

University of Maryland
PHYS 499X
Making Physics Experiments
Syllabus
Spring 2024

Professor

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Course Emphasis

Physics 499x is a laboratory course emphasizing practical skills used for making Physics experiments within the broader context of the maker movement and the maker culture. The course will cover design, fabrication, hands-on skills, repair, and safety. It will utilize the Physics Department's Makerspace (the Vortex) to offer a curriculum focusing on practical skills that are not otherwise covered in the traditional coursework (e.g.: carpentry, electronics disassembly/assembly, soldering, etc.).

Each week the course will have two 50 minute interactive lectures on practical skillsets. A two-hour lab will include hands-on experiential project-based learning in the makerspace, some field measurements on campus, and field trips to various campus locations (e.g. the various machine shops and maker spaces around campus). The first month of the semester the labs will cover skills we will then use to improve and repair some physics lecture demonstrations, or the design and fabrication of new lecture demonstrations.

Most projects will involve developing new lecture-demonstrations or upgrades to existing demonstrations. Projects will be evaluated based on specifications, a written manual, a project oral presentation, and results. Field measurements on campus may include photography, IR camera use, magnetic field measurements and possible Ground Penetrating Radar use. The field trips will be either to (1) campus locations where things are fabricated or (2) unique facilities that show different technologies.

Skills obtained and techniques learned in this course might serve as a gateway into the Physics Makerspace community, and should prepare students for experimental research experiences in future career trajectories, whether in

research or industry.

Students will be evaluated on participation, field work, and lecture demo project activities. Active participation by everyone is expected for us to make a real impact.

More information about the maker movement and culture can be found here:
https://en.wikipedia.org/wiki/Maker_culture

Location

Lecture meets Tuesday and Thursdays 11-11:50 p.m. in the Physics Maker Space: the Vortex.

The laboratory section will meet Thursday 2-3:50 p.m. in the Physics Maker Space: the Vortex.

The Vortex is located in the former physics welding shop (building 111), tucked between the physics and chemistry buildings. The official address is: Physics Welding Shop, 8124 Chemistry Ln, College Park, MD 20740 and you can get to there directly from the courtyard between the physics, chemistry, and math buildings. Occasional lectures or labs may morph into field measurement sessions or field trips to on-campus fabrication facilities.

Laboratory Practice and Write-ups

Students will work in groups in the laboratory activities. Format for the write-ups and possible associated videos will be discussed in lecture and the assignments. Students are encouraged to be creative with regard to the assignments. In cases where modifying the project is desired, an alternative design is needed; ideally those should be reviewed with the instructor prior to the modified project. All students are expected to work creatively during the course.

Grades

The semester grade for the course will be determined in the following way:

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Lab results and resulting documentation	50%
Participation in lab and lecture (sign-in)	20%
Homework and designs	30%

Preliminary list of laboratory activities and homework assignments (all labs will have a safety component), subject to amendment

- 1) Dead electronics tear-down, identification and harvesting
- 2) Intro to woodshop – constructing Schrödinger’s dice
- 3) Taking film (chemical) photographs outdoors

- 4) Welding steel
- 5) Soldering (Wee Blinky construction)
- 6) Solidworks assignment
- 7) Lecture demonstration upgrades
- 8) New lecture demonstrations

Preliminary list of lecture topics (preliminary)

- 1) Overview of making physics experiments; overview of the maker culture; safety intro -- all lectures will touch on safety
- 2) Safety and fire safety
- 3) Creativity and design
- 4) Electrical circuits, sensors and actuators
- 5) Materials overview
- 6) Traditional fabrication and power tools
- 7) Modern 3D/water/laser fabrication
- 8) CAD
- 9) Skills: knots, treads, cable, and sewing
- 10) Metal materials fabrication, welding/soldering
- 11) Plastics and glass
- 12) Composites and adhesives
- 13) Vacuum
- 14) Optics
- 15) Budgets/credit/venture creation
- 16) 3D printing

Additional possible topics:

vacuum forming
laser-cutting
optical systems
micro and nanofabrication
machine design II (power, rotating systems)
microcontrollers
vacuum technology