Modern Physics (PHY 371)

Instructor: Paulo Bedaque, PSC, room 3147. My email is the best way to contact me in an emergency including absence from an exam. The best way to ask a physics question is trough Piazza (see below).

Lecture times: MWF 1:00pm to 1:50pm

Office hours: Mondays 2:00pm. You can also email me to arrange for another time or try your luck and knock on my door and see if I'm available.

Grader: Yukari Yamauchi

Piazza: homework and their solutions, class notes and additional material will be posted on piazza.com. On Piazza students and the professor ask questions, have discussions and make announcements. All students should sign up for the class on Piazza. If you do not get an email inviting you to join Piazza send the instructor an email so he can fix that.

Textbook: There is no single book covering the discussed topics the way w will in this class. For this reason there is no required textbook. But I have a few suggestions that may help:

Special Relativity: For the Enthusiastic Beginner by David Morin (the first half of the book, most of what we will discuss in class, is available for free on the web).

Modern Physics: An Introductory Text, 2nd edition. We will not be following the text closely and will cover the first four parts of the book (and, maybe, a few selected topics of the rest).

Quantum Theory by J.P.McEvoy and Oscar Zarate is a little comics book with a lot of the historical and some of the physics of the early quantum mechanics. I encourage you to read it during the first month of class, before we actually discuss these topics in the lecture.

I will have my lecture notes available but most students will benefit from having a regular textbook.

Grades: The grade will be based on frequent homeworks (10%), one midterm (30%), one written essay (20%) and one final exam (40%). You are encouraged to work on the homeworks in groups but the final solution write up should be entirely yours. The exams are taken in class and are strictly individual. The goal

of the homework is to teach; the goal of the tests is to test.

Attendance: There is no attendance policy in this class. It is he student's responsibility, however, to find out about assignments and the topics discussed in his/her absence.

Syllabus and objectives: The goal of this class is to discuss relativity, quantum theory and a little thermodynamics, the two pillars of modern physics. We will spent about a month discussing special relativity, including spacetime diagrams and the formalism of four-vectors. We will then discuss briefly thermodynamics and then the experiments leading to the demise of classical mechanics and the conceptual revolutions they led to, from the evidence for the existence of atoms to the creation of the quantum mechanics. Time permitting, we will have a simplified discussion of a few more advanced topics. Particularly emphasis will be put on simple reasoning based on dimensional analysis and order of magnitude estimates based on general physical principles.

At the end of the class the student should be able to explain why special relativity, atomic theory and quantum mechanics are the basic theories describing the Universe by pointing out the experiments supporting each of its principles and the chain of reasoning leading to them. The student should also be able to qualitatively explain a variety of natural phenomena by applying these principles through rigorous reasoning.

Special Relativity

Galilean relativity

Speed of light is same all frames/ Michelson&Morley and other experiment
Notion of space-time
Lorentz Transformations and invariance of the space time-interval
Applications of relativistic kinematics (eg. velocity addition; Doppler effect)
Resolution of relativistic paradoxes
4-vector notation
Energy-Momentum four-vector
Applications of relativistic dynamics in collisions and decays.

General relativity: curved spaces and the equivalence principle

Thermodynamics

The concept of temperature

Conservation of energy and the first law of thermodynamics

The second law of thermodynamics and the concept of entropy

Atoms

simple kinetic theory; free classical gases

Chemistry

Rutherford scattering

Quantum Mechanics

Blackbody radiation
Photoelectric effect and notion of photon
Wavenumber and momenta of photon/Compton effect
Bohr atom and concept of atomic transitions
de Broglie hypothesis/ particles as waves
Davisson-Germer experiment
Motivating the Schrodinger equation
The infinite square well
Probability interpretation of wavefunction
Uncertainty principle at a qualitative level

Some qualitative phenomena: tunneling, quantization of spectra, stability of atoms

Spin

Identical particles: bosons, fermions, periodic table

Advanced topics (time permitting)

Insulators, conductors and semi-conductors

The standard model of particle physics

Hadrons and nuclei

Big Bang cosmology

Students with Disabilities: The University of Maryland is committed to providing appropriate accommodations for students with disabilities. Students with a documented disability should inform the instructor within the add/drop period if academic accommodations are needed. To obtain an Accommodation Letter prepared by Disability Support Service (DSS), a division of the University Counseling Center, please call 301.314.7682, e-mail dissup@umd.edu, or visit the Shoemaker Building for more information.

Medical excuses: Students are expected to inform the instructor in advance of medically necessary absences, and present a self-signed note documenting the date of the missed class(es) and testifying to the need for the absence. This note must include an acknowledgement that (a) the information provided is true and correct, and (b) that the student understands that providing false information to University officials is a violation of Part 9(h) of the Code of Student Conduct.

Religious Observances: It is the student's responsibility to notify the instructor within the first three weeks of class regarding any religious observance absence(s) for the entire semester. The calendar of religious holidays can be found at: http://faculty.umd.edu/teach/attend_student.html#religious]

Diversity: The University of Maryland values the diversity of its student body. Along with the University, I am committed to providing a classroom atmosphere that encourages the equitable participation of all students regardless of age, disability, ethnicity, gender, national origin, race, religion, or sexual orientation. Potential devaluation of students in the classroom that can occur by reference to demeaning stereotypes of any group and/or overlooking the contributions of a particular group to the topic under discussion is inappropriate.

Academic integrity: The UMD Honor Code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without

authorization, buying papers, submitting fraudulent documents and forging signatures. On every examination, paper or other academic exercise not exempted by the instructor, students must write by hand and sign the following pledge: **I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment)**. Allegations of academic dishonesty will be reported directly to the Student Honor Council: http://www.shc.umd.edu

University policies: http://www.ugst.umd.edu/courserelatedpolicies.html