PHYS 360 MODERN PHYSICS II

BASIC INFORMATION

Course prefix, catalog number, and title: PHYS 360, Modern Physics II
Number of credits: 3 credit hours
Term and year: Fall 2024
Classes: Mon, Wed, Fri 11:00 - 11:50 AM, South Eng. 221 (lecture) and South Eng. 312 (Lab)

Instructor's name: Prof. Yongki Choi
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Office location: South Engineering 220A
Office hours: Mon, Wed, Fri 11:50 - 1:00 pm and by appointment

BULLETIN DESCRIPTION

Continuation of modern physics covering molecular structure, solid state physics, nuclear and particle physics with an embedded modern physics laboratory with experiment such as atomic and molecular spectroscopy, electron diffraction, nuclear spectroscopy, photoelectric effect and computer simulation of experiments. Pre-requisite: PHYS 350

COURSE OBJECTIVES

The main objective of the course is to develop the conceptual and quantitative methods that are critical for a working knowledge of modern physics. The student will be able to explain modern physics concepts and to use laboratory equipment to reproduce experiments in modern physics, as well as measure physics properties descried by modern physics concepts.

REQUIRED STUDENT RESOURCES

Recommended book: *Modern Physics* by Paul Tipler and Ralph Llewellyn
Recommended book: *Modern Physics for scientists and Engineers* by John Morrison

SYLLABI ON WEB PAGES

Syllabus, Announcements, and Notes will be posted on our Blackboard course homepage: https://bb.ndsu.nodak.edu

HOMEWORK ASSIGNMENTS

Homework will be posted on our Blackboard course homepage. All homework assignments are due on the dates specified.
Late submission will not receive credit.

#COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic	Reading /Assignment
1 (8/28, 8/30)	Course/lab introduction/preparation	Review lab manuals
2 (9/2-9/6)	Measurement/Data analysis (M) & Lab1 (W, F)	Review lab manuals
3 (9/9-9/13)	Molecular/Atomic Spectra & Lab 2 (W, F)	Chapter 9
4 (9/16-9/20)	Molecular/Atomic Spectra & Lab 3 (W, F)	Chapter 9
5 (9/23-27)	Molecular/Atomic Spectra & Lab 4 (W, F)	Chapter 9
6 (9/30-10/4)	Solid State Physics & Lab 5 (W, F)	Chapter 10
7 (10/7-10/11)	Solid State Physics & Lab 6 (W, F)	Chapter 10
8 (10/14-10/18)	Solid State Physics & No lab	Chapter 10
9 (10/21-10/25)	Solid State Physics & Midterm Exam (F)	Chapter 9-10
10 (10/28-11/1)	Nuclear Physics & Lab 7 (W, F)	Chapter 11
11 (11/4-11/8)	Nuclear Physics & Lab 8 (W, F)	Chapter 11
12 (11/11-11/15)	Nuclear Physics & Lab 9 (W, F)	Chapter 11
14 (11/18-11/22)	Particle Physics & No lab	Chapter 12
14 (11/25-11/29)	Particle Physics & Thanksgiving (W, F)	Chapter 12
15 (12/2-12/6)	Particle Physics & No lab	Chapter 12
16 (12/9-12/13)	Review & 1 make-up lab experiment	Chapter 9-12
17 (12/16-/12/20)	Final Exam	Chapter 9-12

PHYS 360: EVALUATION PROCEDURES AND GRADING CRITERIA

Final letter grades for the course will be computed using the following weights:

- Midterm Exam 20 %
- Final Exam 20 %
- 8 Labs Assignments 60 % (The lab assignment with the lowest score will be dropped)
- Total Points 100 %

NO MAKE-UP EXAMS ARE ALLOWED

Grades A: ≥ 85 %, B: 70 to < 85 %, C: 60 to < 70 %, D: 50 to < 60 %, F: < 50 %

Requirements and assessment of the lab reports are described in the attached document.

ATTENDANCE EXPECTATIONS

According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected. Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

AMERICANS WITH DISABILITIES ACT FOR STUDENTS WITH SPECIAL NEEDS

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

ACADEMIC HONESTY

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

The instructor reserves the right to adjust or modify this syllabus if it is deemed beneficial to student learning

PHYS 360 MODERN PHYSICS LABORATORY

GENERAL INFORMATION

Each student will individually complete **Nine experiments** during the semester. Each laboratory will nominally take hours to complete. Students will rotate through the experiments during the course of the semester. Each laboratory period will replace one lecture. Additional times for lab work will be coordinated at the beginning of the semester since the experiments will not usually be completed in one hour. The laboratories will complement the sections covered in lecture and in general the material covered will not be repeated in lecture. Corresponding reading sections will be assigned in the text for the experiment.

TENTATIVE LABORATORY CHOICES

Lab Number & Topic

1. Atomic and molecular spectroscopy
2. Frank-Hertz Experiment
3. Michelson interferometer
4. Measurement of Speed of Light
5. Photoelectric effect
6. Millikan oil drop experiment
7. Ultrasound and Applications
8. e/m, determination of h
9. Electron diffraction

LAB REPORT PREPARATION

1. Read the experiment manual before coming to lab.
2. Data is to be defended before writing up the lab. This means presenting your data to the instructor, and proving that it is adequate to meet the goals of the lab.
3. Lab reports will be prepared using Microsoft Word.
4. Images, plots, etc. will be prepared in MatLab, Excel, or your favorite software and inserted into the Word document. MatLab and Excel are available on the SE312 computers.
5. Lab reports will be submitted using BlackBoard Assignment.

CONTENTS OF LAB REPORTS

Parts A through I below must be included in all reports. One basic standard is that you must include enough information so that another student would be able to easily repeat the experiment, avoiding any problems that you experienced.

A. In an introductory section, explain the purpose of the experiment and the physics behind the experiment. In the body of your report indicate the purpose of each set of measurements or calculations you report. Clearly explain what you have done. **For calculations explain what you are calculating and how it was calculated (including appropriate equations). Carefully identify all the variables used in equations and calculations. SHOW INTERMEDIATE STEPS IN ALL ANALYSIS**.

B. Discuss any problems encountered in the experiment and how you overcame them.

C. Draw or copy a diagram of the experimental apparatus used to perform the experiment. Clearly show how any parts are connected. Also give a complete list of parts (pieces of equipment etc.) used in experiment.

D. Collect and record at least two sets of data for every measurement you take. Assign experimental errors to your measured data. For example, if you take a reading from an analog meter or a meter stick, an estimate of the experimental error would be some reasonable fraction of the smallest division on the scale. For digital instruments you can usually use changes in the signal over time to estimate an error.

E. Calculate errors in the physical constants or other parameters you determined in your experiment. Assume that these are random uncorrelated errors. Calculation of random errors will be discussed in class.

F. Neatly tabulate and plot your data using Excel, Matlab or other software.

G. **Fitting of equations to experimental data**. In experiments you are requested to fit equations to your data to **determine significant experimental parameters**.

H. Always plot "best-fit" functions (that is the appropriate equation using the best-fit parameter value or values) as a solid line (without points). On the same graph plot your data points as large symbols like diamonds not connected by a line. This allows a direct comparison that often tells you if something has gone wrong with your attempt to fit an equation to your data or your measurements are corrupted in some way. **As discussed in class, data points should distribute evenly on both sides of your best-fit curve in a "good" fit**.

I. Finally summarize your experiment. The results found and the conclusions reached should be discussed. For example, if you have determined a physical constant, one part of your summary should be to compare your value with the accepted value for this constant. A discussion of the difference in these quantities in terms of your calculated error in the constant should also be given. Discuss other problems which may produce errors.