MEC E 301
Lab 4: Strain Gauges

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Question 1

Define a list of the design criteria:

- Pressure range: 0-9 kPa
- Resolution should be maximized since the number of bits is fixed to 2^{24}
- Working unit: kPa

One pressure range meets these constraints: $\boxed{\text{001KD}}$.

Question 2

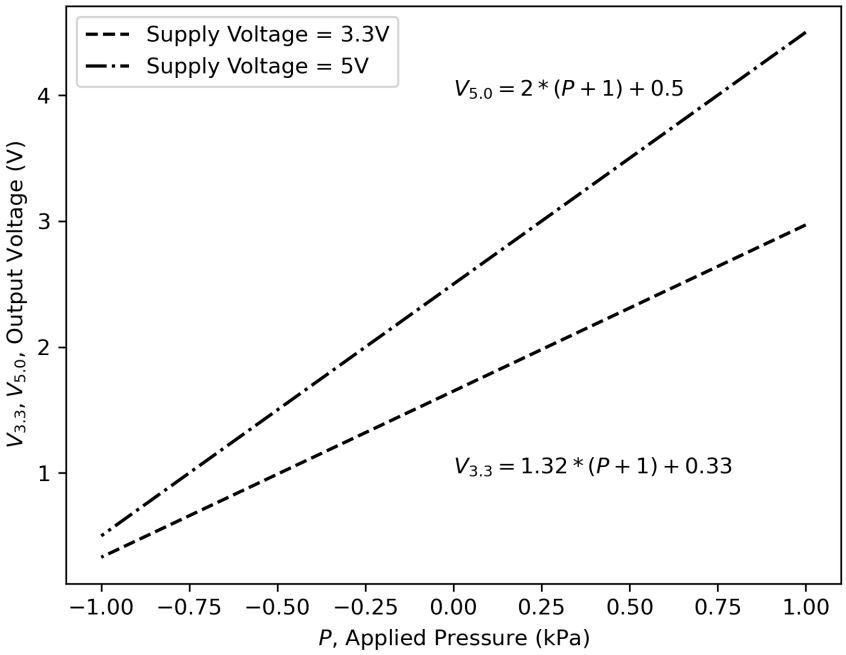

Figure 1: Voltage output of the sensor as a function of pressure over the range of the sensor if the supply voltage is 3.3 V and if it is 5V.

The sensitivity of the sensor for each supply voltage is calculated by taking the derivative of the voltage output with respect to pressure. Since the equations for the voltage output are linear, the sensitivity is constant.

$$\text{Sensitivity}_{3.3V} = \frac{d}{dP}\left(1.32 * (P + 1) + 0.33\right) = 1.32 \text{ V/kPa}$$

$$\text{Sensitivity}_{5V} = \frac{d}{dP}\left(2 * (P + 1) + 0.5\right) = 2 \text{ V/kPa}$$

Question 3

The transfer function being used has an output range of 10% to 90% of the input range. That means the maximum output of the sensor is $0.9V_{\text{input}}$

For the 3.3V supply voltage, the highest output from the sensor is $V_{\text{o, max}} = 0.9 \times 3.3$. The maximum the EDC can read is 5V, so the maximum amplification is:

$$\boxed{\text{Amplification}_{3.3V} = \frac{V_{\text{EDC, max}}}{V_{o,max}} = \frac{5}{0.9 \times 3.3} = 1.68}$$

For the 5V supply voltage, the highest output from the sensor is $V_{\text{o, max}} = 0.9 \times 5$. The maximum amplification is:

$$\boxed{\text{Amplification}_{5V} = \frac{V_{\text{EDC, max}}}{V_{o,max}} = \frac{5}{0.9 \times 5} = 1.11}$$