catalog,
http://www.nmt.edu/images/stories/registrar/2018-2019_UNDERGRADUATE_Catalog_FINAL.pdf

You are responsible for knowing, understanding, and following this policy.

Respect Statement: New Mexico Tech supports freedom of expression within the parameters

of a respectful learning environment. As stated in the New Mexico Tech Guide to Conduct and Citizenship: New Mexico Tech's primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education. Tech seeks to protect academic freedom and build on individual responsibility to create and maintain an academic atmosphere that is a purposeful, just, open, disciplined, and caring community.

Candidate Papers for PHYS 222:

(Others may be suggested by the student with consent of instructor)

- **Rutherford 1899**, Philosophical Mag, xlvii, 109 — Discovery of α and β radiation
- **Geiger & Marsden 1909**, Proc. Royal Soc, 82, 495 — Discovery of the nucleus
- **! Einstein 1916**, Annalen der Physik, 354, 769; *Die Grundlage der allgemeinen Relativitatstheorie* — General Relativity
- **Gamow 1928**, Zeitschrift fur Physik, 51, 204; *Zur Quantentheorie des Atomkernes* — Quantum Tunneling & Radioactive decay
- **Hubble 1929**, Pub. Nat. Acad. of Sci., 15, 168 — Discovery of the Expanding Universe
- **Pauli 1930**, *Open letter to the group of radioactive people at the Gauverein meeting in Tbingen.* — Proposal of the neutrino
- **Pauling 1931**, J. Am. Chem. Soc., 53, 1367 — Quantum description of the chemical bond
- **Anderson 1932**, Phys Rev 43, 491— Discovery of Antimatter
- **Chadwick 1932**, Proc. Royal Soc., 136, 692 — Discovery of the Neutron
- **Lawrence & Livingston 1932**, Physical Review 40, 19 — Invention of the cyclotron
- Knoll & Ruska 1932, Zeitschrift fur Physik, 78, 318 — Invention of the electron microscope
- **Fermi 1934**, Zeitschrift fur Physik, 88, 161 — Theory of β-decay (weak interaction)
- **Bethe 1939**; Physical Review, 55, 434 — Explanation of the Sun's power source
- Meinter & Frisch 1939/ Frisch 1939; Nature, 143, 239 / Nature, 143, 276 — Nuclear Fusion
- **Cockcroft & Watson 1932**, Proc. Royal Soc., 137, 229 — Transmutation of elements
- Lattes et al. 1947, Nature, 169, 54 — Discovery of mesons (pion)
- Rochester & Butler 1947, Nature, 160, 855 — Discovery of strangeness (Kaon)
- **Hopper & Biswas 1950**, Phys Rev, 80, 1099 — Discovery of baryons heavier than the proton/neutron
- **Reines & Cowan 1956**, Nature, 178, 446 — Discovery of the neutrino
- **Lee & Yang 1956**, Phys Rev, 104, 254 — Discovery of Parity violation
- **McAllister & Hofstadter 1956**, Phys Rev, 102, 851 — Discovery of proton substructure
- **Aharonov & Bohm 1959**, Phys Rev 115, 485 — Aharonov-Bohm effect
- **! Englert & Brout 1964 -or- ! Higgs 1964**, Phys. Rev. Letters, 13, 321 / Phys Rev Letters, 13. 508 — Proposal of the Higgs mechanism
- **Gell-Mann 1964**, Physics Letters, 8, 214 — Quark model
- **Penzias & Wilson1965**, Astrophysical Journal, 142, 419 — Discovery of the Cosmic Microwave Background
- **! Weinberg 1967**, Physical Review Letters, 19, 1264 — Electro-weak Unification
- **Hewish et al. 1968**, Nature, 217, 709 — Discovery of Pulsars
- **Breidenbach et al. 1969**, Phys Rev Letters, 23, 935 — Discovery of quarks
- **Augustin et al. 1975 -or- Aubert et al. 1974**, Phys Rev Letters, 33, 1406 / Phys Rev Letters, 33, 1404 — "November Revolution", discovery of Charm
- **Taylor & Weisberg 1982**, Astrophysical Journal, 253, 908 — Discovery of Gravitational radiation
- Arnison et al., Physics Letters B, 122, 103 — Discovery of the W boson
- **Anderson et al. 1995**, Science, 269, 198 — Discovery of Bose-Einstein condensation
- **Reiss et al. 1998 -or- Perlmutter et al. 1999**, Astronomical Journal, 116, 1009 / Astrophysical Journal, 517, 565 — Discovery of the Accelerating Universe
- **Kajita et al. 1999**, Nuclear Physics B Supplement, 77, 123 — Discovery of neutrino oscillations
- **Aad et al. 2012 -or- Chartrchyan et al. 2016**, Physics Letters B, 716, 1 / Physics Letters B, 716, 30 — Discovery of the Higgs Boson
- **Abbott et al. 2016**, Phys Rev Letters, 116, 061102 — Direct detection of gravitational waves

Bold = (An english translations of) the article is available
! $\equiv$ advanced mathematical level