

Project Title:

Designing Experiments and Writing Lab manuals for Upper level Physics Courses

1. A concise description of the project**Background**

Proper Laboratory experiences are integral part of all STEM programs. In this project I aim to bridge the gap between theoretical concepts and experimental understanding of PHY2021 (Waves and Optics) & PHY2051 (Modern Physics) courses that we currently teach in our department to students who want to pursue a career in Physics and Engineering fields. In the last academic year when our University adopted 4-credit model, we could not properly address to those deficiencies due to lack of resources. In addition to that I will be working to design the experiments and write Laboratory manuals for PHY2091 (Sophomore Physics Lab) & PHY3091 (Junior Physics Lab) courses.

In the last decade no student in our department pursued BS degree in Physics. Those who were strong in Physics and Mathematics were opting for BS degree in Engineering Science. Therefore, PHY2091 (Sophomore Physics Lab) & PHY3091 (Junior Physics Lab) courses were never taught in our department since I started teaching at Lincoln University as a visiting Assistant professor in 2017. There are no available manuals for those Labs in our department. Recently, with the discontinuation of BS in Engineering Science Program, students are enrolling to BS in Physics program again. Some of those students want to apply for graduate school in Physics and Engineering programs. So it is urgent that we properly design and implement fully functional Sophomore Physics Lab in Fall 2026 and Junior Physics Lab in Spring or Fall 2027.

Proposed Development:

(i) Five experiments will be designed and incorporated in Waves and Optics course (PHY2021). One experiment will be on sound waves. One experiment will be on waves on a vibrating string. Three more experiments will be on optics. All those experiments will be hands-on. Some of the instruments, which are used for Freshman Physics Lab and General Science Lab, can be used for these experiments.

(ii) Five experiments will be designed and incorporated in Modern Physics (PHY2051). Some of the experiments will be hands-on. If needed, couple of experiments will be based on computer simulation available at <https://phet.colorado.edu/> & <https://ophysics.com/>. My priority will be to design hands on experiments with available equipment or to look for other funding source (Title III)

(iii) Ten experiments will be designed and Laboratory manual will be written for this writing intensive 4 credit course PHY2091. The experiments will be based on concepts of Mechanics, Oscillations, Heat & Thermodynamics, Spectroscopy, Electromagnetism and RLC circuit. All experiments will be hands-on.

(iv) Ten experiments will be designed and Laboratory manual will be written for this writing intensive 4 credit course PHY3091. The experiments will be based on electronics, atomic physics, nuclear physics and other advanced concepts of Physics e.g. Hall Effect, Polarization, Plank's constant etc. All experiments will be hands-on.

2. Measurable goals and objectives for the project

- (i) Written Manuals for the experiments in PHY2021, PHY2051 courses
- (ii) Written Lab manuals for PHY2091 & PHY3091 courses
- (iii) Objectives are to teach those Labs in Fall 2026 and Spring 2027

3. The timeframe for the project

Summer 2026:

Literature search, Laboratory inventory search, equipment purchase and writing manuals for the experiments incorporated in PHY2021 & PHY2051 courses; Writing the manual for PHY2091 course.

Fall 2026 and Early Spring 2027:

Writing the manual for PHY3091 course.

January 2027:

Final report to be submitted to LU Faculty Affairs.

4. How the project will enhance teaching and research at Lincoln University?

First, this project is to make sure the students get adequate exposure to upper Level Physics Labs. Without fully functioning upper Level Physics Lab, students' knowledge would be incomplete and many graduate school may deny their application to the graduate program.

Second this project will enhance the ability of the students to do research at Lincoln University and beyond when they go to graduate school. Ability to teach upper Level Physics Labs and familiarity with instruments will also positively influence faculty's research at Lincoln University.

Third, this will also influence the faculty to pursue research in physics education.

5. How the outcome of the project will be measured?

The outcome of the project will be measured by the completion of the written manuals, integration of experiments in PHY2021 & PHY2051 courses and teaching of PHY2091 & PHY3091 courses in upcoming semesters

6. How, when, where, and with whom the project's outcome will be shared?

The project and publication will be shared with my department, students, FRDC, and the university at large. I will present my project at the LU faculty research symposium in Spring 2027.