print name (first last): ________________________

course: ECET 337 2025/07/26

lab date (mo/day/yr): ________________________

lab section (day time): ________________________

instructor: ________________________

RC Transient Response

Prelab Calculations

_____ 1. Exponential Ramp Design (10%)

_____ 2. Positive and Negative Pulses Design (10%)

Performance Checks

		In lab	or	Late
_____ 1.	RC Ramp Generator	(40%	or	20%)
_____ 2.	RC Pulse Shaper	(40%	or	20%)

Lab Performance Scoresheet

Prelab initial submission (on time, with calculations, complete) … (20%)→ __________

All required signed ***Performance check offs*** ……………………………… (80%)→ __________

Total→ (out of 100%) __________

Prelab Activity: Refer to the attached Design Summary

1. Design an RC circuit that will shape a 0 V to 3 V, 50% duty cycle square wave into an exponential rise, (a ramp). Select the time constant to allow a complete rise, from the table below, based on your birthday.

Month of your birthday	Time constant, τ, (μsec)
January & February	100
March, April, May	125
June & July	150
August, September, October	175
November, December	200

Your birth month _________ Your time constant = ____________

Select 10 nF $\leq$ C $\leq$ 100 nF. Calculate the needed R. Find and *measure* these parts.
Repeat this process until you have an actual capacitor and a resistor that produces the desired time constant.

C = ________ R = ________

Draw the schematic below.

2. Design an RC circuit that will shape the 0 V to 3 V, 50% duty cycle square wave into positive and negative pulses that just complete their fall back to 0 V by the end of the pulse-width. As in problem 1, use your personal time constant, and find an R and C that produces the desired time constant.

C = ________ R = ________

Draw the schematic below.

Objectives

Verify the design of two RC pulse shapers.

Approach and Results

1. **RC Pulse Shaper – Square to Exponential Rise (a Ramp)**
   - **a.** Connect a BNC-to-minigrabber to the output of the wave generator.
   - **b.** Connect CH1 of the oscilloscope to that input.
   - **c.** Display the signal from the function generator on CH 1 of the oscilloscope. Assure that both CH1 and CH3 are DC coupled.
   - **d.** Set the generator to provide a square wave, 0 V to 3 V, 50% duty cycle, at 440 Hz.
   - **e.** Display this signal, filling most of the screen vertically, showing 1 cycle.
   - **f.** Add measurements of the signals V_{top}, V_{base}, and f.
   - **g.** *Disable* the signal from the function generator. Do *not* turn the generator *off*.
   - **h.** Build the circuit you designed to shape the signal into an exponential ramp, question 1 from the prelab exercise.
   - **i.** Connect the function generator's output to the input of your circuit.
   - **j.** Connect an oscilloscope probe (x10 ???) to CH3 and then across the capacitor. Adjust the oscilloscope to place this signal so that its 0 V level aligns with the input's level. Set the CH3 V/div to the same value as used for CH1.
   - **k.** Enable the output of the function generator, then adjust the oscilloscope controls as necessary to provide a good display.
   - **l.** When the circuit is providing the correct shape, capture the oscilloscope's display, with the cursors displayed to be included in your report. A *good* photo with your phone is fine.
   - **m.** Measure and record the value of the capacitor and the resistor.

     $C_{measured}$ = _________ $R_{measured}$ = _________
   - **n.** Measure your circuit's time constant, as shown in the tutorial. Capture this display.

     $\tau_{measured}$ = _______ $\tau_{calculated}$ = ________
   - **o.** Increase the capacitor's value by a factor of 10. Record the effect on the output's waveshape. Capture that waveform.
   - **p.** Lower the capacitor's value to 1/10 of the original value. Record the effect. Capture that waveform.
   - **q.** Return the original capacitor to the circuit and verify that the circuit still works.

Demonstrate the oscilloscope display, screen capture and explain the effects to your lab instructor.

2. RC Pulse Shaper – Square to Spikes

a. *Disable* the signal from the function generator. Do *not* turn the generator *off*.

b. Build the circuit you designed to shape the signal into the positive and negative spikes, question 2 from the prelab exercise.

c. Connect the function generator's output to the input of your circuit. Adjust the CH1 settings to put 0 V across the *center* of the screen and to just fully display the full square wave vertically.

d. Adjust CH3's settings to match those of CH1.

e. Connect the oscilloscope probe to CH3 and at the output of the pulse shaper circuit. Remember to set the CH 3 information to tell the oscilloscope about the probe attached.

f. Enable the output of the function generator, then adjust the oscilloscope controls as necessary to provide a good display.

g. When the circuit is providing the correctly shaped capture the oscilloscope's display to be included in your report.

h. Measure your circuit's time constant. Capture this display, with the cursors displayed.

τ_{measured} = _______ $\tau_{\text{calculated}}$ = ________

i. Increase the capacitor's value by a factor of 10. Record the effect on the output's waveshape, and capture the output waveshape.

j. Lower the capacitor's value to 1/10 of the original value. Record the effect on the output's waveshape. Capture the output waveshape.

k. Return the original capacitor to the circuit and verify that the circuit still works.

Demonstrate the oscilloscope display, screen capture and explain the effects to your lab instructor.

Analysis and Conclusions

1. Explain why you took the output across the capacitor in order to produce a ramp, instead of taking it across the resistor. Include the exponential equation for v_C in your explanation.

2. Explain the relationship of the time constant (and therefore component values) to the pulse width needed to produce the complete spike in section 2. Include the exponential equation for v_R in your explanation.