

A New Sequence of Advanced Laboratory Courses at the University of Wisconsin Oshkosh

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Two credit sophomore, junior, and senior advanced laboratory courses have recently replaced a one credit Modern Physics lab and a three credit Experimental Physics course. Physics Lab I, II, and III are offered in the spring and are coordinated with the two theory courses physics majors have most recently completed or are currently enrolled in. Physics Lab I for sophomores, for example, contains experiments in Modern Physics (a class they complete in the Fall semester) and Classical Mechanics (a class in which they are concurrently enrolled in the Spring semester). Junior-Senior level theory courses are offered on an alternate year basis; therefore, Physics Labs II and III typically contain experiments from two of the following four courses – Optics, Thermodynamics & Statistical Mechanics, Electricity & Magnetism, and Quantum Mechanics.

A: What Once Was

First Year: General Physics Sequence – Fall & Spring
one credit lab each semester
closely linked (temporally & content) to in-class material
goals: reinforce basic concepts with reliable experiments

Second Year: Modern Physics – Fall
one credit lab
not closely linked to in-class material
many computer simulations
goals: reinforce theory via simulation (???)

Third Year or Fourth Year: Experimental Physics
three credit, stand-alone course
one hour lecture, three hours lab
collection of experiments from across curriculum
some simple, some more sophisticated
flexible lab-group scheduling
formal lab write-ups, posters, oral presentations
goals: acquisition & analysis techniques
presentation skills

B: What Has Taken Its Place

First Year: General Physics Sequence – Fall & Spring
one credit lab each semester
closely linked (temporally & content) to in-class material
goals: reinforce basic concepts with reliable experiments

Second Year: Physics Lab I – Spring
two credit, stand-alone lab
closely linked to most recent core theory courses
Modern Physics & Classical Mechanics

Third Year or Fourth Year: Physics Lab II – Spring
two credit, stand-alone lab
closely linked to most recent core theory courses
Optics & Electrodynamics

Fourth Year or Third Year: Physics Lab III – Spring
two credit, stand-alone lab
closely linked to most recent core theory courses
Thermodynamics & Quantum Mechanics

Physics I, II, & III goals:

do something, *think* about results, *pursue* discrepancies
acquisition & analysis techniques, independent work
presentation skills (lite)

C: Physics Lab I Curriculum

Modern Physics related:

Speed of Light in a Co-axial Cable & Error Propagation

Planck's Constant from LEDs

The Photoelectric Effect

e/m for an Electron

Nuclear Gamma Spectroscopy

Gamma Absorption by Lead

Nuclear Half-Life

Millikan Oil Drop

Classical Mechanics related:

Coupled Harmonic Oscillators

More Coupled Harmonic Oscillators

Torsion Constant & Torsion Pendulum

Nonlinear Oscillations

Motion of a Ball on a Rotating Turntable

plus:

formal lab write up (rough draft + revision)

short oral presentation

D: Physics Lab II Curriculum (so far)

Optics related:

Laws of Geometrical Optics

Beam Expander

Lasers and Coherence

Polarization

Interferometry I

Interferometry II

Electrodynamics related:

Bragg Diffraction with Microwaves

Ampere's Balance

Electric Potential Mapping

other:

Phase Diagrams (Mechanics)

Chaotic Pendulum

plus:

formal lab write up (rough draft + revision)

short oral presentation

possibilities for future development:

Wheatstone Bridge & Kelvin Bridge

Self & Mutual Inductance

Magneto Optic Kerr Effect

E: Physics Lab III Curriculum (so far)

Thermodynamics related:

Calibration of a Thermistor

NMR: Negative Temperatures

Quantum Mechanics related:

Polycrystalline Electron Diffraction

High Energy Electron Diffraction

Electron Paramagnetic Resonance

Numerical Solutions to Schrödinger's Equation

plus:

formal lab write up (rough draft + revision)

short oral presentation

possibilities for future development:

Mach-Zehnder Interferometer (that'd be nice...)

Calorimetry: Specific Heats

Calorimetry: Latent Heats

Rückhardt's Experiment

Surface Tension & Surface Energy

What Has Been Discovered

Physics Lab I has been taught three times

Physics Lab II has been taught two times

Physics Lab III has not been taught

students like the focus on recent/current courses

dredging material from previous Fall difficult, though
many students have a hard time working independently
procrastination runs rampant

Culture of the Incomplete is tenacious

instructor trying to change nice-guy image

a desire to find out what went wrong is not a general trait

how do we combat acceptance of crummy results?

how do we teach recognition of good data?

how do we teach inclination to explore?

despite all that... some students do *excellent* experimental work

