PHY 421 §1 2014 Fall (CRN 3817) Syllabus Modern Physics Laboratory

Course-Section Web Site: www.science.marshall.edu/foltzc/p421_14f.htm

Class meets: _T_R_ 10:00–11:50 in Science 281, from Aug.25 – Dec.05 (+ final Dec.09 @ 12:45)
Expect to do lab work in pairs (perhaps some trios) – form a team for each experiment.
In addition to _T_R_ 10–12 , lab work may be done at other times during the week.
All team members should be there (contributing!) whenever that project is being done.
Sci.281 is "free" M_W_F 9–1pm and M_W_F 2–6+pm … see me to unlock it for your team.

Instructor: Dr. Curt Foltz ; Science 159 ; foltzc@marshall.edu ; (304) 696-2519
office hours: MTW_F 12:30–2:00pm ; M_W__ 3:30–5:30pm ("free" M_W_F 9–12 , 2–3:30)

Catalog Course Description: PHY 421 Modern Physics Laboratory 2 hrs.
Laboratory exercises on modern physics topics, encompassing both experiments of historic significance and current applications. To be taken with Physics 320 or equivalent.

Recommended: Experimentation (Addison-Wesley, 1994) by David C. Baird
or try An Introduction to Error Analysis (University Science Books,1996) by John R. Taylor
or borrow Advanced LabVIEW Labs (Prentice Hall, 1999) by John Essick … in Sci.281
perhaps see Data and Error Analysis (Allyn & Bacon 1988) by William Lichten, in Sci.281
industry perspective in Design of Experiments (Elsevier, 2003) by Jiju Anthony
detail reference Building Scientific Apparatus (Cambridge, 2009) by John H. Moore

Overview: PHY 421 is a bridge from the "canned" intro labs, where you were told exactly what to do, toward open-ended exploration that you might do in capstone or grad school. We want you to figure out how to use a device, by inspecting its connections … then read its documentation to verify. We want you to assemble your own set-up arrangement and see how well it works … or re-arrange it to get better data. We want you to decide that you need a micrometer to measure a width … or that you need 2 more hours of data-taking.

For many of these experiments we expect precise & accurate results, so measure carefully. We want you to know how precise you results are; so record measurement uncertainties, to propagate them thru the data analysis. Some uncertainties will be obviously statistical, but you must estimate others. Several labs obtain a value for some fundamental constant – watch for systematic errors that will deflect the value you obtain.

Proceed cautiously, treating the apparatus gently – much of this equipment is expensive, and not easily repaired – and we usually don't have a spare.

Plan to do 8 or 10 experiments during the semester. Some experiments are more difficult than others, some are not difficult but are time-consuming. Expect a glitch to occur in an otherwise straight-forward demonstration, which might cost an entire week.

Grade Components: Lab notebook … random inspections … and Lab work … 20%
"contributed talk" 12 minute presentations … 3 × 10% each = 30%
"physics journal" concise Lab reports … 3 × 10% each = 30%
"group meeting" informal presentation … 2 – 4 (the rest) = 20%

Experiments to Select from : Others might become available as the semester progresses

Speed of light using laser from spinning mirror	2 days
Detecting ether motion by rotating a Michelson Interferometer	2 days
Muon detection deep beneath Earth's atmosphere	1 day
Compton scattering of x-rays or gamma-rays measuring $E(\theta)$	2 days
X-ray diffraction thru foils and electron diffraction thru foil	1 day
x-ray Bragg scattering from crystals	2 days
UV-vis photon wavelengths and their photoelectric effect	1 day
photon polarizations and their interference	2 days
Electron charge-to-mass ratio (e/m)	1 day
electron charge e, a la Milliken	2 days
blackbody emission spectrum	1 day
electron spin resonance	2 days
Zeeman effect	2 days
Collisional excitation of atomic levels (Franck-Hertz)	2 days
deuterium atom emission spectrum, difference from H	2 days
complicated atom emission and absorption spectrum	1 day
X-ray line emission by various materials	2 days
Nuclear alpha and beta shielding, deflection, and detection	2 days
nuclear radioactivity and randomness investigation	1 day
nuclear half-life investigation	1 day
nuclear magnetic resonance	2 days

Statements that are valid for ALL Classes at Marshall:

These are printed in your MU catalog – the most recent version is also on-line at
www.marshall.edu/academic-affairs/?page_id=802

+ Academic Dishonesty Policy: progress in science is founded on honesty and openness – no lying, no cheating, no stealing, no copying – zero tolerance!

+ Absence Policy: email me ASAP after any missed class (before visiting Dean of Students); if class-work slides "too far" behind (3 weeks max) before Nov.01, you should withdraw.

+ Incomplete Grade Policy: to receive an "I", you must have completed ¾ of the course successfully (passing); course work must be completed within 1 semester (by 2014 May)