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 = 100V, f = 50Hz, $R_L = 75\Omega$. Select diode as 1N4148. Use 10:1 step down transformer. Plot the following:
a) Primary peak Voltage
b) Secondary peak Voltage
c) Output voltage across Resistor
d) Output voltage across Diode
e) Current through the circuit
Also calculate the efficiency.

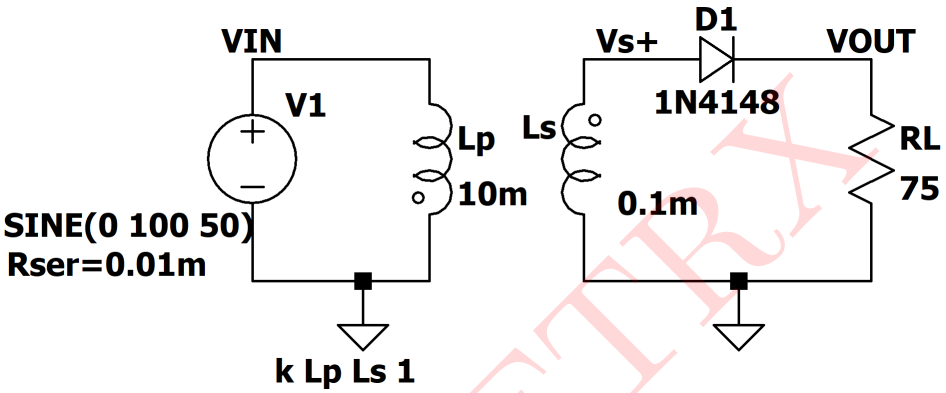

Figure 1: Circuit 1

Solution:

$V_{m_{peak}} = 100V$

For the secondary peak voltage, as the coils of the transformer are in ratio of 10:1

$$V_{m_{sec}} = \frac{V_m}{10} = 10V$$

Peak inverse voltage $= -V_m = -10V$

For the peak current,

$$I_m = \frac{V_m}{(R_S + R_L)}$$

$$I_m = \frac{10}{0.01m\Omega + 75\Omega}$$

$$I_m = 0.1333A$$

$$I_m = 133.33mA$$

$$\text{AC power} = \left(\frac{I_m}{2}\right)^2 \times (R_S + R_L)$$

AC power = 0.333W

$$\text{DC power} = \left(\frac{I_m}{\pi}\right)^2 \times R_L$$

$$\text{DC power} = 0.1358\text{W}$$

$$\%\ \eta = \frac{DCpower}{ACpower} \times 100$$

$$\%\eta = \frac{0.1358}{0.333} \times 100$$

$$\%\eta = 40.5280\%$$

SIMULATED RESULTS:

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

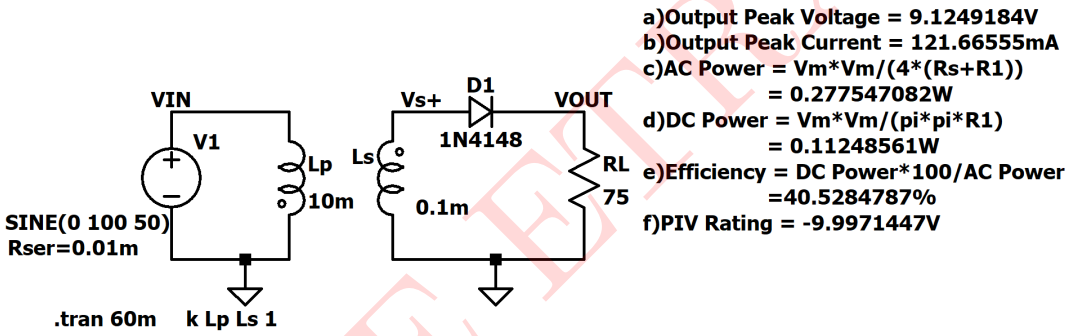

Figure 2: Circuit Schematic and Simulated Results

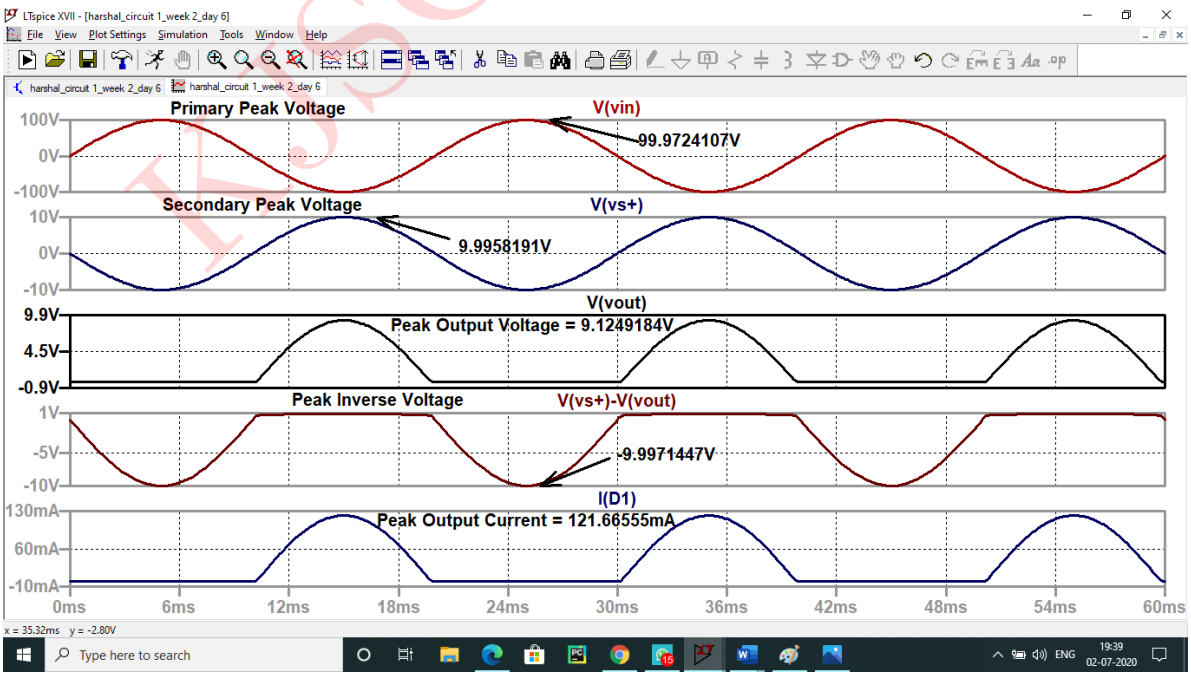

Figure 3: Plots in LTSpice

Comparison of Theoretical and Simulated values:

Parameters	**Theoretical Values**	**Simulated Values**
Output Peak Value(V_m)	10V	9.1247V
Output Peak Current (I_m)	133.33mA	121.665mA
AC Power	0.333W	0.27754W
DC Power	0.13508W	0.11248W
Efficiency	40.5280%	40.5284%
PIV Rating	−10V	−9.997144V

Table 1: Numerical 1

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Numerical 2: Simulate a full wave rectifier circuit with input amplitude = 150V, frequency = 50Hz, $R_L = 150\Omega$.
Select the diode as 1N4148. Use 10:1 step down center tap transformer. Plot the following:
a) Primary Peak Voltage
b) Secondary Peak Voltage
c) Output Voltage across the resistor
d) Output Voltage across the diodes
e) Current flowing through the diodes.

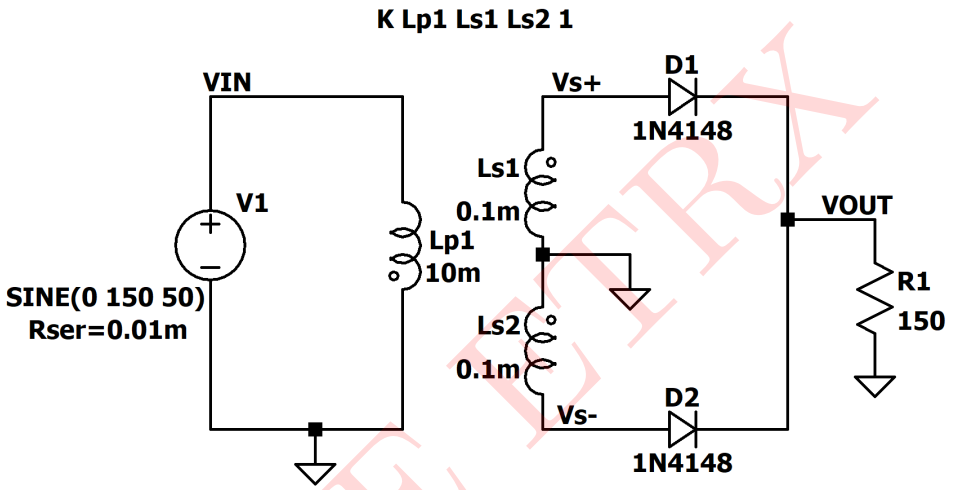

Figure 4: Circuit 1

Solution:

$V_{m_{peak}} = 150$V (Primary Peak Voltage)

For the secondary peak voltage, as the coils of the transformer are in ratio of 10:1

$$\mathrm{V}_{m_{sec}} = \frac{V_m}{10} = 15V$$

Peak inverse voltage $= 2 \times -V_m = 2 \times -15 = -30V$

For the peak current,

$$\mathrm{I}_m = \frac{V_m}{(R_S + R_L)}$$

$$\mathrm{I}_m = 0.0999A$$

$$\mathrm{I}_m = 99.99mA$$

$$\text{AC power} = \left(\frac{I_m}{2}\right)^2 \times (R_S + R_L)$$

AC power = 0.7499W

$$\text{DC power} = 4\times\left(\frac{I_m}{\pi^2}\right)^2 \times R_1$$

$$\text{DC power} = 0.60791\text{W}$$

$$\%\ \eta = \frac{DCpower}{ACpower} \times 100$$

$$\%\eta = \frac{0.6079}{0.7499} \times 100$$

$$\%\eta = 81.0654\%$$

SIMULATED RESULTS:

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

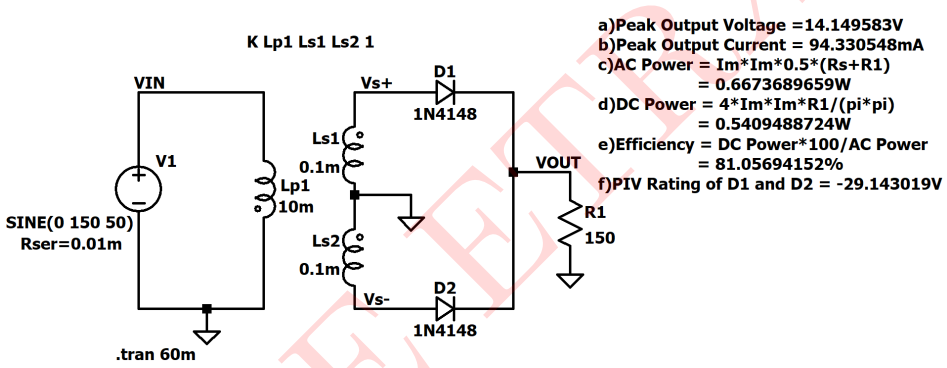

Figure 5: Circuit Schematic and Simulated Results

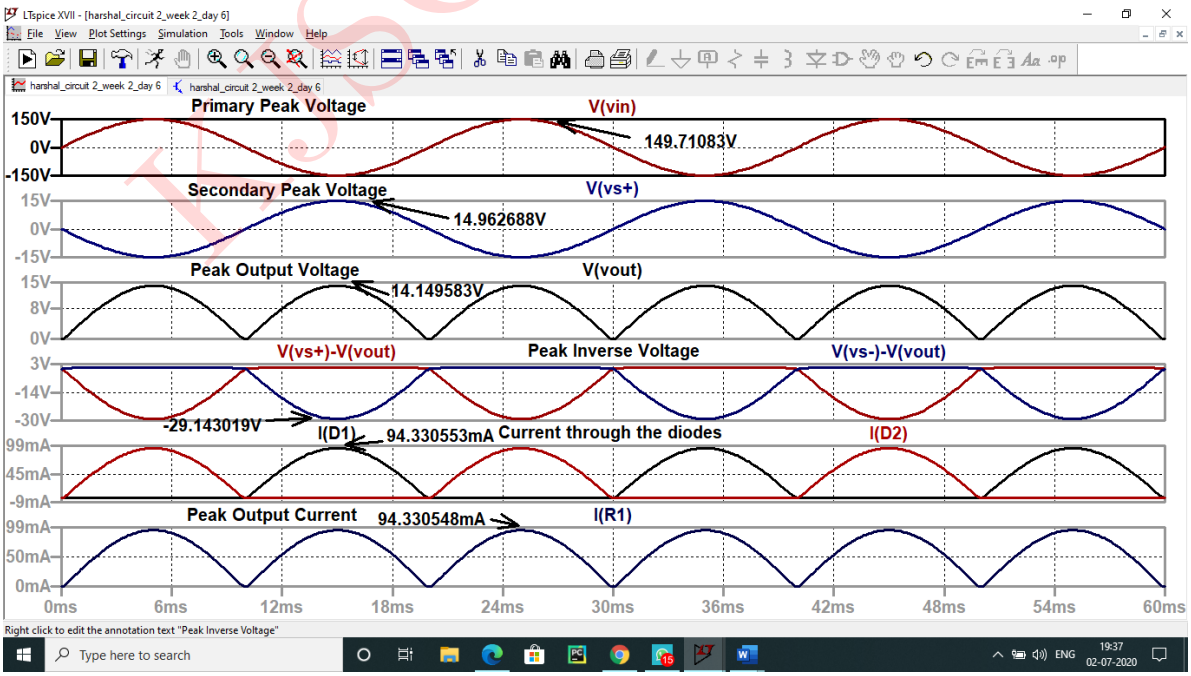

Figure 6: Plots in LTSpice

Comparison of Theoretical and Simulated values:

Parameters	**Theoretical Values**	**Simulated Values**
Output Peak Value(V_m)	15V	14.149V
Output Peak Current (I_m)	99.99mA	94.33054mA
AC Power	0.7499W	0.6673W
DC Power	0.6079W	0.54094W
Efficiency	81.0654%	81.0569%
PIV Rating	−30V	−29.143V

Table 2: Numerical 2

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