K. J. SOMAIYA COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS ENGINEERING
ELECTRONIC CIRCUITS
DIODE APPLICATIONS

Numerical 1: Simulate a half wave rectifier circuit given in Figure 1 with input Amplitude = 110V peak, f = 60Hz, and $R_L = 75\Omega$ using LT spice. Use 10:1 step down transformer. Plot the following using LTspice:

i) Primary peak voltage

ii) Secondary peak voltage

iii) Output voltage across resistor

iv) Output voltage across diode

v) Current flowing through the circuit

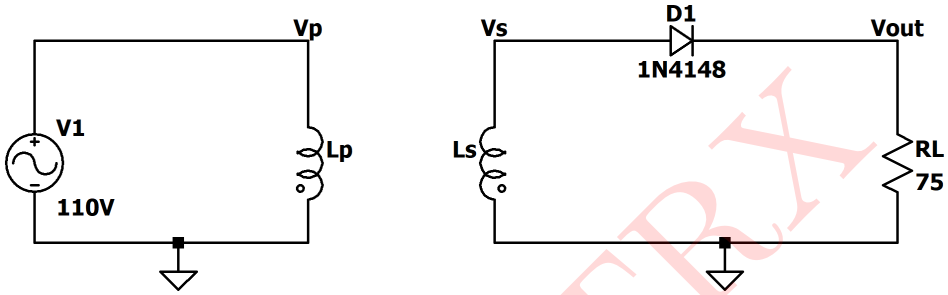

Figure 1: Circuit 1

Solution:

Transformer ratio is 10:1,

$$\frac{V_p}{V_s} = \frac{10}{1}$$

$$\mathrm{V}_s = V_m = \frac{110}{10} = 11V$$

DC output power is,

$$\mathrm{P}_{DC} = \frac{V_{DC}^2}{R_L} = \frac{V_m^2}{\pi^2 \times R_L}$$

$$\therefore P_{DC} = 0.16346W$$

AC output power is,

$$\mathrm{P}_{AC} = \frac{\left(\frac{V_m}{2}\right)^2}{R_f + R_L} = \frac{\left(\frac{11}{2}\right)^2}{(0.01 \times 10^{-3}) + 75}$$

$$\therefore P_{AC} = 0.4033W$$

Efficiency,

$$\eta = \frac{P_{DC}}{P_{AC}} \times 100$$

$$\therefore \eta = 40.53\%$$

PIV Rating $= -V_m = -11V$

$$I_m = \frac{V_m}{R_f + R_L} = \frac{11}{(0.01 \times 10^{-3}) + 75}$$

$\therefore \mathrm{I}_m = 0.1466A$

SIMULATED RESULTS

The given circuit is simulated in LTspice and the results obtained are as follows:

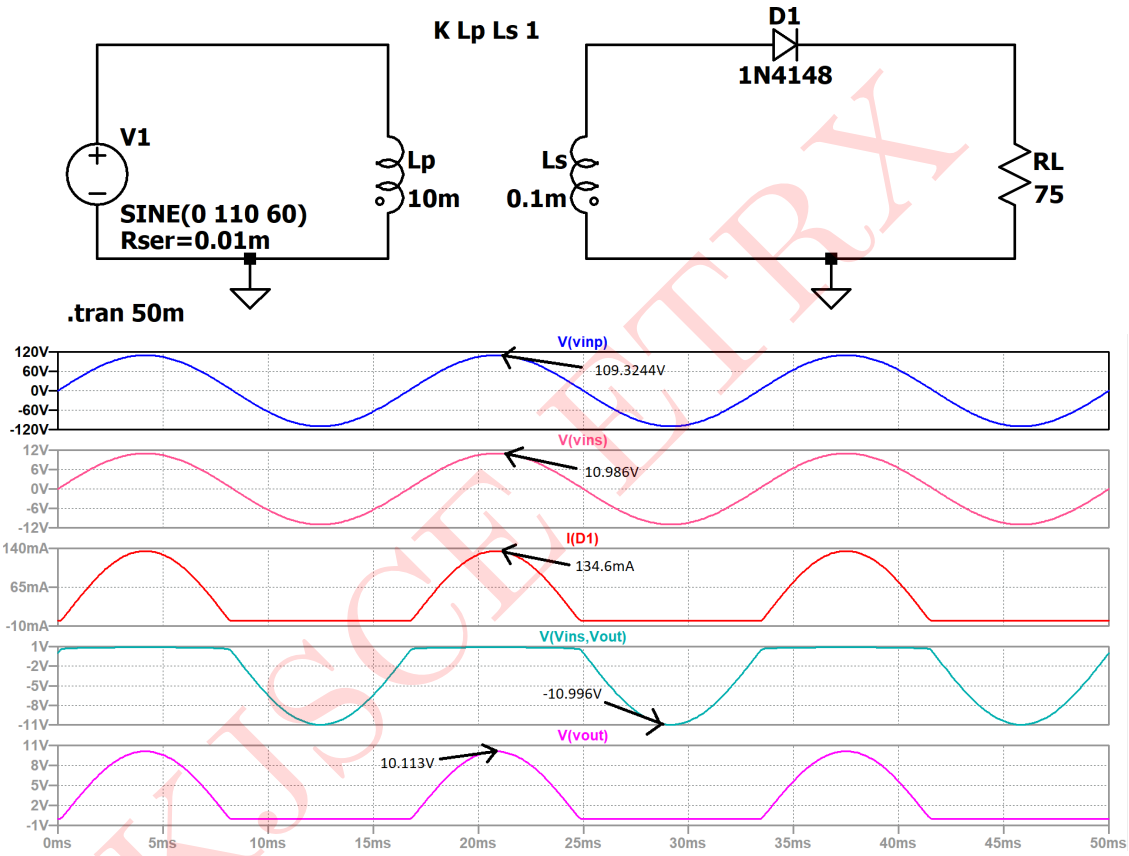

Figure 2: Circuit Schematic and Simulated Results

Verifying the Calculated Values with Simulated Values:

Parameter	Calculated Value	Simulated Value
V_m	11V	10.996V
I_m	0.1466A	0.1346A
P_{DC}	0.4033W	0.4031W
P_{AC}	0.16346W	0.16334W
η	40.53%	40.521%
PIV Rating	$-11V$	$-10.9965V$

Table 1: Numerical 1

Numerical 2: Simulate a full wave rectifier circuit given in Figure 3 with input Amplitude = 120V peak, f = 50Hz, and $R_L = 50\Omega$ using LT spice. Use 10:1 step down transformer. Plot the following using LTspice:

i) Primary peak voltage

ii) Secondary peak voltage

iii) Output voltage across resistor

iv) Output voltage across diodes

v) Current flowing through the diodes

vi) Current flowing through the circuit

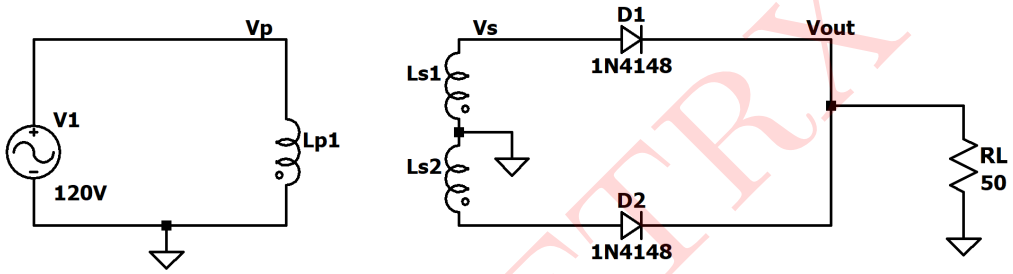

Figure 3: Circuit 2

Solution:

Transformer ratio is 10:1,

$$\frac{V_p}{V_s} = \frac{10}{1}$$

$$\mathrm{V}_s = V_m = \frac{120}{10} = 12V$$

DC output power is,

$$\mathrm{P}_{DC} = \left(\frac{2I_m}{\pi}\right)^2 \times R_L = \left(\frac{2 \times 0.2399}{\pi}\right)^2 \times 50$$

$$\therefore P_{DC} = 1.16624W$$

AC output power is,

$$\mathrm{P}_{AC} = 0.5 \times (I_m)^2(R_f + R_L)$$

$$\therefore P_{AC} = 1.4388W$$

Efficiency,

$$\eta = \frac{P_{DC}}{P_{AC}} \times 100$$

$\therefore \eta$ =81.056%

PIV Rating $= -2 \times V_m = -24V$

$$I_m = \frac{V_m}{R_f + R_L} = \frac{12}{(0.01 \times 10^{-3}) + 50}$$

$$\therefore \mathrm{I}_m = 0.2399A$$

SIMULATED RESULTS

The given circuit is simulated in LTspice and the results obtained are as follows:

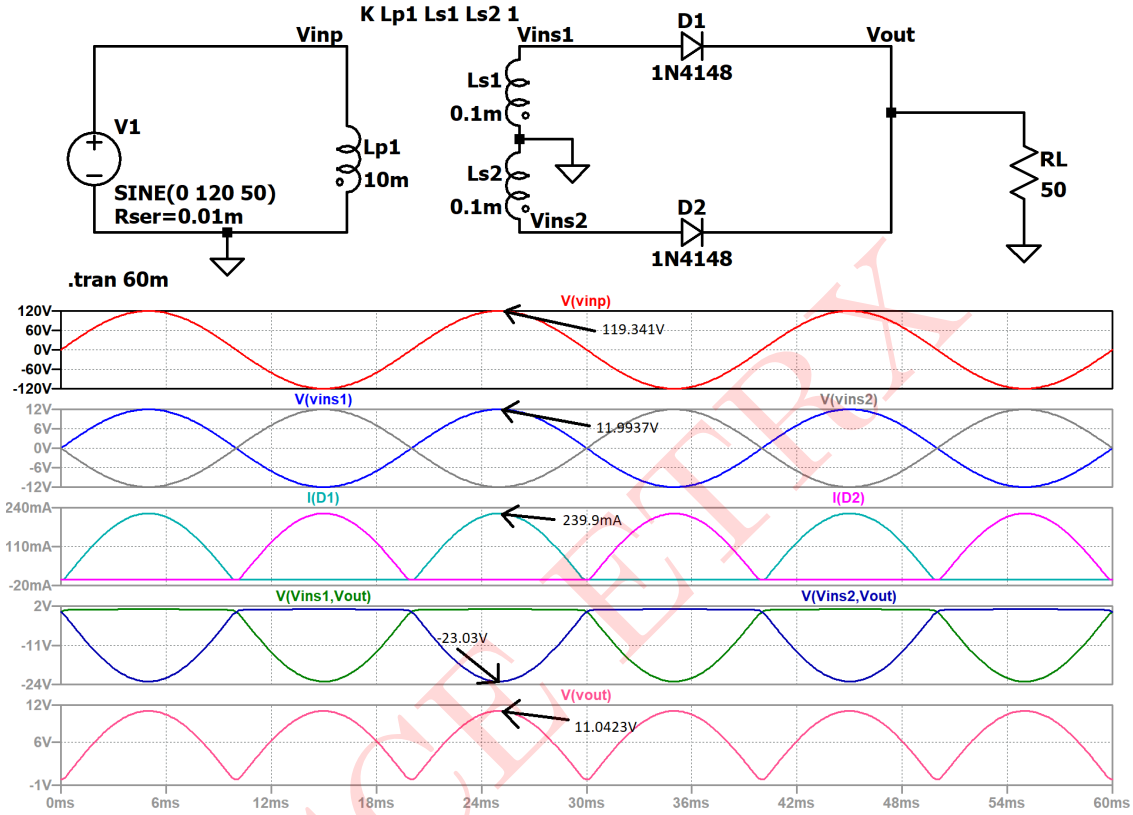

Figure 4: Circuit Schematic and Simulated Results

Verifying the Calculated Values with Simulated Values:

Parameter	Calculated Value	Simulated Value
V_m	12V	11.9937V
I_m	0.2399A	0.2208A
P_{DC}	1.16624W	0.988W
P_{AC}	1.4388W	1.218W
η	81.056%	81.116%
PIV Rating	$-24V$	$-23.03V$

Table 2: Numerical 2

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