# Syllabus

## Physics 122 Lab— Fall 2019

Our freshman laboratory program aspires to provide students with engaging and rewarding interactions with the physics of the world around them. The weekly laboratories address a cross-section of the concepts introduced in the lecture part of the course. This lab introduces the student to techniques for obtaining and analyzing experimental observations using diverse methods and equipment.

The sessions are led by a Teaching Assistant (TA), who is usually a physics graduate student. In general, students are asked to report their activities and results clearly and concisely in formats ranging from "worksheets" to a formal Lab report write-up. The time spent outside of lab on preparation, data analysis, and presentation will vary somewhat, but an average of no more than 3 hours of outside work per lab is encouraged.
Some guidelines to remember throughout the semester:

1. Make sure always to get your raw data signed and initialed by your TA before leaving the lab session.

2. Reports will be graded according to the rubric given below.

3. Punctuality in attendance and completion of assignments are critical.

4. Rotation of individual roles in a team effort to ensure everyone's participation in the exercises.

5. Approaching all issues with professional courtesy and respecting the efforts, opinions, and property of others.

6. **Disruptive behavior**, including horseplay and reckless use of equipment, will NOT be tolerated!

7. **Academic honesty.**
   New Mexico Techs applicable policy regarding academic honesty is expressed in the NMT Undergraduate Catalog, and it will be strictly enforced. You are responsible for knowing, understanding, and following this policy.

   Laboratory exercises are a group effort, and discussing the material with each other is encouraged. Data obtained during the lab session is expected to be the same within each group (tables, graphs, etc.). However, your written assignment must be your own work; any help received must be acknowledged, and proper citation of the utilized sources must be included. Plagiarism is not tolerated. Any suspicion of a violation of the letter or intent of the NMT policy will be reported to the Lab Director, who will determine the appropriate charges to bring to the office of the Associate Vice President for Academic Affairs.

   In general, obtaining answers that in any way bypass the need to think about the assignment is a violation of the academic honesty policy, and can have serious consequences. If in doubt, please ask your instructor before submitting any work as your own.

**NMT Services and Polices**

**Reasonable accommodations.** New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office of Counseling and Disability Services (OCDS) as soon as possible. To schedule an appointment, please call 835-6619.

**Counseling services.** New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. The confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

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**Respect Statement.** New Mexico Tech supports freedom of expression within the parameters of a respectful learning environment. As stated in the New Mexico Tech Guide to Conduct and Citizenship: New Mexico Techs primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education. Tech seeks to protect academic freedom and build on individual responsibility to create and maintain an academic atmosphere that is a purposeful, just, open, disciplined, and caring community.

## List of Laboratory Exercises

**Week 1. No Lab**— first Week.

**Week 2. Wave Superposition**— Two types of wave superposition are investigated in this laboratory; standing waves on a string and sound beats. The first is caused by the superposition of oppositely moving waves while the latter is due to the superposition of waves of different frequencies.

**Week 3. Oscilloscopes**— This lab is a tutorial introduction to the use of the oscilloscope, which is one of the primary instruments to measure the voltage of electrical signals.

**Week 4. Electric Field and Superposition Principle**— This is a computer lab based on the following simulation:
*http://phet.colorado.edu/en/simulation/charges-and-fields*
This simulation is used to understand the concept of electric field and its application using the principle of superposition.

**Week 5. Electric Field Mapping**— The purpose of this lab is to explore the relationship between the electric potential and the electric field. The electric potential is set up by a DC power supply and measured with a Digital Multimeter for three different electrode configurations. The measurements are used to map the equipotential lines and the associated electric field in each case.

**Week 6. Capacitors and Dielectrics**— In this lab, the LCR meter is used to measure the value of the capacitance for various geometries as well as to determine the effective capacitance when capacitors are connected in series and in parallel. For the case of the plate capacitor, the effect of a dielectric material inside the capacitor is also explored.

**Week 7. Ohm's Law**— In this lab, the relationship between the electric potential difference across, and the current flowing through, a so-called Ohmic material is explored. The measuring techniques developed in this lab will be essential in the following labs.

**Week 8. Kirchhoff's Laws**— In this lab, Kirchhoff's loop and node laws are explored using direct and alternating current circuits. The lab is divided into four parts. In the first two, we test Kirchhoff's laws; in the next two, we use these laws to examine two simple but widely used circuits: the voltage divider and the RC circuit. This lab assumes that the student already knows how to measure current and voltage using a Digital Multimeter; how to operate LCR meters and oscilloscopes and has some experience using DC power supplies and signal generators.

**Week 9. Magnetic Forces I –Ampere's Law.** In this experiment, Ampere's law is used to investigate the magnetic field produced by an electrical current, and conversely, the force exerted on a current by a magnetic field. The experiment is divided into two parts. In the first part, we develop a qualitative feel for the magnetic field produced by current along a straight wire, and for the force acting on such current by a permanent laboratory magnet. In the process, a simple measurement of the earth's magnetic field is made. The second part involves a quantitative determination of the magnetic force between parallel wires using a current balance.

**Week 10. Magnetic Forces II** — In this lab, we investigate the magnetic force on individual charges. In the process, we estimate the charge-to-mass ratio for electrons.

**Week 11. Velocity of an Electromagnetic Signal**— In this lab, the oscilloscope is used to measure the speed of an electric signal in various cables.

**Week 12. Faraday's Law**— In this lab, Faraday's is explored in a variety of applications like determining the magnetic field in the gap of a permanent magnet and inside a solenoid, the inductance of a coil and the time constant of an RL circuit. The lab assumes that you are familiar with the use of necessary devices to measure voltage and current as well as the use of power supplies, signal generators, and oscilloscopes.

**Week 13. Mutual Inductance**— In this Lab, We will investigate the Mutual Inductance between two coils in the configuration in a concentric configuration.

**Week 14. Displacement Current**— In this Lab, We investigate the displacement current through a Capacitor in an LR-circuit. We compare the displacement and conduction current in this circuit.

**Week 15. No Lab**— Thanksgivings Week.

**Week 16. No Lab**— Last Week.

Physics 122 Lab; Rubric for Reports

| | good | average | poor |
|---|---|---|---|
| Presentation (10 points): Your Report should be neat and easy to read. | Report is neat and easy to read. | Report is somewhat neat, but difficult to read due to grammar or spelling errors. | Report riddle with grammar or spelling errors. |
| pre-lab | good | average | poor |
| Introduction (10 points): Write a concise paragraph to introduce this lab to your peers. It must include the objective(s) of the lab. | hits all major objectives. | misses some of the objectives. | misses all of the objectives. |
| Data (20 points): Raw data must be separated from results when tables are indicated, they must have captions, and their columns must have headers that include units. All data must have units. | Contains raw data well organized and easy to read. Tables have all required parts: captions and headers. | raw data is somewhat organized, but readable. Tables miss required elements: captions and headers. | Raw data is missing or difficult to read. |
| Methods (10 points): Write a concise paragraph for each part of the lab to describe to your peers what measurements were taken and how they were taken. | Hits all parts of the lab, include sketches when appropriate, clearly explain what is to be measured and how. | misses some parts of the Lab or some descriptions are not clear. | missing or misleading. |
| Analysis (40 points): Write a sample calculation for each required result that you are obtaining. Your results must be consistent with your data. When plots are indicated, make sure that they have labels, units, and captions. | All required results have a sample calculation backing them up; plots have labels, units, and captions | Some required results are missing or do not have an associated sample calculation. Required Plots are missing or they missing parts: labels, units, and captions. | missing or misleading. |
| Discussion (10 points): Write a concise paragraph, where you state your results and discuss them in the context of this lab. Your peers should be able to understand your findings. | All results are stated and discussed | Some results are missing or not discussed | missing or misleading |