Name_____________________________________

1. (10 points) ___________

2. (25 points) ___________

3. (40 points) ___________

4. (25 points) ___________

Total (100 points) ___________

GOOD LUCK
1. A diode circuit and voltage waveform $v_s(t)$ are shown. **(10 points)**

![Diode Circuit Diagram]

List which diodes are ON (i.e., forward biased and conducting current) and which are OFF for $0 < t < 2$. Assume **ideal diodes**.

<table>
<thead>
<tr>
<th>ON Diodes:</th>
<th>OFF Diodes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List which diodes are ON and which are OFF for $2 < t < 4$. Assume **ideal diodes**.

<table>
<thead>
<tr>
<th>ON Diodes:</th>
<th>OFF Diodes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

2. Consider the diode circuit shown below with a signal voltage waveform $v_s(t)$ as shown. Draw the specified voltage waveforms in the table below. **(25 points)**

![Diode Circuit Diagram]

Sketch the voltage waveform for $v_o(t)$ assuming an **ideal** diode. Label the time axes and the signal values.

Sketch the voltage waveform for $v_o(t)$ assuming a **constant voltage drop model** for the diode (**the diode voltage is at 0.5V when conducting**). Label the time axes and the signal values.
3. Answer the following questions. \( |V_{BE}| = 0.7V \) for an ON transistor and \( |V_{CE}| = 0.2V \) when the transistor is in saturation.

a) For the bipolar transistors and conditions shown in the following table calculate the missing entries. (15 points).

<table>
<thead>
<tr>
<th>Device</th>
<th>( I_C ) (mA)</th>
<th>( I_B ) (mA)</th>
<th>( I_E ) (mA)</th>
<th>( \alpha )</th>
<th>( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>b</td>
<td></td>
<td>1</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>10</td>
<td>110</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) In the circuit shown, calculate the collector current and collector voltage assuming \( \beta = 100 \). (10 points).

\[ I_C = \quad \text{and} \quad V_C = \quad \text{and} \]

\[ +10V \quad 1mA \quad 100\,\text{k}\Omega \]

(\[ \]

\[ 1mA \quad 100\,\text{k}\Omega \] \]

(\[ \]

\[ +10V \quad 1mA \quad 20\,\text{k}\Omega \] \]

\[ +10V \quad 1mA \quad 20\,\text{k}\Omega \] \]

(\[ \]

(15 points).

c) For the circuit shown determine the region of operation (cutoff, active, or saturation) for the transistor with \( \beta = 49 \). (15 points).
4. For the circuit shown, the emitter voltage is 4 V. Calculate the collector voltage and collector, base, and emitter currents for the transistor. Use this information to calculate $\alpha$ and $\beta$. Do not assume large $\beta$. $|V_{BE}| = 0.7V$ for an ON transistor. (25 points).

$I_C = \underline{\hspace{2cm}}$  $I_B = \underline{\hspace{2cm}}$

$I_E = \underline{\hspace{2cm}}$  $V_C = \underline{\hspace{2cm}}$

$\alpha = \underline{\hspace{2cm}}$  $\beta = \underline{\hspace{2cm}}$