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Introduction to Mechatronics and Measurement Systems | (3rd Edition)

Chapter 3, Problem 2 Bookmark Show all steps: ON

Step-by-step solution

Step 1 of 7

Consider input signal.

$V_{\text{in}} = 1.0\sin(2\pi t)\ \text{V}$

Peak (amplitude) voltage is, $0.1\ \text{V}$.

Angular frequency is,

$f = 1\ \text{Hz}$

Time period is,

$$\begin{aligned} T &= \frac{1}{f} \\ &= \frac{1}{1} \\ &= 1\ \text{sec} \end{aligned}$$

(a)

Refer to the circuit diagram in third chapter 2^{nd} problem part (a).

For positive cycle, the diode is in reverse bias.

For negative cycle, the diode is in forward bias.

Analyse the output response when $V_{\text{in}} > 0$ and then $V_{\text{in}} < 0$. When V_{in} is positive, the diode is reverse biased and therefore equivalent to an open circuit. No current flow through the resistor and the output V_{out} equals V_{in}. When V_{in} is negative, the diode is forward biased, and it is equivalent to short circuit. Therefore, there is no voltage drop across the diode across the diode and V_{out} is zero. Combining these two cases, the resulting output waveform retains the positive peak in the sine wave and loses the negative peaks.

Draw the output waveform V_{out}.

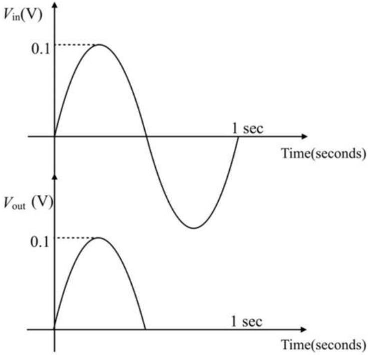

Figure 1

Thus, output waveform has been plotted.

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Step 2 of 7

(b)

Refer to the circuit diagram in third chapter 2nd problem part (b).

For positive cycle, the diode is in forward bias.

For negative cycle, the diode is in reverse bias.

Analyse the output response when $V_{in} > 0$ and then $V_{in} < 0$. When V_{in} is positive, the diode is forward biased and therefore equivalent to short circuit. Therefore, there is no voltage drop across the diode across the diode and V_{out} is zero. When V_{in} is negative, the diode is reverse biased the output V_{out} equals V_{in}. Combining these two cases, the resulting output waveform retains the negative peak in the sine wave and loses the positive peaks.

Draw the output waveform V_{out}.

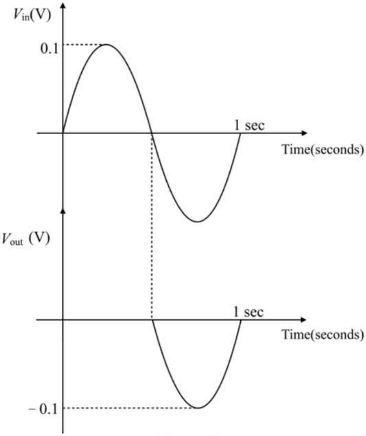

Figure 2

Thus, output waveform has been plotted.

Comment

Step 3 of 7

(c)

Refer to the circuit diagram in third chapter 2nd problem part (c).

For positive cycle, the diode is in forward bias.

For negative cycle, the diode is in reverse bias.

Analyse the output response when $V_{in} > 0$ and then $V_{in} < 0$. When V_{in} is positive, the diode is forward biased and therefore equivalent to short circuit. Thus, the input voltage is parallel to resistor and V_{out} is equal to V_{in}.When V_{in} is negative, the diode is reverse biased and therefore equivalent to open circuit. Thus, V_{out} is equal to zero. Combining these two cases, the resulting output waveform retains the positive peak in the sine wave and loses the negative peaks.

Draw the output waveform V_{out}.

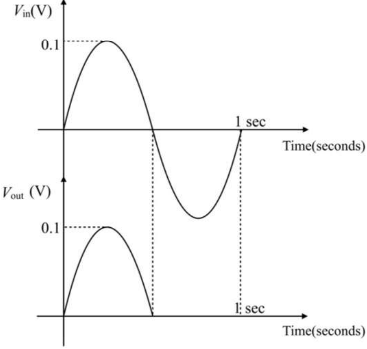

Figure 3

Thus, output waveform has been plotted.

Comment

Step 4 of 7

(d)

Refer to the circuit diagram in third chapter 2nd problem part (d).

For positive cycle, the diode is in reverse bias.

For negative cycle, the diode is in forward bias.

Analyse the output response when $V_{in} > 0$ and then $V_{in} < 0$. When V_{in} is positive, the diode is reverse biased and therefore equivalent to open circuit. Thus, V_{out} is equal to zero for positive cycle. When V_{in} is negative, the diode is forward biased and therefore equivalent to short circuit. Thus, the input voltage is parallel to resistor and V_{out} is equal to V_{in}. Combining these two cases, the resulting output waveform retains the negative peak in the sine wave and loses the positive peaks.

Draw the output waveform V_{out}.

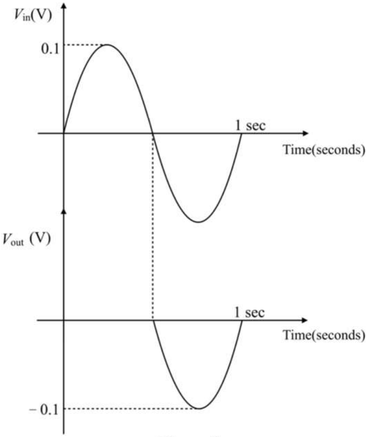

Figure 2

Thus, output waveform has been plotted.

Comment

Step 5 of 7

(e)

Refer to the circuit diagram in third chapter 2nd problem part (e).

For positive cycle, the diode is in reverse bias.

For negative cycle, the diode is in forward bias.

Analyse the output response when $V_{in} > 0$ and then $V_{in} < 0$. When V_{in} is positive, the diode is reverse biased and therefore equivalent to open circuit. Thus, V_{out} is equal to V_{in}.

When V_{in} is negative, the diode is forward biased and therefore equivalent to short circuit. Thus, the circuit becomes voltage divider. The output voltage is half of the input voltage.

Comment

Step 6 of 7

Draw the output waveform V_{out}.

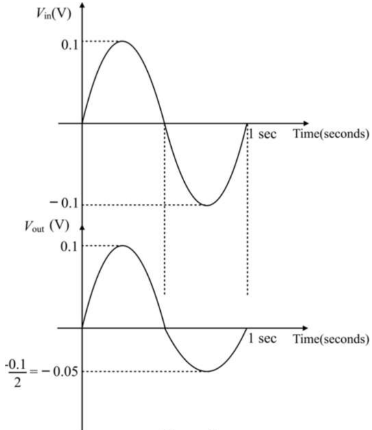

Figure 5

Thus, output waveform has been plotted.

Comment

Step 7 of 7

(f)

Refer to the circuit diagram in third chapter 2nd problem part (f).

Redraw the circuit diagram.

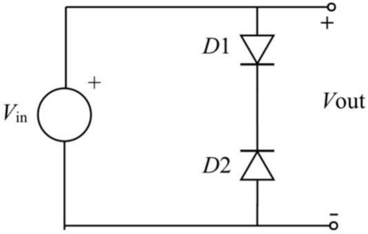

Figure 6

For positive cycle, the diode D_1 is forwards bias and D_2 is reverse bias.

For negative cycle, the diode D_1 is reverse bias and D_2 is forward bias.

For negative cycle, the diode is in reverse bias.

Analyse the output response when $V_{in} > 0$ and then $V_{in} < 0$.

Therefore, both the cases, the output voltage V_{out} follows input voltage V_{in}.

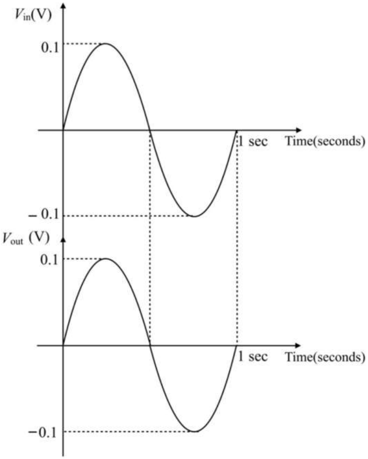

Figure 7

Thus, output waveform has been plotted.

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Chapter 3, Solution 13

In steady state dc, the capacitor is equivalent to an open circuit. Therefore, the steady state current through the capacitor...

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