Solution for Exercise
Assignment #2

Ex 3.5 Solution Plan: We need to find the turns ratio of the transformer which achieves the load voltage.

\[ V_{\text{avg}} = \frac{V_{\text{max}} - V_{\text{min}}}{2} \]

\[ = 15V. \]

\[ V_{\text{max}} = 15.2V \]

\[ C = \frac{I_L T}{2V_4} \]

\[ = 0.1 \times \frac{1}{60} \]

\[ = \frac{2 \times 0.4}{2} \]

\[ C = 2083 \mu F \]

\[ V_{\text{max}} = V_{\text{m secondary}} + 2V_{\text{diode}} \]

\[ V_{\text{m max}} = 15.2 + 2(0.7) \]

\[ V_{\text{m secondary}} = 16.6V. \]

\[ V_{\text{m primary}} = 110\sqrt{2} \]

\[ = 155.6V \]

\[ n = \frac{V_{\text{m primary}}}{V_{\text{m secondary}}} \]

\[ n = \frac{155.6}{16.6} \]

\[ n = 9.47 \]
Ex 3.6 Solution Plan: Same as previous problem.

We determine the capacitance like in the previous problem.

Thus $C = 2083 \mu F$.

In this case we have $V_{\text{secondary}} = V_{\text{max}} + V_{\text{diode}}$.

$$n = \frac{V_{\text{primary}}}{V_{\text{secondary}}} = \frac{15.2 + 0.7}{15.9} = 0.978$$

$n = 9.78$

Ex 3.7 Solution Plan: To sketch the waveforms for the above clipper circuits.

(a) [Diagram of clipper circuit with diodes and voltage levels labeled]

(b) [Diagram of equivalent circuit with voltage levels labeled]

From equivalent circuit, we have

$$\frac{V_o - 5}{1k} + \frac{V_o - V_{\text{in}}}{1k} = 0 \Rightarrow V_o = \frac{V_{\text{in}} + 5}{2}$$
Similarly with D2 in breakdown and D1 on:

\[ V_0 = \frac{V_{in} - 5}{2} \]

With both diodes off, \( V_0 = V_{in} \).

\[ \text{Ex: 3.17} \]

Solution Plan: We need to find the increment in \( V_0 \) to double the current. This is done by simple substitution and solving the 2 equations.

Suppose for \( V_{o1} \), we have \( i_{o1} \) and at \( V_{o2} = V_{o1} + \Delta V_0 \), the current is \( i_{o2} = 2i_{o1} \).

\[ i_{o2} = I_s \exp \left( \frac{(V_{o1} + \Delta V_0)}{nVT} \right) \]

\[ = 2i_{o1} \]

\[ = 2I_s \exp \left( \frac{V_{o1}}{nVT} \right) \]

\[ I_s \exp \left( \frac{V_{o1}}{nVT} \right) \exp \left( \frac{\Delta V_0}{nVT} \right) = 2I_s \exp \left( \frac{V_{o1}}{nVT} \right) \]

\[ \exp \left( \frac{\Delta V_0}{nVT} \right) = 2 \]

\[ \Delta V_0 = nVT \ln 2 \]

\[ = 18 \text{ mV} \]

Similarly for \( i_{o2} = 10i_{o1} \), we find \( \Delta V_0 = nVT \ln(10) \)

\[ \Delta V_0 = 59.9 \text{ mV} \]
Ex 3.20 Solution Plan: We calculate and observe the effect of junction capacitance for various voltage considerations.

\[ C_j = \frac{C_{j0}}{\left[1 - \left(V_{oa}/\phi_0\right)^m\right]} \]

\[ = \frac{5 \times 10^{-6}}{\left[1 - (V_{oa}/10^8)^{0.5}\right]} \]

a) \[ C_j = \frac{5 \times 10^{-6}}{\left[1 - (5/10^8)^{0.5}\right]} \]

\[ C_j = 1.86 \text{ pF} \]

b) \[ C_j = \frac{5 \times 10^{-6}}{\left[1 - (-50/10^8)^{0.5}\right]} \]

\[ C_j = 0.627 \text{ pF} \]