Physics 420   University of Maryland   **Principles of Modern Physics**   Fall 2022 **Prof. B. L. Hu**

Description: Topics covered: Special relativity. Early quantum physics. Quantum mechanics. Hydrogen atom, Spin, Periodic table. Quantum statistics. (Molecules). This 3-credit course is designed primarily for engineering and physical sciences majors. Prerequisites: PHYS270 and PHYS271 (formerly: PHYS263) or PHYS273; and MATH246. Note: Credits only granted for PHYS371 or PHYS420, not both.

Lectures: **Mon** and **Wed 3:30-4:45pm** in **PLS 1140** [**Plant Science** Bldg is between Toll and Hornbake]
Lecturer: Prof. B.L. Hu Office: PSC3153, Phone: 301-405-6029 leave message, but you will get faster response via email blhu@umd.edu. Any important document you wish to present to me please pre-warn me by email. Do not hang anything on, or slip it under, my door, it may easily get lost. Leave it with our MCFP **Faculty Assistant**: Melanie Knouse in PSC 3140 Phone 301-405-6016 mknouse@umd.
My Office hours: M,W before/after classes -- please email me ahead of time to make arrangements.
TA:

Textbooks Required: *Modern Physics* by Serway, Moses and Moyer, 3rd Edition, Thomson, Brooks, Cole 2005. ISBN 0-534-49339-4. Reading: The progression of lectures for the planned topic(s) can be found in the Course Schedule below. T*ry to read the material in the text before coming to the lecture*. This will enable you to ask questions about ideas you may not grasp fully on the first reading and to gain a better overall perspective. ***Study the lecture notes closely** as that form the backbone of the course*. Follow the examples in the book, work on the problems. Keep this routine so you wouldn't fall behind.

Course webpage: Please check for new announcements, adjustment of topics or due dates in the course website at ELMS/CANVAS system: www.elms.umd.edu/page/student-support where you will also be able to access your exam grades. For questions call the Help Desk at 301.405.1500 or email elms@umd.edu.

Homework: There are 9 sets of homework problems, each set worth 20 points. Your lowest scored set will not be counted. Homework will contribute a max of 160 points* out of 600 max of your course score. Please scan your HW and submit through ELMS before 8pm on the due dates. Solutions will be posted soon after, thus no late homework will be accepted. I encourage group discussions but stress strongly the importance of thinking through and working out all the assigned problems on your own. *Don't rely on others' help, don't copy from the web, or just passively read the solutions.* It makes a real difference in your grasp of the subject matter which shows clearly in your exam performance.

*Grading scheme: 5 problems per set. One problem worth 8 points will be graded in detail, the remaining 4 problems, each worth 3 points, will be looked over, with partial credits assigned for approach and accuracy.

Mid-Term Exams: Two 75-minute closed book mid-term exams are scheduled on **October 12 (Wed) and Nov. 21 (Mon) during the lecture periods**. Each exam covers the lecture and text topics since the previous exam, and is likely to contain one or more problems based on the assigned homework. Each exam counts 25% towards your course grade. If you know for sure that you cannot take an exam (excuses are only for certified medical, official university or legal duty-related reasons, as stipulated in the University Rules) please notify me well in advance to discuss alternatives. There will be **no make-up exams.**

Final Exam is on **Final Exam Dec 16 1:30pm - 3:30pm** held in the classroom, covering chapters to be announced. It is worth 30% of total. Not showing up for the final exam will automatically set your course grade to an F.

Exams are meant to test your understanding and ability to apply concepts and techniques taught in the course, not how well you memorize the materials. You may bring one 4x6" index card to each mid-term exam, and a total of 3 to the final exam. Only definitions of quantities and defining equations, but no derivations or solutions, are allowed. The values of constants and some integrals will be provided. Only a non-programmable calculator with standard trigonometry function is allowed, no smart phones, I-Pads etc.

Academic dishonesty is a serious violation and will be dealt with strictly, according to University policy.

Course Grade: Your course score has 600 points max with 160 points for homework, 120 points for each of the two mid-term exams, and 200 points for the final exam. The course grade will be `curved'.

PHYSICS 420   CONTENTS and SCHEDULE   Fall 2022   Prof. B. L. Hu

Lectures: Week/Date	**Readings:** Chapters in *Serway,* *Moses and Moyer*, 3rd ed 2005	**Topics:** *schedule* [check ELMs for updates]	**Homework** # Due Date
1 8/29, 31	Chap **1** Relativity, Lorentz Transformations, Spacetime diagram		**#1** 9/14
2-3 9/7, 12, 14	Chap **2** Relativistic Energy-Momentum, 4-vectors, Scattering		**#2** 9/21
4 9/19, 21	Chap **3** Quantum theory of light. Particle nature of waves: Compton scattering. Photoelectric effect.		**#3** 9/28
5 9/26, 28	Chap **4, 5** Early Quantum Physics. Bohr Atom. Matter wave		
6 10/3	Chap. **5** Uncertainty Principle. Properties of wave functions		**#4** (4&5) 10/7
10/5, 10	Chap. **6** Schrodinger Equation. Operators, Probability Interpretation. Born Rules		
7 ==10/12 Wednesday==	==Exam 1==	==Chapters 1-5==	
8 10/17	Chap **6** Particle in a 1-Dim Box. Eigenvalues, expectation values		
10/19	Chap **8.1** Particle in a 2 & 3 D box. Degeneracy of eigenvalues		**#5** (Ch6)10/28
9 10/24	Chap **6** Density of State (preparing for Q Statistics). Quantum Oscillators		
10/26	Chap **7** Particle Flux, Junction Condition, Step/Barrier Potentials		**#6**(Ch7)11/4
10 10/31	Chap **6.5**, **7** Finite-Depth Well, Tunneling/ Reflection		
11/2	Chap **8** Hydrogen Atom: Spherical Harmonics. Orbital and Magnetic Q Numbers		
11 11/7	Chap **8** Radial function. Principal Q#. Energy levels, multiplicity		**#7**(Ch8)11/11
11/9	Chap **9** Atom in a magnetic field: Zeeman Effect without spin		**#8**(Ch9)11/18
12 11/14	Chap **9** Spin. Zeeman effect with spin. Spin-Orbit Coupling. Pauli Exclusion Principle		
11/16	Chap **9** Exchange Force. Atomic Structure.		
13 ==11/21 Monday Exam II Chapters 6 to 9.4== up to Nov 14 lecture (including Pauli Principle)			

No Class on Wed 11/23 [please note: We'll *add 15min to each of the 5 remaining lectures*]
*** *Have a Warm Thanksgiving! Travel Safe, Stay Safe* ***

14 11/28	Chap **9, 10** Periodic Table. Statistical Mechanics: Ensembles		**#9**(Ch10)12/9
11/30,	Chap **10** Canonical Distribution: Maxwell-Boltzmann, Equipartition. Micro to Macro		
15 12/5, 7	Chap **10** Q Statistics: Photons & Phonons. Fermi Gas model of metals, Laser.		
16. 12/12 Review			

Final Exam: Dec 16 (Friday) 1:30-3:30pm in a room to be announced.

Covers materials in the lectures on topics corresponding to Serway's **Chapters 2, 6-10 inclusive.**

*** Good Luck to all your exams!   Happy Holidays! *****