# ME430 Senior Laboratory 1 – HW1

## Root Sum Square (RSS) Design Exercise

For this assignment, assume that all "uncertainty" statements are to a confidence of 95%.

An engineer would like to design a procedure to experimentally determine the mass density of a fiber-reinforced polymer composite material. He/she will determine the density by measuring the size of the sample, its weight in water, and then using this information to determine the density.

The engineer is told that a small sample of the composite material, with nominal dimensions of 4 mm × 5 mm × 1 mm thick, "weighs" 16 mg in water.

1. Assume that the nominal density of water is known to be 1000 kg/m3. What is the nominal density of the composite material?
2. Suppose that the uncertainty on the scale is 0.2 mg, the uncertainty in measurement of the sample dimensions is 0.25 mm, and the density of water is known to 1%. What is the uncertainty on the density of the composite material? What are the contributions of each measurement to this uncertainty on a percentage basis?
3. Repeat question 2, assuming that the uncertainty on sample dimensions is 0.1 mm.
4. Given that the uncertainty on the measurements are the same as given in question 2, recommend a new procedure would achieve in an uncertainty of 5% or less on the determination of sample density.
5. Suppose that a micrometer, accurate to ±1 mil (95% confidence), is used to measure the dimensions of the sample, and the other measurements have the same uncertainty as give in step 2. Is it possible to reduce the thickness of the sample, and achieve an uncertainty on density less than 2%? Why are why not?

