KU LEUVEN

FACULTY OF ENGINEERING TECHNOLOGY

CAMPUS GROUP T

Lab Report for EE1

Lab: Spring-mass system

Date of experiment: 27/11/2024

Lab group:159E

Darius-Andrei Corlan

Ishak Leventoglu

Lab responsible:

Rob Houtmeyers

Academic year 2024-2025

< Depending on the experiment, some headings are not applicable or worded slightly differently. You might want to change the order of the headings. In order to do so, adjust the titles or remove them from the report. >

1 INTRODUCTION

1.1 Research Question/ Problem Statement

Describe briefly, clearly and yet precisely the goal of the experiment / measurements and the strategy with which you will achieve that goal.

2 Background / Theory

Briefly and concisely describe the theoretical foundation on which the experiment is based. State the corresponding scientific laws. Clearly describe the symbols and the most important quantities. Explain the formulas accurately but concisely. If necessary, clarify the theories and formulas with a sketch, figure or image. Include the in-text citations and immediately add the caption. A figure has an informative caption below the graph, illustration or photo and is numbered. Refer to your figures in the text (in other words, make sure to cross-reference).

3 METHOD & MATERIALS

3.1 Experimental Set-up

Draw the experimental set-up schematically or include a picture of the experimental set-up. If requested, clarify and specify the most important components of the set-up and add a legend. Add any possible citations again, and immediately add them to the caption below the figure or photo and refer to your figures in the text.

3.2 Measuring Instruments

Write down the list of the used measuring instruments. If applicable, mention the used materials and reference values. Add, for example, the following points:

- Measuring instruments: brand/ supplier, range, and the precision
- Reference values

- Fixed data (environmental temperature, pressure, …),
- Possible corrections and adjustments
- Searched reference values

3.3 Method

Give a description of the systematic approach. Briefly explain the experimental flow, possibly using a diagram or a figure and a corresponding source reference to the detailed method in the course text.

4 RESULTS SPRING CONSTANT

4.1 Measurements

First add one or more sentences that already provide the main measurement results as text or refer to a table. Then add the measurement results in a compact and clear table, possibly clarified by appropriate graphs. If legibility is compromised due to the large number of measurement results, certain measurements in the table can also be included in the appendices. A table always has a caption above it and is numbered. Provide an informative, clear caption.

The header of a table consists of (at least) 2 lines:

- 1st line: the default symbol for the quantity
- 2nd line: the unit used in brackets, possibly preceded by a prefix or an appropriate power of 10. Only SI units are allowed.

Numbers are presented as simply as possible. Make a suitable choice of the unit and use prefixes such as mega or giga. Only significant figures are mentioned.

Avoid spreading a table over two pages. If a table does not fit on one page due to its size, repeat the header of the table on the next page.

Specifically for this experiment:

Create a well-organized table with measured and calculated values. The table shows the values of the weights mg used, the position x as read from the ruler, the corresponding value of x_e and the calculated value of k. Note: Do not confuse the elongation x_e with the length l of the spring or the position x on the ruler, and do not forget the weight of the holder!

4.2 Graphs

Graphs follow the same layout method as figures. Make sure that charts are sufficiently large and legible. Think about the scale and the choice of units. Make sure that there is a scale along each axis: 3 to 10 graduation marks with round numbers at regular intervals (2 to 3 significant figures). Do not include readings along the axes. For each axis, place the symbol of the quantity plotted and in brackets the unit used. Make sure the readings themselves are clearly visible.

If possible, draw a line of best fit or a theoretical line through the measurement points (e.g. via a regression analysis or least squares method). Include the corresponding equation (and R^2) in the figure. Provide a legend with meaningful names if there are several curves on one graph. Centrally align the figures. And of course, provide an informative caption with a number which is referred to in the text.

Specifically for this experiment:

Insert a graph with the measured force as a function of the elongation. Draw the appropriate trend line and also include its equation on the graph.

4.3 Calculations

Present the calculations of the measurements in an orderly manner. If several similar calculations are performed, give at least 1 complete, clearly worked out example calculation and an error calculation for all calculated quantities. Clearly indicate for which measurement value from the table the calculations are made. First work out the calculations using variables/symbols, only then enter the numbers. If necessary, provide explanations (for example, textually explain the mathematical technique used). Always put the final result in standard notation.

Specifically for this experiment:

3.3.1 Example calculation for table of results

For each calculated quantity, perform an example calculation for the fifth data point in your table.

3.3.2 Error calculation

Determine the errors of m, x and k for the same measurement value.

3.3.3 Calculation of spring constant and error

Determine the average value of the spring constant k from the table, and it's error.

From the trend line on the graph, determine a more accurate value of the spring constant and the error on this value. (See the introduction)

5 DISCUSSION SPRING CONSTANT

In this section, repeat the central questions / goals from the lab assignment and formulate an answer, possibly grouped per sub-experiment. Interpret your results and decide: has the

purpose of the experiment been achieved? Try to explain any discrepancies. For example, discuss the following:

• Accuracy and precision of the measuring method (s): Which method affects the measurement error of the final result most significantly? What causes the biggest uncertainty?

• Correctness of the final result: Avoid terms such as "reasonably good" or "about"; either a measurement is correct with the expected value within the measurement error, or not.

• Give a final assessment of the obtained results in comparison with the results of others, for example from previous experiments, other students or previous literature.

If your research concerns a relationship between 2 or more physical quantities, describe the shape and strength of the relationship found and, as far as possible, explain the comparison with the theoretically expected relationship. Point out the slope of the line and / or its physical interpretation. Beware of terms such as "directly proportional", "inversely proportional", "exponentially increasing/ decreasing". These have one specific physical meaning; use it correctly!

Suggestions: If necessary, formulate tips for improving the measurement methods and / or alternative measurement setups. Be sure to give suggestions for better measuring methods or accuracy of the calculations if the test did not go as expected.

Specifically for this experiment:

*In your discussion, you will include **at least** the answers to the following questions:*

- *Does the spring comply with Hooke's law? Explain!*
- *What is your best value of k?*
- *Does the average value from the table correspond to the value from the graph within the measurement error?*

If you find any discrepancies or anomalies, ask the laboratory manager for an explanation and include this in your discussion.

Also answer the questions from point 4 of the lab text.

Do this with a fully written text, in which you also repeat the content of the question. So do not take the question literally, but start as follows:

"If the x-axis is reversed, the formula .... changes as follows: ..."

Mention here also possible references of your research work

6 RESULTS PERIOD

6.1 Measurements

Specifically for this experiment:

Again, create a well-organized table with measured and calculated values. For each value of the mass m are included: the 3 measured times t_1, t_2, t_3, the average value of the measured

period T_{ex}, the ideal and the corrected theoretical values (T_{id} and T_{cor}), and the percentage deviations of the experimental values with respect to the ideal and with respect to the corrected period (PA_{id} resp. PA_{cor}). For the calculation of the theoretical values you use the previously determined graphical value of k.

6.2 Graphs

Specifically for this experiment:

Draw graphs of T_{ex}, T_{id} and T_{cor} as a function of m (3 curves on 1 graph!). On a second graph, plot both percentage deviations as a function of m.

6.3 Calculations

Specifically for this experiment:

For each calculated quantity, perform an example calculation for one data point in the middle of your table. Indicate this data point in your table.

Calculate the error on a typical value of T_{ex}, and on the corresponding value of T_{id}. The error on T_{cor} will be almost the same as the error on T_{id}. (Why?)

7 DISCUSSION PERIOD

*In your discussion, you will include **at least** the answers to the following questions:*

- *How does the ideal period depend on the masses? What form does the graph $T_{id} = f(m)$ take?*
- *Do the curves show the expected form?*
- *Does T_{cor} correspond better to the experimental values than T_{id}?*
- *Does T_{cor} correspond to Tex within the error margin ? And T_{id}?*
- *How does the **difference** between T_{id} and T_{cor} depend on the mass? Why is that so?*
- *What can you say about the variation in percentage deviation as a function of m?*
- *How could you improve the accuracy of the value of k? And the accuracy of the period of vibration?*

8 GENERAL CONCLUSION

Briefly repeat the most important finding and / or final assessment of the results obtained in comparison with results from previous experiments, from others or from literature. Do not put new information here.

9 BIBLIOGRAPHY

Put the list of sources here. Use a reference manager. The default reference style is IEEE or APA. However, this can be deviated from for the various assignments if the teacher mentions this explicitly. So always check this carefully.

FACULTEIT INDUSTRIËLE INGENIEURSWETENSCHAPPEN
CAMPUS GROEP T LEUVEN
Andreas Vesaliusstraat 13
3000 LEUVEN, België
tel. + 32 16 30 10 30
iiw.groept@kuleuven.be
www.iiw.kuleuven.be

Correction key

FORM AND CONTENT OF THE REPORT			
	Needs to improve (-)	Basic (+/-)	OK (+)
Report general: structure, academic language			
Formatting tables, graphs, formulas, drawings			
Correct and complete measurements			
Correct and complete calculations			
Answering questions, conclusions and discussions			
			A-B-C-D

BONUS MALUS: GROUP	
	Malus
Feedback form not uploaded /not filled out (starts at lab 2)	
Word file instead of PDF uploaded	
Report submitted too late	
Excel / Cap not uploaded	

BONUS/MALUS: INDIVIDUAL		
	Bonus	Malus
Preparation		
Student 1		
Student 2		
Participation during the lab		
Student 1		
Student 2		
Other		
TOTAL STUDENT 1		**A-B-C-D**
TOTAL STUDENT 2		**A-B-C-D**