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

Numerical 1:
Simulate a half wave rectifier circuit with input Amplitude = 150V peak, f = 50 Hz and $R_1 = 110\Omega$ using LTSpice. Select diode as IN4148. Use 10:1 step down transformer.
Plot the following using LTSpice:
a) Primary peak voltage
b) Secondary peak voltage
c) Output voltage across resistor
d) Output voltage across diode
e) Current flowing through the circuit
Also, calculate the efficiency of the Half wave rectifier circuit.

SOLUTION:

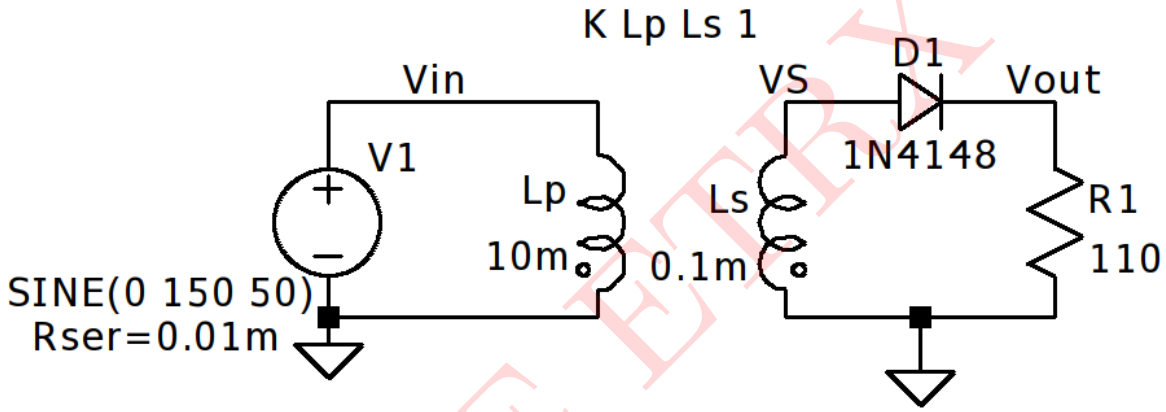

Figure 1: Circuit Diagram

$$V_m = \frac{V_1}{10}$$
$$V_m = 15\text{V}$$
$$I_m = \frac{V_m}{R_1}$$
$$I_m = \frac{15}{110}$$
$$I_m = 136.36\text{mA}$$
$$P_{DC} = \frac{V_m^2}{\pi^2 \times R_1}$$
$$P_{DC} = 0.2072\text{W}$$
$$P_{AC} = \frac{V_m^2}{4R_1}$$
$$P_{AC} = 0.51136\text{W}$$
$$\text{Efficiency} = \frac{P_{DC}}{P_{AC}} \times 100$$
$$\text{Efficiency} = 40.52\%$$
$$\text{PIV rating} = -V_m = -15\text{V}$$

SIMULATED RESULTS:

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

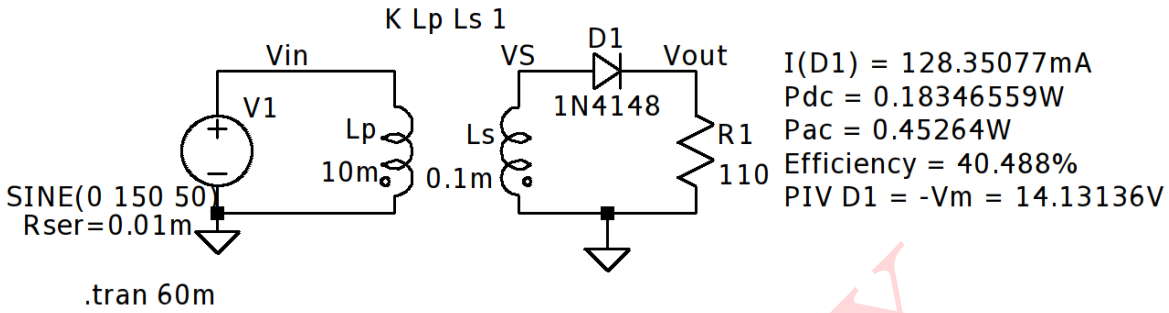

Figure 2: Circuit Schematic and Simulated Results

Waveforms:

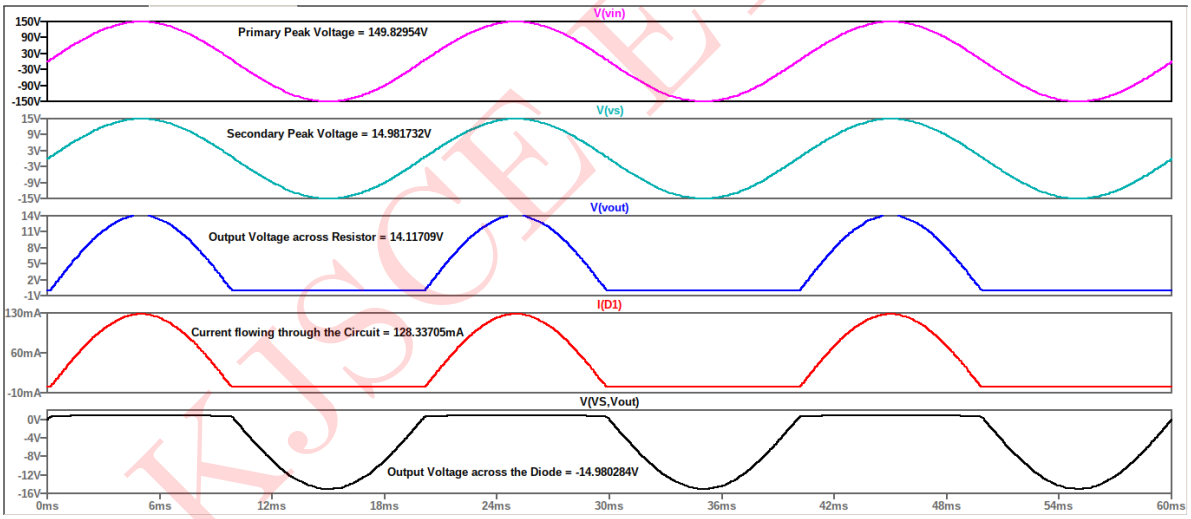

Figure 3: Simulated Waveforms

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Output Peak Voltage	15V	14.113136V
Output Peak Current	113.36mA	128.3311mA
AC Power	0.51136W	0.51136W
DC Power	0.2072W	0.18346559W
Efficiency	40.52%	40.488%
PIV Rating	−15V	−14.113136V

Table 1: Numerical 1

Numerical 2:
Simulate a Full wave rectifier circuit with input Amplitude = 140V peak, f = 50 Hz and $R_1 = 110\Omega$ using LTSpice. Select diode as IN4148. Use 10:1 step down center tap transformer. Plot the following using LTSpice:
a) Primary peak voltage
b) Secondary peak voltage
c) Output voltage across resistor
d) Output voltage across diodes
e) Current flowing through the diodes
f) Current flowing through the circuit
Also, calculate the efficiency of the Full wave Center tapped rectifier circuit.

SOLUTION:

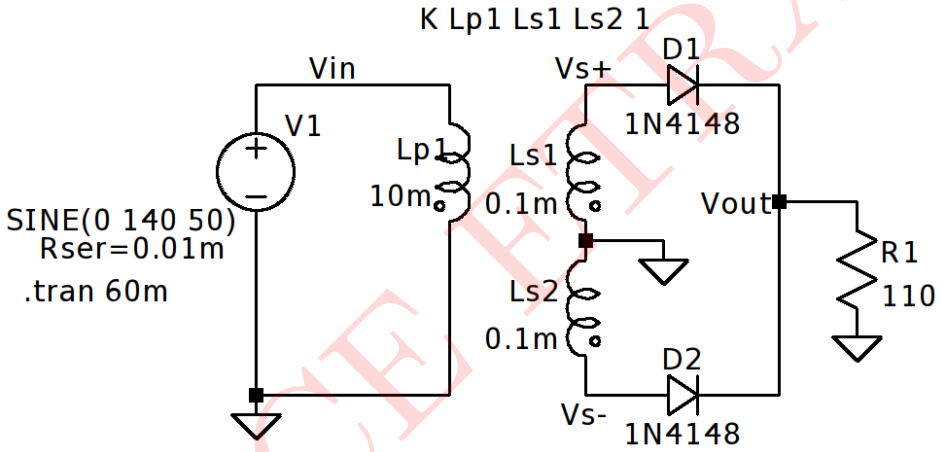

Figure 4: Circuit Diagram

$$V_m = \frac{V_1}{10}$$
$$V_m = 14\text{V}$$
$$I_m = \frac{V_m}{R_1}$$
$$I_m = \frac{14}{110}$$
$$I_m = 127.27\text{mA}$$
$$P_{DC} = \frac{4I_m^2 \times R_1}{\pi^2}$$
$$P_{DC} = 0.72211276\text{W}$$
$$P_{AC} = \frac{I_m^2 \times R_1}{2}$$
$$P_{AC} = 0.890871\text{W}$$
$$\text{Efficiency} = \frac{P_{DC}}{P_{AC}} \times 100$$
$$\text{Efficiency} = 81.0569\%$$
$$\text{PIV rating} = -2V_m = -28\text{V}$$

SIMULATED RESULTS:

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

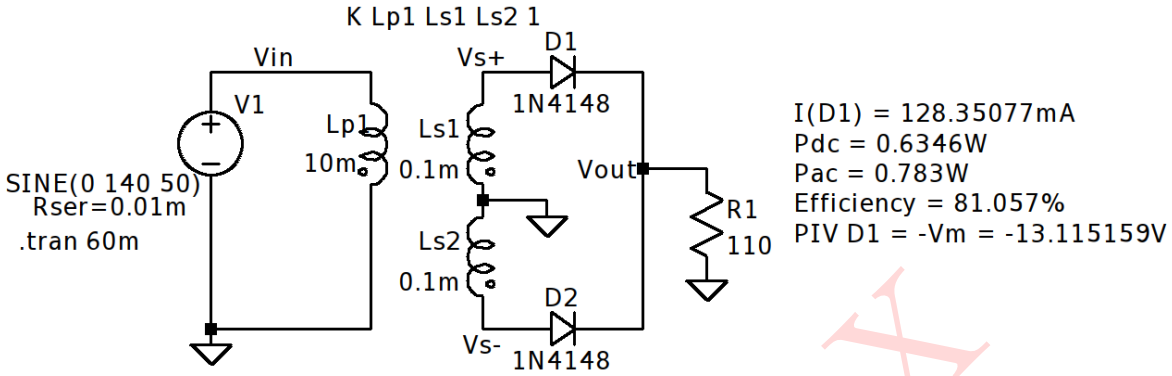

Figure 5: Circuit Schematic and Simulated Results

Waveforms:

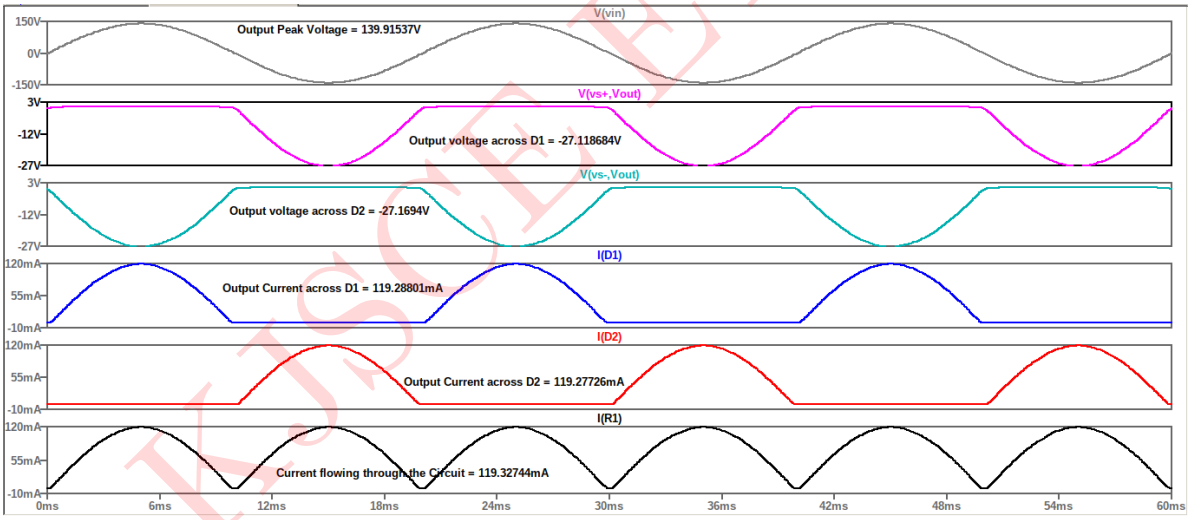

Figure 6: Simulated Waveforms

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Output Peak Voltage	14V	13.115159V
Output Peak Current	127.27mA	119.30864mA
AC Power	0.890871W	0.783W
DC Power	0.72211276W	0.634W
Efficiency	81.0569%	81.057%
PIV Rating	−28V	−27.093769V

Table 2: Numerical 2