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| Accelerometer & Spectral Analysis  Mini-Lab (ML3) Agenda  * Work in your assigned group to answer the mini-lab problems | T-316-LABB Fall 2023 |

# Instructions

* Develop your *solution* such that you find it suitable as a study guide.
* Be sure to finish incomplete problems outside of class.
* You will be tested on this material at the end of the course during the oral examination

# Principles of operation (“PO”) questions.

1. What physical quantity is the measurand and how is it input to the sensor?
2. What happens inside the sensor to transform sensor input to sensor output?
3. What physical quantity is the output and how is it read?

# What we hope you’ve learned (learning objectives). After completing the mini-lab, students should be able to:

* Explain the principle of operation of the given accelerometer (MTN/1100Q) using the manual of the accelerometer.
* Determine the range and sensitivity of an accelerometer.
* Use the spectral analysis technique to identify dominant frequencies in an experimentally-acquired signal.

# Part 1. Interpreting the manufacturer’s specifications.

***Problem 1***. Describe:  
- the measurand  
- the output

***Problem 2***. Using the manufacturer’s specifications determine the following characteristics and identify them on a figure like the one shown. Add the appropriate labels and units.

- Min and max input values  
- Min and max output values  
- Sketch the expected calibration curve  
- Expected sensitivity

- Expected calibration equation. (Specify the excitation voltage, if relevant.)

Expected sensor calibration curve  
- Expected output at zero input

***Part 3: Interpreting transducer output with spectral analysis***

For this part of the minilab, you will measure vibrations of a cantilevered bar. Find the bar and clamp it at one end. Measure the length of the bar from the tip to the clamped mark and measure the thickness and width of the bar. The accelerometer is attached to the free end of the bar.

***Problem 3.*** If you pluck the end of the bar, the bar should vibrate for a while and settle back down to rest over time. The bar’s vibration frequency in this case is called its “natural frequency.” The theoretical natural frequency of this vibration can be estimated using the equation where , , and represent the Young’s modulus, moment of inertia, mass, and length of the bar, respectively.

By plucking the end of the bar record the accelerometer data and save into file. Use this data file to determine the frequency obtained from the experiment.

***Problem 4.*** Does the measured natural frequency of the bar match the theoretical natural frequency? It is most likely lower than the theoretical estimate. What feature(s) of your experimental setup might cause such a mismatch?

***Part 4: Operating principles***

***Problem 5.*** Write a paragraph or two outlining the basic principles of operation of an accelerometer such as the one used during the mini-lab.