Earthquake detector - Seismometer

A seismometer is a very [illegible]t responds to movements of the Earth's surface. The surface of the Earth is in constant r[illegible] phenomena, which causes seismic vibrations. However, a good seismometer can be se[illegible] passing trucks, dropping objects and people walking nearby. Therefore, in addition to[illegible]ke detector, it can also monitor entry passages, traffic flow, etc. The basic principle of a[illegible] a sensor that can detect small movements, an amplification method, and some sort [illegible]g device. Seismic activity can be observed in up to three axes, the vertical axis, north[illegible]est axis. If you add a timing and recording mechanism to a seismometer, it becomes a seismograph.

Figure 1 shows a functional block diagram for an electronic seismograph. The motion sensor can be any device that varies its output according to movement, from the most common magnet and coil to modern accelerometers, but also includes optical sensors, piezoelectric sensors, etc. Pre-amplification and low-pass filter stages are usually employed for noise filtering. A large gain amplifier is also generally needed since seismic vibrations have a frequency of a couple of Hz and a magnitude of less than a micrometre.

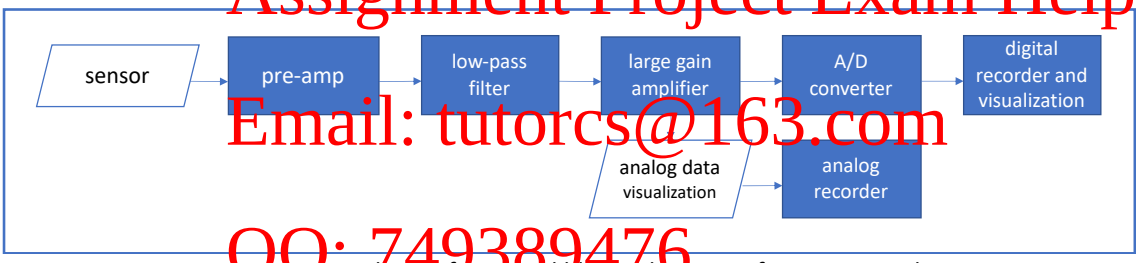

Figure 1: Example of a functional block schematic of a seismograph.

In a **group of 3 students**, you are to design a seismometer comprising two axes: vertical and horizontal. A few points to take note of:

- You must design and then prototype the circuit using the breadboard.
- Use the AD2 as a power source.
- You can use any sensor of your choice, for example, piezoelectric, accelerometer, or DIY magnet and coil.
- You can use the 2-channel oscilloscope from the AD2 as analog data visualization.
- You don't need to convert to digital data.
- You can construct this system using components of the workshop component kit.
- You don't need to wait for an earthquake to test your circuit, hit the table, drop an object, walk by, etc.

Each group is expected to complete this task within 6 weeks (from Week 6). In the period of 6 weeks, there will be three workshop sessions dedicated to building and prototyping your seismometer (Weeks 6, 7 and 11). There are many ways that you can solve this problem, think like an engineer!

The assessment for this project contributes to **20% of your overall ENAD mark**. The 20% will comprise of:
(1) **10% for individual seismometer demonstration and group oral presentation** during Week 12,
(2) **10% for group project report** (maximum 15 pages, plus reference and appendix) due end of Week 12.
The group report must include:

a) A methodology framework used to solve the problem, explaining how the group approached the issue;
b) The block and circuit diagrams of your seismometer including component values;
c) A theoretical characterisation of your seismometer, including relevant equation(s), your filtering cut-off frequency and amplification gains;
d) Evidence of experimental setup and, if applicable, simulations. Evidence can be photos of circuits on breadboards, screenshots of simulations, *etc.*;

e) Results, discussion and conclusions, e.g., reasons and measurements, signals from sensor before/after filtering, output signals (e.g., vertical movement and horizontal movement), sensor characteristics (e.g., range, accuracy, precision, sensitivity, resolution and repeatability), *etc.*;
f) Justification of agreement or disagreement between theory, simulations, and experiments; and
g) References (not counted as part of the 15 pages).