MATERIALS

1. LCR Meter
2. Function Generator (FG)
3. Oscilloscope (both channels)
4. 0.22 µF Capacitor
5. (1) 2.2 kΩ and (1) 10 kΩ Resistor
   Red red red brn blk org

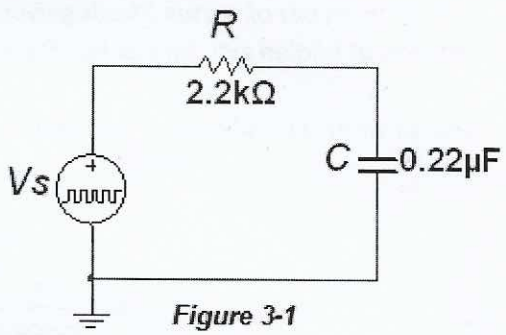

Figure 3-1

PROCEDURE

1. Calculate the time constant using nominal values. $\tau(nom) =$ 484 MF
2. Measure the actual resistance and capacitance of the components in ***Figure 3-1*** above.
   $R =$ 2.18 kΩ $C =$ 0.22 NF
3. Calculate the time constant using measured values. $\tau(meas) =$ 479.6 MF
4. Using the Function Generator features, create a square wave (50% Duty Cycle) with a pulse from 0V to 5V amplitude (you will need to use the offset feature to do this) and 100 Hz.
5. Attach the Channel 1 probe to the FG leads to view the waveform. You may need to adjust the horizontal and vertical settings to see a couple of cycles on the screen.
6. Construct the circuit above on a breadboard and place the Channel 1 probe across the source and the Channel 2 probe to measure V_C. = 5.10
7. If horizontal and vertical settings are adjusted appropriately, you will be able to view the full charge and discharge cycles similar to what is shown in ***Figure 3-2*** below.

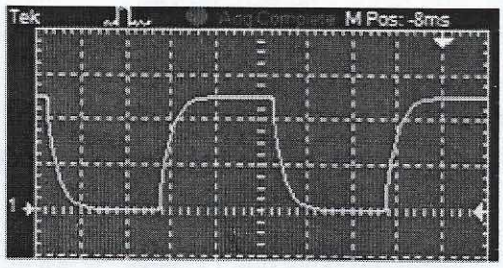

Figure 3-2

8. Add measurements of Max Voltage first for Channel 1 (V_S), then Channel 2 (V_C).
   Record them here: $Vs(max) =$ 5.10 V $Vc(max) =$ 4.90 V
   Take and save a screenshot for your submittal.
9. Stop the signal. Using the cursors (Y1 is the horizontal cursor that measures voltage and X1 is the vertical cursor that measures time), determine the time it takes to charge to 95% (3 time constants)
   1438.8 µS

by first moving the Y1 cursor to (0.95 * $V_{S(max)}$) and then moving the X1 cursor to the point where X1 crosses the Y1 cursor and the waveform. This point will be difficult to find. It is helpful to use the ZOOM feature of the oscilloscope.
Record the measured value here and **take and save a screenshot** for your submittal showing your measurements including time: $3\tau =$ 1.8mS

Using your measured value for 3τ, what is τ and what is C?

$\tau =$ 0.6mS 600µS $\quad C = \frac{\tau}{R(meas)} =$ _____

How do these measured values compare to theoretical/calculated or nominal values?

_____

10. Remove the source and probes from the circuit and replace the 2.2 kΩ resistor with the 10 kΩ resistor. Has the time constant changed? Yes

    If it has changed, what is its new value? $\tau(new) =$ 2.2mS

11. In the same configuration as before, replace the source and o-scope probes in the circuit. (Don't forget to hit the Run/Stop button again to resume readings.) Observe and record what is different about V_C? 4.43 V

12. Measure the frequency, maximum, and minimum voltages of the capacitor. **Take and save a screenshot** showing the V_S and V_C voltages with these three measurements. 4.92V -360mV

13. Now, decrease the frequency of the source to 50 Hz and adjust the horizontal scale as needed. Observe as the V_C waveform changes. (Don't forget to hit the Run/Stop button again to resume readings.) What has changed about V_C from that which was observed in Step 11?
    Voltage increased from 4.43V to 4.84V

14. Again, stop the signal and use the cursors (Horizontal cursors measure voltage and Vertical cursors measure time) and Zoom to determine the time it takes to charge to 95% (0.95*$V_{S(max)}$)
    Record the measured value here and **take and save a screenshot** showing your measurements:
    $3\tau =$ 7.69 mS

    Using your measured value for 3τ, what is τ and what is C (measured)?

    $\tau =$ 2.56 mS $\quad C = \frac{\tau}{R(meas)} =$ .259µF

    How does the value of the capacitance compare to the measured/calculated value found in Step 9 above?

SUBMITTAL: Make sure all submitted work is clearly your own. DO NOT USE MY WORDS, and DO NOT USE MY DATA/ILLUSTRATIONS. DO NOT USE ANY OTHER STUDENTS WORK. ALWAYS WRITE TECHNICAL PAPERS IN THE 3RD PERSON!!!! Your submittal will include the following report sections:

LAB COVER SHEET

TITLE PAGE

OBJECTIVE – using complete sentences, describe your thoughts on what you think the objectives of the exercise were.

PROCEDURE – using numbered steps, summarize the procedure performed in this lab

DATA – This section will include data/results created and clearly labeled/identified by you: A circuit schematic, all of the calculated (CALCULATIONS) /measured data recorded in this handout and required screenshots

DISCUSSION – using complete sentences, compare the theoretical (calculated) time constants with measured values.

CONCLUSION – using complete sentences, state the success of this experiment (how well your measured data compared to theoretical values). State how this is known. State significant observations. Conclusively state what was learned in performing this experiment.