



St. Mary's College
Department of Math and Science

Course Title: Physical Science II
Course Number: PHY401
Term: Fall 2025.
Lecture – Tues/Thurs 9:30-10:50 am.
Lab – either Tues or Thurs 2:20-3:40 pm.
Professor: Joseph B. Strong, PhD
Email: drstrong@smac.edu
Phone: 785-437-2471, extension 410

Prerequisites

PHY201 or permission of the instructor.

Required Materials

Physical Science, by Faughn, Chang and Turk.
SMC College Lab Book for PHY401, Strong.
Simple Scientific Calculator (sin, cos, tan functions)

Suggested Materials

The Realist Guide to Religion and Science, Fr. Paul Robinson.

Course Description

PHY401 continues the study of the physical sciences started in PHY302. This semester focuses on the atom and the fundamentals of chemistry. Students are expected to develop an understanding of the strengths and weaknesses of scientific models used so they can better judge the conclusions made based on scientific experimentation. The lab section makes the concepts of the text more tangible and allows students to experience the challenges of collecting data and making sense out of it.

Objectives

Students will be expected to develop a fundamental understanding of:

- the interaction of electromagnetic radiation with matter as an investigative probe
- the theory of the atom, radioactivity and nuclear reactions
- the periodicity of atomic properties
- the factors influencing chemical bonding
- the importance of molecular structure on chemical behavior
- the factors that control the rates of chemical reactions

In addition, they will be expected to:

- manipulate measured values properly
- predict the products and energy change during nuclear reactions
- use elemental analysis, and spectral data to predict molecular formula and shape
- Predict bonding and use VSEPR to predict molecular shape
- balance chemical equations, and use them to predict products and yields

Grading Policy

- Grades will be based on the following rubric:

Quizzes:	10%
Homework and Lab reports:	25%
Tests:	25%
Exam:	40%

- Quizzes will be used to check how diligently students are reviewing notes, preparing for labs, working on assignments, and paying attention in class.
- Laboratory experiments will be performed based on the schedule below. Reports are due as shown on the syllabus.
- There will be two tests during the semester, and a final exam. Test dates are subject to change.

Assignment Policy

- All submitted work should be on your own paper, either handwritten or typed. DO NOT submit work written in the margins of any given handout.
- Any part of any assignment that seems to be taking too long is taking too long. If you can't get through something after expending some effort on it, put it aside and come to me for help as soon as possible. I can usually give a student a gentle nudge in the correct direction so you can accomplish the task in a more time-efficient manner.

- The prelabs are due **before** the start of the corresponding lab. Their purpose is to help you read through and engage the material so you are ready to learn from the lab as you perform it.
- Prelabs are to be done on your own. This means that helping each other is okay in a general way but not with any specifics. If you feel you need step-by-step help with any particulars you need to see me for assistance. Please be honest.
- Lab partners are to share in the responsibilities of collecting the data, calculating results, and writing up the report. If your name is on the report you are asserting you did your fair share of the work. Putting your name on someone else's work as if it is your own is plagiarism; you need to be a real part of the effort in every way you can. Come see me if you need help doing your fair share and I will help you. Please be honest.
- Please write the lab report as if the person reading it cares to know what you are reporting. By you working to express the results in a meaningful way you will develop a better understanding of the material and how to communicate better. For example - all the data you collect and use needs to be labeled in an understandable way so the reader can find it and use it if need be. The data needs labels and units in order to be of any value. Complete sentences are needed to convey a thought. Please review the section in the lab book entitled "Lab Reports" for specific instructions.
- Under no circumstances is AI to be used to generate any portion of any assignment.
- Please use the experiments, prelabs, and lab reports for what they are meant to be - a learning tool for you to engage the material. They are not just busywork to get through. Without that engagement by you, the class will get harder instead of easier because all the topics tie together.

Attendance Policy

- You are expected to attend class unless you have notified the instructor. If you know you are going to miss a class, please get prior approval. Any unexcused absence that occurs during a test, quiz, or lab will result in a zero. Assignments must be turned in on time even if you are absent, so please make arrangements. Any exceptions must be in writing.

Course Schedule

Legend: "Hour 2" refers to your scheduled lab period.

"Readings" refers refer to material that you should complete **before** that class period. It is assumed that you preview and review the "Lecture notes" available on Sharepoint.

Week #1. 08/31 - 09/06:

- Hour 1. Lecture Notes: A short history of the atom, part I
 - i. Readings: Text sections 15.1 – 15.4, 16.3
 - ii. Review Lab book p.6-11
- Hour 2. Lab #1: Is Light a Wave or a Particle? Newton vs. Hooke
 - i. Readings: Lab Book p.13-18
- Hour 3. Lecture Notes: A short history of the atom, part II
 - i. Readings: Text sections 12.1 – 12.5

Week #2. 09/07 - 09/13:

- Hour 1. Lecture Notes: A short history of the atom, part III
- Hour 2. Lab #2: Determining the Electron's Charge
 - i. Readings: Lab Book p.19-28
 - ii. Prelab for Lab #2 due
 - iii. Report for Lab#1 due
- Hour 3. Lecture Notes: A short History of the atom, part IV
 - i. Readings: Text sections 11.1 – 11.4, 11.6, 12.6

Week #3. 09/14 - 09/20:

- Hour 1. EM radiations interaction with Matter
 - i. Readings: Review Chapter 11 as needed
- Hour 2. Lab #2 continued
- Hour 3. Lecture Notes: Mapping the Electron Cloud
 - i. Readings: Text sections 12.7 -12.9, 16.1 – 16.2

Week #4. 09/21 – 09/27:

- Hour 1. Lecture Notes: Atomic Interactions I
 - i. Readings: Text sections 15.5, 16.4 – 16.6

Hour 2. Lab #3: Experimental Determination of Avogadro's Number

- i. Readings: Lab Book p.29 - 33
- ii. Prelab for Lab #3 due
- iii. Report for Lab#2 due

Hour 3. Lecture Notes: Atomic Interactions II

Week #5. 09/28 - 10/04:

Hour 1. Lecture Notes: Nuclear Stability

- i. Readings: Text section 13.1 – 13.3, Lab Book p. 50 - 57

Hour 2. Lab #3 continued

Hour 3. **Test Chapters 11 and 12**

Week #6. 10/05 - 10/11:

Hour 1. Lecture Notes: Nuclear Reactions and Carbon dating

- i. Reading: Text sections 13.4 – 13.8, Lab Book p. 57 - 60

Hour 2. Lab #4: Moseley's Discovery of the nuclear proton

- i. Readings: Lab Book: p. 44 – 49
- ii. Prelab #4 due
- iii. Report for Lab #3 due

Hour 3. Lecture Notes: Nuclear Energy

- i. Readings: Text sections 14.10 – 14.15

Week #7. 10/12 – 10/18

Hour 1. Lecture Notes: Combustion Analysis I: Percent composition

- i. Lab Book: p. 58-82

Hour 2. Lab #4: continued

Hour 3. Lecture Notes: Combustion Analysis II: Determining Molecular formulas

Week #8. 10/19 – 10/25:

Hour 1. Lecture Notes: VSEPR I: Predicting Molecular shape

- i. Readings: Lab Book p.96 - 98

Hour 2. Lab #5: Radioactive Decay

- i. Readings: Lab Book p.50 - 63 (mostly review)
- ii. Prelab #5 due
- iii. Report for Lab #4 due

Hour 3. Lecture Notes: VSEPR II: Importance of Shape

Week #9. 10/26 – 11/01:

Hour 1. Lecture Notes: Polarity I

- i. Readings: Text sections 15.11 – 15.14

Hour 2. Lab #5 continued

Hour 3. **Mid-semester break day**

Week #10. 11/02 – 11/08:

Hour 1. Lecture Notes: Polarity II

- i. Readings: Text sections 16.7, 17.9

Hour 2. Lab #6: Absorption Spectroscopy

- i. Readings: Lab book p.64 - 68
- ii. Prelab #6 due
- iii. Lab #5 due

Hour 3. Lecture Notes: Organic Molecules I

Readings: Text p.376-380, Lab Book p. 79-80

Week #11. 11/09 – 11/15:

Hour 1. Lecture Notes: Organic Molecules II

Hour 2. Lab #7: Absorption Spectroscopy II: Determining Solution Concentration

- i. Readings: Lab book p.69 - 73
- ii. Prelab #6 due
- iii. Lab #5 due

Hour 3. Identification of Organic Molecules I: IR spectroscopy

- i. Readings: Lab Book p.82-84, 89

Week #12. 11/16 – 11/22

Hour 1. Lecture Notes: Identification of Organic Molecules II: NMR analysis

- i. Readings: Lab Book p.84 - 89

Hour 2. Lab #7 continued

Hour 3. Lecture Notes: Organic chemistry

Week #13. 11/23 – 11/29:

Hour 1. Lecture Notes: Chemical Thermodynamics and Kinetics I

Hour 2. **Thanksgiving**

Hour 3. **Thanksgiving**

- Week #14. 11/30 – 12/06:
- Hour 1. Lecture Notes: Chemical Thermodynamics and Kinetics II
 - Hour 2. Lab #8: Identification of Organic Molecules
 - i. Readings: Lab book p.78 – 90 (mostly review)
 - ii. Prelab #8 due
 - iii. Lab #7 due
 - Hour 3. Lecture Notes: Chemical Thermodynamics and Kinetics III
- Week #15. 12/07 – 12/13:
- Hour 1. Semester Wrap up
 - Hour 2. Lab #8 due by end of the week
 - Hour 3. Semester Wrap up
- Week #16. Final Exams