PHYS1105 Syllabus

Course Description and Prerequisites

This course, Mechanics Laboratory (PHYS1105), provides training in instrumentation and offers in-depth understanding of physics concepts and laws that are discussed in PHYS1303 (Introductory Mechanics) and PHYS1307 (General Physics - Mechanics). This is achieved through observation, measurement, data acquisition and analysis in each lab. The lab sessions are grouped into modules, with each module focusing on one specific topic, such as Newton's laws of motion or gravity and dark matter, and follow the two lecturing courses as close as possible so that students apply the concepts discussed in lectures in lab, or are exposed to the concepts with hands-on experience shortly before the discussions of them in lecture. Each module may contain one, two or three lab sessions. In each module, there are two (sometimes three) documents, the *pre-lab* and the *instructions* (the third one: *instruments*), that students **must** read before coming to the lab. The *pre-lab* document describes the physics and its connection to the real world. The *instructions* offer detailed information about how to set up the instruments and perform the measurements. The purpose of the document regarding the instruments is to broaden the knowledge of the tools that will be used in the module.

The 3-hour lab session is organized in two parts: the 1-hour co-operative problem solving session and the 2-hour lab. The class is divided into groups of 3 students each and assigned a role: Manager, Scribe, and Skeptic. Each group will work on the co-op problem. The Manager will direct the solution, the Skeptic will question it, and the Scribe will record it. One person is selected in the group to complete and submit the solution form in Canvas. This solution will be graded and the grade distributed to the group members. This grade comprises 10% of the final grade. The roles will be changed each week for a period of three weeks, after which, the groups will be reconstituted. Lab partners will be assigned at the beginning of each module. The 2-hour lab portion begins with a quiz to check on your readiness for the measurement part. This quiz is open-book and discussion in your group is allowed. Students must answer all questions in this quiz correctly before being given the instruments to conduct the measurements. Those who fail to score 100% will have to read the documents in the lab and re-take the quiz, at the expense of the lab time of your whole group. The score of this particular quiz will not go into your final grade.

There is one report for each module, except Module 0. A template of the report is provided. Students are encouraged to write the report during each lab session when discussions in your group and with the TAs are possible. The lab report (in PDF) is to be submitted in Canvas during the week after the last lab of a module. That is, the deadline to submit the report in Canvas is 11:59 PM of the day one week after the last lab in the module. To help provide in-depth understanding of the physics in the

module, a list of questions (often open questions) in a file called *Q_and_D* is provided. Please download this file from Canvas before the start of the measurements and read the questions. Try to find the answers to the questions in the measurements and through discussions in your group. One student in the group will upload the group's Q and D answers (as a PDF file) together with the group's lab report in Canvas. These will be graded and the grades distributed to the group members. It is the responsibility of all group members to make sure that the submission is done before the deadline in Canvas.

There is no prerequisite to this course but basic knowledge and skills of a college student are assumed. These include math (algebra, trigonometry, calculus), computers and computing (install and run a program, document editing, excel-like spreadsheet level data processing and graphing, curve fitting and histogram).

The lab sessions will be run by TAs. The course instructors are professors Richard Guarino (rguarino@smu.edu) and Robert Kehoe (kehoe@physics.smu.edu).

Learning objectives and lab manuals

Learning outcomes	At the conclusion of this lab course, devoted students will receive training on basic instruments with data acquisition software in measurements of time, distance, velocity, acceleration, mass and force. Students will understand measurement uncertainties (errors) and verify or re-discover laws in mechanics. Students will also learn how to research for information that is not provided in the lab manual, to analyze and present (with plots and tables) observations and measurements, and finally to write lab reports in a scientific way.
Lab manuals	The lab manuals are included in the required textbook.

Required Items

- Laptop/Notebook with Office 365.
- University Laboratory Manuals Preliminary Edition by Jingbo Ye, Richard Guarino, and Austin Mullins. ISBN: 979-8-8233-1303-2
- Any scientific calculator.

Course Format and Information

This is a lab course. Students **must** read the documents *pre-lab* and *instructions* and understand the requirements before coming to the lab. After discussions with the TAs and the lab instructors, and a thorough understanding of the problem in the lab, students will set up the instruments and perform the measurements. Students should start to analyze the acquired data and start to write the lab report immediately after the measurement, and discuss with the TAs about issues in the lab. Lab partners should work together on their lab report during the lab period.

Class attendance is required. Lab make-up can be arranged for those with a formal sick leave from a physician or a formal leave request from your academic supervisor on family emergency or other excused absence following strictly the SMU policy. No other requests for lab make-up will be accepted. All make-up work must be finished before the final week. Students that are present for all lab sessions within a module may participate in group reporting. Students that are absent for one or more lab sessions within a module are required to make-up the missing sessions and must submit their own Q and D and Lab Report.

Grading policy:

The final grade will be the simple average of the scores of each co-op (10% weight), *Q and D* (20% weight) and the report (70% weight). The grade of the lab report has two parts: the technical correctness (95%) and professionalism (5%). This 5% professionalism in the lab report grade will be deducted if a student violates SMU and course specific policies. There will be no written tests and exams in this course. The Numerical grade and letter grade conversion is based on:

Letter	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Numerical (%)	90.0	85.0	80.0	75.0	70.0	66.6	63.3	60.0	56.6	53.3	50.0	

SMU Required Syllabus Statements: please refer to these SMU policies and supports as posted at https://www.smu.edu/OIT/AcademicTech/Instructional-Guidelines/Syllabus/required-syllabus-statements

Covid-19 policy related to this class: we follow SMU's policy posted at https://www.smu.edu/Coronavirus. Since this is a lab course and people have to work closely around the instruments, we require masks be worn by students and instructors when they are in the lab. Students who fail to comply with this policy and after being reminded three times in the same lab session will not earn the grade of professionalism for that lab module.

Schedule: See details listed in Canvas. Below is a list of the modules and labs in each week

Module # and name	Lab	Week and #
0, Introduction and basic skill training	Information and training on excel	#1, Jan. 17 - 19
	Capstone and sensors	#2, Jan. 24 - 26
1, Error Analysis	Error Analysis	#3, Jan. 31 – Feb. 2
2, Kinematics	Coordinate systems	#4, Feb. 7 - 9
	Velocity and acceleration	#5, Feb. 14 - 16
3, Forces and Dynamics	Free-body force diagram and the equilibrium condition	#6, Feb. 21 - 23
	Newton's 1st and 3rd Laws of motion	#7, Feb. 28 – Mar. 2
	Newton's 2nd Law of motion	#8, Mar. 7 - 9
Spring Break	No Classes	#9, Mar. 14 – 16*
4, Motion Periodic and in 2-dimensions	Simple harmonic motion	#10, Mar. 21 - 23
	Projectile motion, horizontal launch	#11, Mar. 28 - 30
	Projectile motion, angled launch, and Uniform circular motion	#12, Apr. 4 – 6**
5, Energy and Momentum Conservation Laws	Elastic and inelastic collisions	#13, Apr. 11 - 13
	Kinetic and potential energy transfer	#14, Apr. 18 - 20
6, Gravity and Free-fall	Measure gravity g with the g-ball and a pendulum; Newton's Law of universal gravitation in the solar system and a remote galaxy, dark matter	#15, Apr. 25 - 27

* Spring Break Mar. 13 – Mar. 17 No Labs
** Good Friday Apr. 7