1. (25 points) Build the circuit below and calculate current by measuring voltage across a known resistor. Find the total current ($I_1$) and each of the branch circuit currents ($I_2$) and ($I_3$). Note: you may need more measurements than just current. Calculate the value of the unknown resistor (given for practice exam). Must show work and include units. Must include units.

$V_{DC} = 10V_{DC}, R_1 = 220\Omega, R_2 = 2.7K\Omega, R_3 = 1K\Omega$ let $R_{unknown} = 560$ for practice

\[
\begin{array}{|c|c|c|}
\hline
I_1 & I_2 & R_{unknown} \\
\hline
I_3 & & \\
\hline
\end{array}
\]
2. Build the circuit below and measure $V_{\text{OUT}}$ peak and the $V_{\text{RIPPLE}}$ peak to peak with the oscilloscope. Include AC coupled scope capture of $V_{\text{RIPPLE}}$. Measure the actual value of the capacitor. Must include units.

Vin = 10sin(2π 1000t) + 0,  $C_1 = 10\mu F$, $R_{\text{load}} = 1K\Omega$, D1 =1N4001

<table>
<thead>
<tr>
<th>Vin Frequency in Hz</th>
<th>$V_{\text{OUT}}$ peak</th>
<th>C measured</th>
<th>$V_{\text{RIPPLE}}$</th>
</tr>
</thead>
</table>

3. RC Circuit

1. build the RC circuit run AC sweep from 10 Hz to 300 kHz. Vin = 1Vpp

2. Cutoff break point from the Gain plot

Breakpoint Gain (dB) _________  Frequency _________ Filter Type ______

15K

Vin $\rightarrow$ 0.0022uF $\rightarrow$ 2n2 $\rightarrow$ Vout
4 a. Build the circuit below you will need two supplies and using the DC sweep on the computer find the $V_{TN}$ (threshold voltage) by sweeping the Vgs DC supply from 0Vdc to 5Vdc until you observe I_D of 0.1ma for the 2N7000 MOSFET. Must include units. VDD = 12Vdc, Rload = 1KΩ, Vgs = 0V to 5V Include plot. Add a step to plot the Id current in mA. Cannot use a current meter.

<table>
<thead>
<tr>
<th>$V_{TN}$</th>
</tr>
</thead>
</table>

4 b. (25 points) Also measure $V_{DS}$ and I_DS using the meters only for the (off state) $V_{GS} = 0\, V_{DC}$ and the (on state) $V_{GS} = 5\, V_{DC}$. Must include units. Do not use current meter.

<table>
<thead>
<tr>
<th>$V_{GS}$ (off)</th>
<th>0 V$_{DC}$</th>
<th>$V_{GS}$ (on)</th>
<th>5 V$_{DC}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DS}$ (off)</td>
<td></td>
<td>$V_{DS}$ (on)</td>
<td></td>
</tr>
<tr>
<td>I_DS (off)</td>
<td></td>
<td>I_DS (on)</td>
<td></td>
</tr>
</tbody>
</table>

VDD = 12Vdc, Rload = 1.5KΩ, Vgs = variable