Circuit building activity

Exercise 1: Design, and simulate a dual-output waveform generator circuit, utilizing an op-amp integrator, and a Schmitt trigger configured with DC biasing, to generate triangular, and square waveforms. The output is to be observed at V_o.

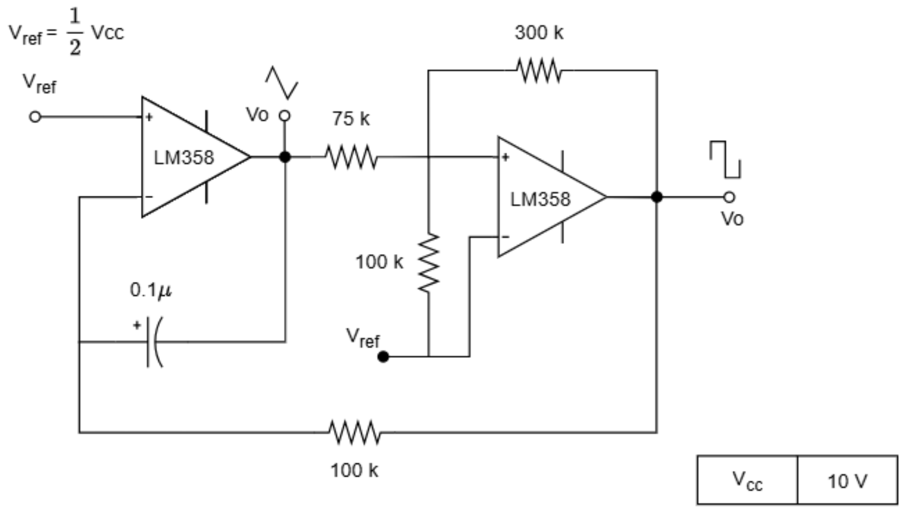


Figure 1. Waveform generator circuit.

Circuit building activity

Exercise 2: Design, and simulate an action potential generator circuit in LTspice utilizing a NE555 timer and a transistor stage to generate voltage waveforms that closely replicate the characteristic shape and timing of biological action potentials. The output is to be observed at V_o.

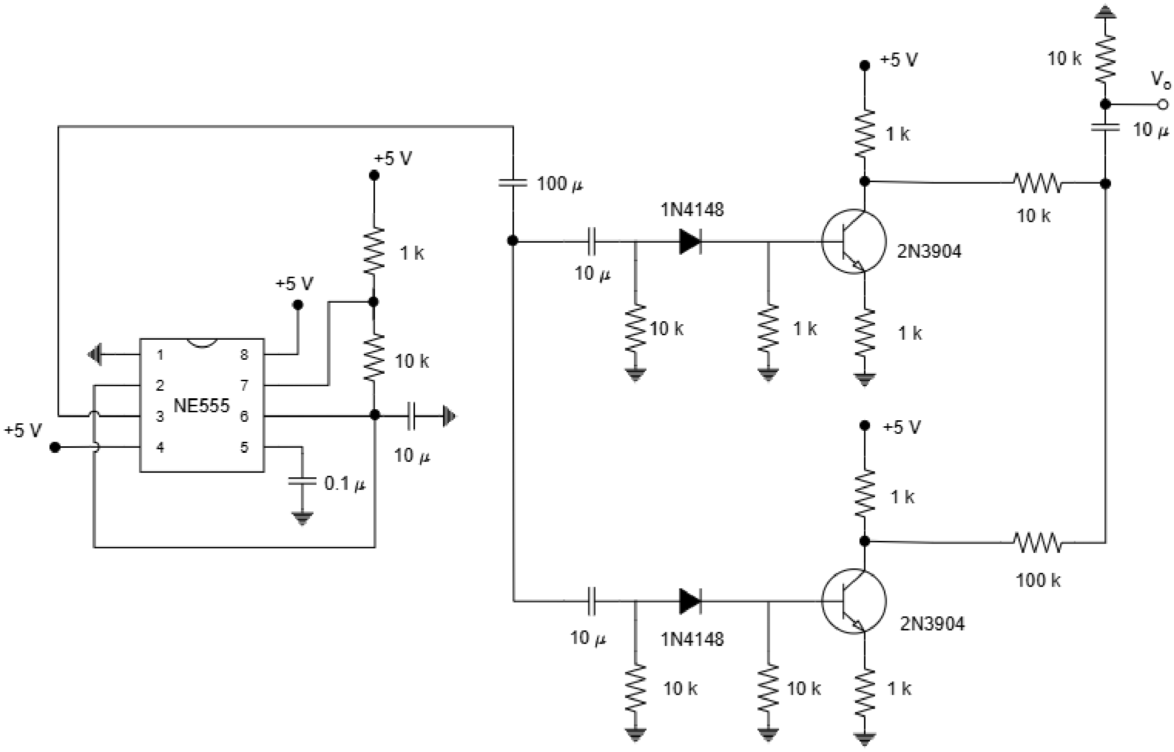
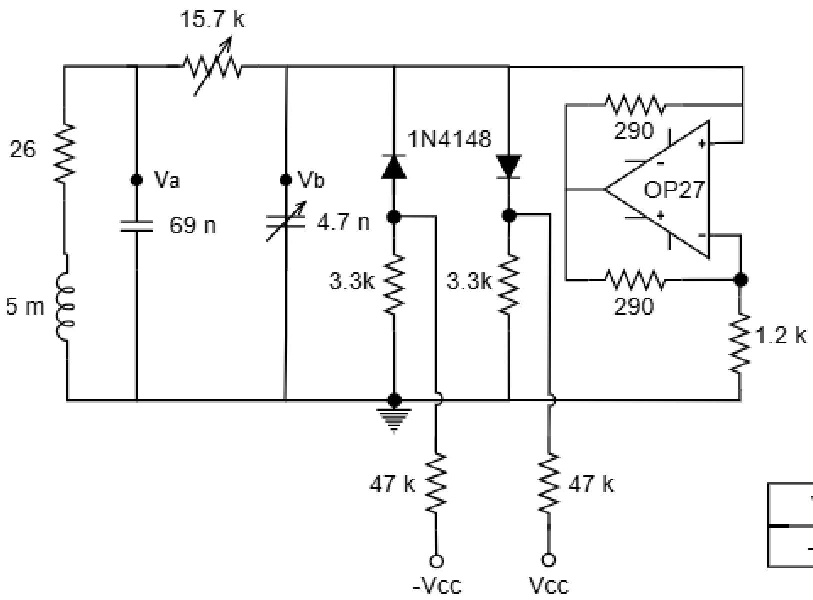


Figure 2. Action potential generator circuit.

Circuit building activity

Exercise 3: Build Chua's circuit in LTspice to analyze, and characterize it's nonlinear dynamics and chaotic behavior. The output is to be observed at V_a with respects to V_b.



V_{CC}	9 V
$-V_{CC}$	-9 V

Figure 3. Chua circuit.

Circuit building activity

Exercise 4: Design, and simulate an electrocardiograph (ECG) with a circuit employing an LM741 operational amplifier, voltage divider networks, and RC filtering stages to generate the bioelectrical potentials. The output is to be observed at V_o.

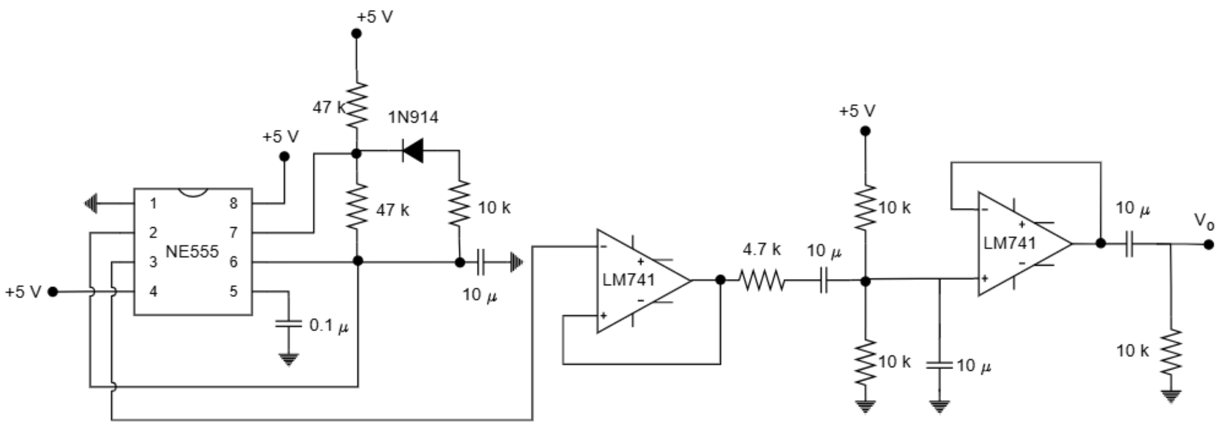
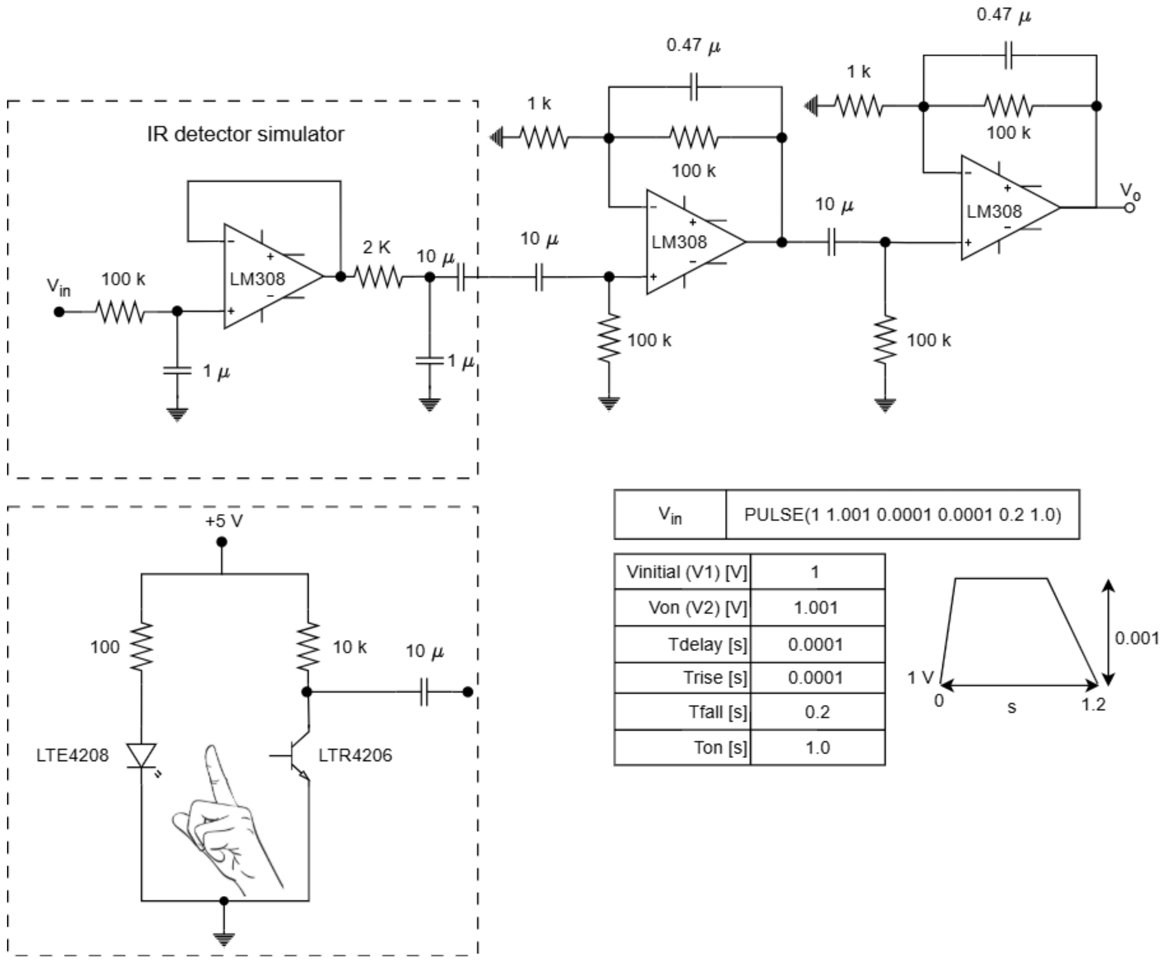


Figure 4. Electrocardiograph (ECG) simulator circuit.

Circuit building activity

Exercise 5: Develop a basic infrared pulse meter circuit to detect and measure pulse rate and capture blood pressure waveforms for physiological monitoring. Physically, the IR emitter and detector are placed with the thumb intervening in the light path to sense pulse waveforms. The simulation realizes this physical interface with an equivalent circuit that mimics the signal modulation. The output is to be observed at V_o.



V_{in}	PULSE(1 1.001 0.0001 0.0001 0.2 1.0)

Vinitial (V1) [V]	1
Von (V2) [V]	1.001
Tdelay [s]	0.0001
Trise [s]	0.0001
Tfall [s]	0.2
Ton [s]	1.0

Figure 5. Pulse meter circuit.

Circuit building activity

Exercise 6: Simulate Colpitts oscillator circuit in LTspice to generate pure sine wave from a dc source of desired frequency. The output is to be observed at V_o.

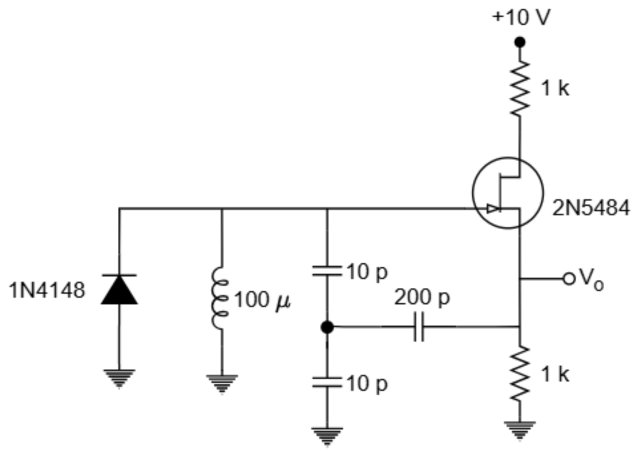


Figure 6. Colpitts oscillator circuit.