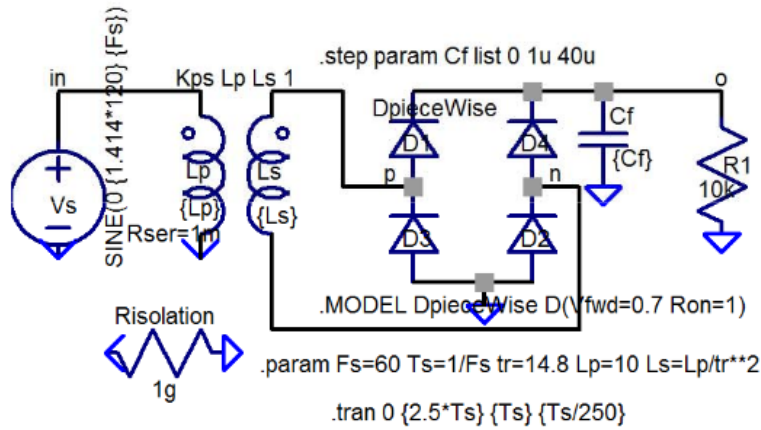# Design & Simulate 9
ECE2204 CRN:82929

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Problem 9.2-3.a.1:

Design

The circuit below takes a 120V(rms) 60Hz AC input and outputs a positive rectified DC current. Redesign the circuit to output an output voltage of $V_O = -12V$, a ripple voltage of $V_r = 0.05V$, and use diodes with $V_\gamma = 1.2V$. Assume an output load resistance of $R_L = 17k\Omega$

$$V_S max = |V_O(max)| + 2V_\gamma = |12V| + 2 \times 1.2V = 14.4V$$

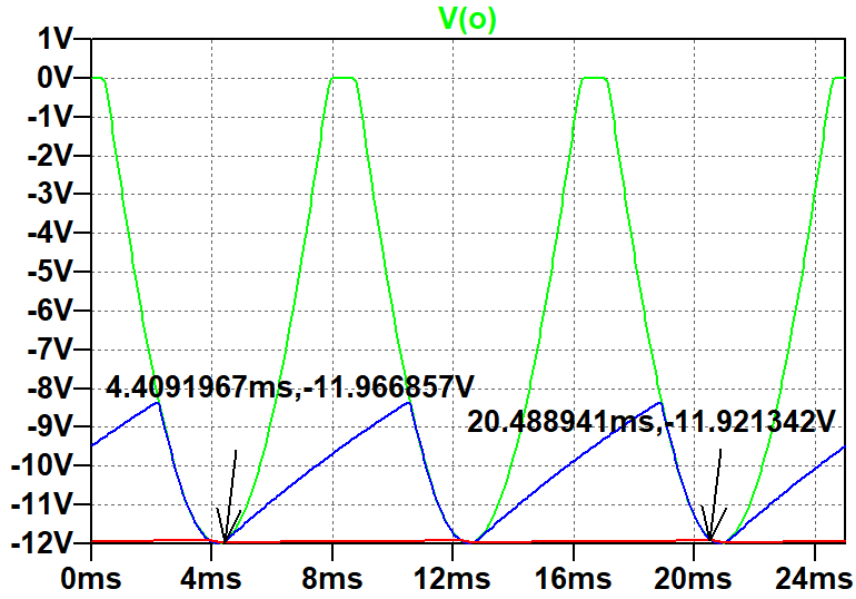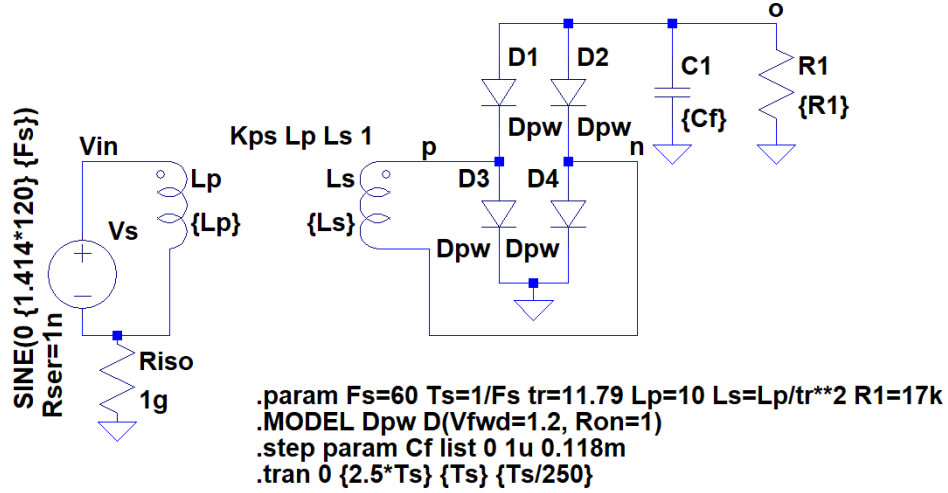$$V_{Srms} = \frac{14.4V}{\sqrt{2}} = 10.18V$$

$$Tr = \frac{120V}{10.18V} = 11.79$$

$$PIV = V_S(max) - V_\gamma = 14.4V - 1.2V = 13.2V$$

$$Cf = \frac{V_M}{2fRV_r} = \frac{12V}{2(60Hz)(17k\Omega)(0.05V)} = 0.118mF$$

Validation

LTSpice Implementation (values within $< 1\%$)

.param Fs=60 Ts=1/Fs tr=11.79 Lp=10 Ls=Lp/tr**2 R1=17k
.MODEL Dpw D(Vfwd=1.2, Ron=1)
.step param Cf list 0 1u 0.118m
.tran 0 {2.5*Ts} {Ts} {Ts/250}

$$V_r = |-11.967V + 11.921V| = \pm 0.041V$$

Simulated V_r is within the required $\pm 0.05V$.

$$Err_{V_O} = \frac{12V - 11.967V}{12V} = 0.0028 = 0.28\%$$

Problem 8.2-5.b.1:

Design

Convert the prior problem into a center tapped transformer DC rectifier.

$$V_S max = |V_O(max)| + V_\gamma = |12V| + \times 1.2V = 13.2V$$
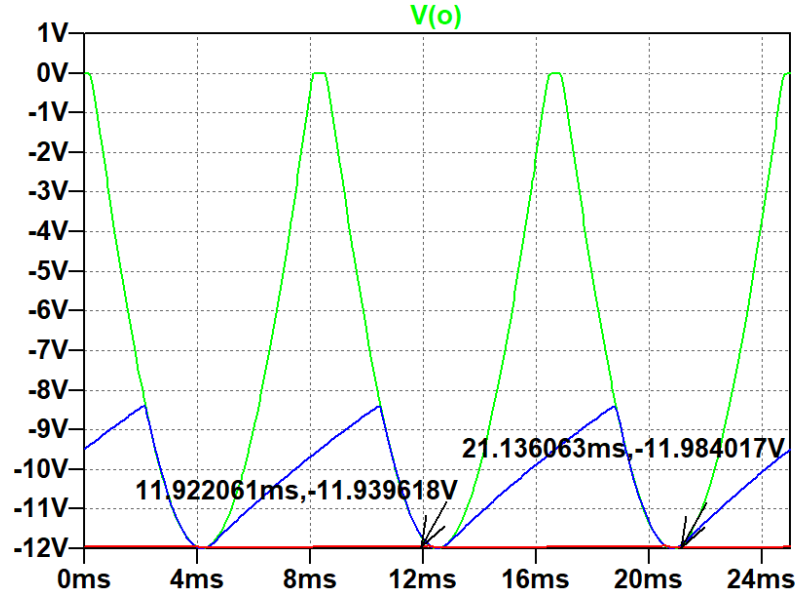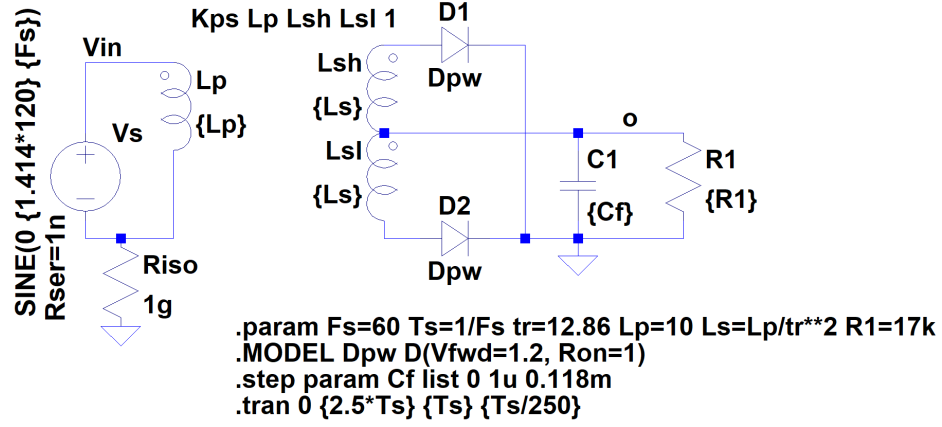
$$V_{Srms} = \frac{13.2V}{\sqrt{2}} = 9.33V$$

$$Tr = \frac{120V}{9.33V} = 12.86$$

$$PIV = V_S(max) = 13.2V$$

$$Cf = \frac{V_M}{2fRV_r} = \frac{12V}{2(60Hz)(17k\Omega)(0.05V)} = 0.118mF$$

Validation

```
.param Fs=60 Ts=1/Fs tr=12.86 Lp=10 Ls=Lp/tr**2 R1=17k
.MODEL Dpw D(Vfwd=1.2, Ron=1)
.step param Cf list 0 1u 0.118m
.tran 0 {2.5*Ts} {Ts} {Ts/250}
```


$$V_r = |-11.984V + 11.939V| = \pm 0.050V$$

Simulated V_r is exactly at the specified $\pm 0.05V$.

$$Err_{V_O} = \frac{12V - 11.984V}{12V} = 0.0028 = 0.28\%$$

This assignment should demonstrate a basic understanding of using filter and rectifier circuits.

I have neither given nor received unauthorized assistance on this assignment.