1) Design a band-pass RLC filter with a passing band around the natural frequency at about $f_n = 5 \text{ kHz}$ with 0 dB gain and a bandwidth of $\delta f = 2 \text{ kHz}$.

2) Generate both linear plot (from 0 to 10 kHz) and Bode plots (from 0 to 100 kHz) for the magnitude of the filter as a function of frequency.

3) Feed a sinusoidal signal $x(t)=\cos(2\pi ft)$ as the input to the filter and find the gain for $f=1, 5, 10, 20,$ and $50 \text{ kHz}$. Compare your results with expectations.

4) Use the same three components to implement a low-pass filter with the same $f_n$, but a passing band for all $f<5 \text{ kHz}$, then repeat part 2).

5) Repeat all steps in 4) for a high-pass filter with a passing band for all $f>5 \text{ kHz}$.

6) Build a tunable square wave oscillator using a 555 timer. It should produce a square wave alternating between 0 and 5 V with a duty cycle of 50%, and a frequency tunable from 100 Hz to 20 kHz by adjusting a potentiometer. Listen to the generated signal by a speaker or earphone to determine the upper limit of your hearing range. (You may need to use an op-amp follower to drive the speaker/earphone.)

7) Filter the signal generated by the oscillator by each of the three filters built previously and then listen to the filtered signal when its frequency sweeps from 100 Hz to 20 kHz.