The circuit board layout to the right has two hairpin filters and places to solder surface mount components. Two of the filter design problems will allow you to explore the hairpin and chip component filters on the left side of the board. But first, you need to demonstrate that you have learned some modern filter theory.

Using modern filter theory, start with a 5th order low-pass prototype of your choice and design a bandpass filter with a passband from 1.7 to 2.3 MHz. Go through all the steps, and then simulate your design using LTspice. Bring the design and plot showing S11 and S21 to class on Wednesday.

Next, identify the functional blocks on the circuit board:

This is a microstrip hairpin filter. Estimate the frequency.

This is the PC footprint of a Mini-Circuits Diode Ring Mixer. The RF port is at the upper left, the IF port is at the lower left, and the LO port is at the lower right. The little circles are ground vias to the backside of the board.

This is a place to solder some surface mount components.
This microstrip hairpin bandpass filter is printed on FR-4 circuit board. The dimension from the bottom to the top of the U on the filter is 3.0 cm, and the width of the traces is 2.54 mm.

Using an approximate value of 4 for the effective dielectric constant for 50 ohm microstrip on 0.0625” thick FR-4 board, estimate the center frequency of the filter.

This filter has a bandwidth of 10% of the center frequency. Sketch a design for a filter with a center frequency of 900 MHz and a bandwidth of 45 MHz in space below. Would you expect this filter to have more or less loss than the filter above? Which dimensions change and which ones can you leave the same? Sketch the filter passband, and include some notes showing what passband features correspond to which dimensions on the printed circuit layout.
Design and simulate a filter with a center frequency of 98 MHz and a 3 dB bandwidth of 20 MHz using chip capacitors and hand-wound inductors to fit on the circuit board layout shown below. The chip capacitor values must be available from Digikey or Mouser. Assume inductor Q of 120 and predict the loss of this filter.
None of this will be on the quiz on Wednesday, but it is fun to think about.