زانکۆی سەلاحەدین - هەولێر
Salahaddin University-Erbil

Quality Assurance and Curriculum Development

Course Book

2024 - 2025

Department of Physics

College of Education

Academic year: 2024-2025

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Course Description

Module	Language
Mechanics Laboratory	English
Academic Year	**Semester:**
2024-2025	Autumn
ECTS	**Prerequisite:**
6	-

Course Objective

The Mechanics Laboratory course aims to provide students with a hands-on understanding of fundamental principles in mechanics through practical experiments. It focuses on developing the skills to conduct precise measurements, analyze experimental data, and interpret results in the context of classical mechanics.

By engaging in a variety of experiments, such as studying pendulum motion, verifying Hooke's Law, and determining physical constants like the acceleration due to gravity and spring constants, students will:
- Build competence in experimental setups and the use of laboratory equipment.
- Strengthen their theoretical knowledge by linking observed phenomena with underlying physics principles.
- Develop critical thinking and problem-solving abilities through data analysis, error evaluation, and reporting results.

This course emphasizes teamwork, analytical skills, and precision, preparing students for further exploration of physics and related disciplines.

Learning Outcomes

Upon successful completion of the Mechanics Laboratory course, students will be able to:

1. Understand Fundamental Concepts:
- Grasp the principles of mechanics through hands-on experiments, including simple harmonic motion, Hooke's Law, and pendulum dynamics.
- Relate theoretical knowledge to practical applications in mechanics.

2. Conduct Experiments:
- Set up, calibrate, and operate laboratory apparatus such as pendulums, springs, and resonance tubes accurately.
- Perform measurements with precision and record experimental data systematically.

3. Analyze Data and Results:
- Calculate physical constants (e.g., acceleration due to gravity, spring constant) using experimental data.
- Interpret experimental results, identify trends, and compare with theoretical predictions.

4. **Evaluate Errors and Uncertainties**:
- Identify potential sources of error in experiments and discuss their impact on results.
- Employ error analysis techniques to evaluate measurement accuracy and reliability.

5. **Develop Scientific Communication** Skills:
- Present experimental findings clearly and effectively through lab reports, graphs, and tables.
- Use proper scientific terminology and notation in describing methodologies and results.

6. **Enhance Problem-Solving and Teamwork**:
- Collaborate effectively with peers to conduct experiments and troubleshoot challenges.
- Apply critical thinking to propose solutions for experimental limitations and improve procedures.

These outcomes ensure that students gain a comprehensive understanding of mechanics through a blend of theory and practical experience, equipping them for advanced studies and applications in physics.

References: *

1. Halliday, D., Resnick, R., & Walker, J. (2018). ***Fundamentals of Physics*** (11th Edition). Wiley.
- A comprehensive resource for understanding the theoretical foundations of mechanics and experimental techniques.

2. Young, H. D., & Freedman, R. A. (2020). ***University Physics with Modern Physics*** (15^{th} Edition). Pearson.
- Covers classical mechanics principles and provides detailed explanations relevant to lab experiments.

3. Serway, R. A., & Jewett, J. W. (2018). ***Physics for Scientists and Engineers*** (10^{th} Edition). Cengage Learning.
- Includes practical problem-solving approaches and in-depth discussions on experimental physics.

4. Hsu, T. (2016). ***Laboratory Experiments in Physics for Modern Mechanics***. Springer.
- A helpful guide for conducting experiments with clear instructions and sample data analysis.

5. Knight, R. D. (2016). ***Physics for Scientists and Engineers: A Strategic Approach*** (4^{th} Edition). Pearson.
- Combines theory with practical application, offering insights into experimental mechanics.

6. Cagnac, B., & Bensimon, D. (2005). ***Experimental Methods in Physics***. Oxford University Press.
- Covers laboratory techniques, error analysis, and procedures for mechanics experiments.

7. Taylor, J. R. (1997). ***An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements*** (2^{nd} Edition). University Science Books.
- A vital resource for understanding error calculations and data interpretation in laboratory settings.

These references will provide additional support and enhance understanding for students engaging in the mechanics laboratory course.

Type of Teaching: *

The Mechanics Laboratory course is conducted in 2-hour weekly sessions for each group, integrating theoretical instruction with practical activities. It adopts a hands-on and interactive teaching methodology, blending theoretical concepts with experimental practice. Students collaborate in small groups to perform experiments using specialized equipment, such as pendulums, springs, and resonance tubes. The instructor provides demonstrations, detailed guidance on experimental setups, and ensures adherence to safety protocols. Key concepts are introduced through concise lectures and reinforced through structured experiments, data analysis, and group discussions. The course emphasizes active participation, critical thinking, and systematic reporting to deepen students' understanding and application of mechanics principles.

Requirements For Credit Points: *

1. Student attendance in Laboratory is important.
2. Discussion in Laboratory is necessary.
3. Assignments for each Laboratory
4. Mid-term examination
5. Report
6. Quiz

Grade Distribution: *

Assessment Breakdown and Structure

Effort Component (50%), in the first round of assessment, students will engage in a comprehensive blend of practical and theoretical evaluations. The breakdown is as follows:
Practical Exams: All practical exams will be conducted in the classroom to assess students' applied skills.
Attend and daily activities (5 marks): This includes active classroom participation, selecting and engaging in debate topics, and collaborative group work.
Theoretical Exam (Quiz): A single written exam, worth (**5 marks**), will evaluate students' understanding of theoretical concepts.
Academic Report (15 marks): Students are required to submit a detailed report that demonstrates their analytical and writing skills.
Seminar Presentation (10 marks): Each student will present a seminar based on their report, showcasing their ability to communicate and defend their work effectively.
In addition to **Searching for sources (6 marks), Use of technology (4 marks), and Problem-solving (5 marks).** These activities collectively account for **50%** of the total effort mark, emphasizing continuous learning and participation.

Final Examination (50%), the final exam will test students' ability to synthesize and present information in various formats. The structure includes:
Academic Poster (20 marks): Students will design and prepare an academic poster that concisely presents key research findings or project insights.

Debate (30 marks): Students will participate in a structured debate, demonstrating their critical thinking, argumentation, and engagement with complex topics.

Second Round (Individual Effort)
In the second round, all assessments will be completed independently by the student, ensuring a comprehensive evaluation of their skills. The breakdown is as follows:
Report Writing (20 marks): A revised and detailed report submission.

Academic Poster Preparation (10 marks): A standalone poster that communicates their research effectively.
Seminar Presentation (20marks): A presentation based on their report, focusing on clear articulation and in-depth understanding. This approach guarantees a balanced evaluation that promotes both collaborative and individual competencies.

Weekly Plan

Detail	
Week	**Detail**
1	- On the first day in the physics laboratory, students are introduced to lab safety protocols, rules, and proper handling of equipment through an orientation session. They also familiarize themselves with basic tools like stopwatches, rulers, and balances, practicing simple measurements to prepare for future experiments.
2	- Simple Pendulum Experiment - To study the motion of a simple pendulum and to determine the acceleration due to gravity (g) using a simple pendulum
3	- Determination of the Spring Constant of a Spiral Spring - To verify Hooke's law and to determine the spring constant (k) of a spiral spring.
4	- Determination the value of acceleration due to gravity (g) using compound pendulum - To find the value of acceleration due to gravity (g) using a compound pendulum.
5	- Determining the Speed of Sound in Air in a Resonance Tube open at one end - The aim of the experiment is calculating the speed of sound in air using a tuning fork and a tube of

Workload

Module*			
Prerequisite:			
Detail			
Type	**Number**	**Time Factor**	**Total**
Attendance	**14**	**4hr**	**14 *4 = 56**
Academic Report	**1**	**14hr**	**1*14 = 14**
Quiz	**1**	**6hr**	**1*6 = 6**
Seminar	**1**	**10hr**	**1*10 = 10**
Searching for Resources	**2**	**6hr**	**2*6 = 6**
Technology Use	**2**	**6hr**	**2*6 = 16**
Problem-Solving	**2**	**8hr**	**2*8 = 16**
Academic Poster	**1**	**12hr**	**1*12 = 12**
Academic Debate	**1**	**26hr**	**1*26 = 26**
			162 hr.