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

Numerical 1: Simulate a Half wave rectifier circuit with Amplitude = 220Vpeak, f = 50Hz, $R_L = 95\Omega$ using LT spice. Select diode as IN41481. 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 diodes
e) Current flowing through the circuit
Also, calculate the efficiency of the Half wave rectifier circuit.

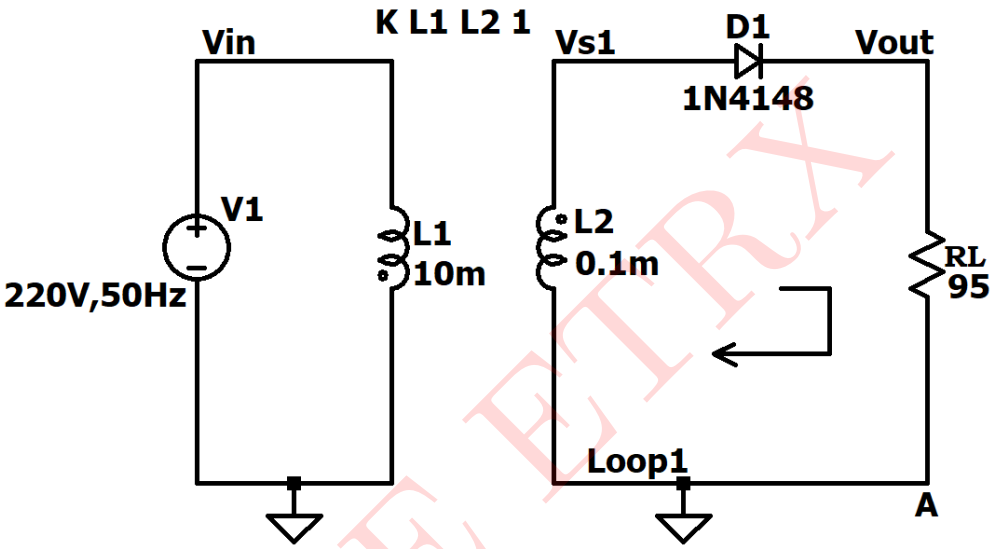

Figure 1: Circuit 1

Solution:

Since the circuit is a step down transformer with step voltage ratio $= \frac{V_2}{V_1} = \frac{N_2}{N_1}$, hence,

$\frac{V_S}{220} = \frac{1}{10}$

$\therefore V_S = 22V$

Applying KVL to the loop1

$V_S - V_{D_{ON}} - V_{out} = 0$

$V_m = V_{out} = 22 - 0.7 = 21.3V$

$$I_m = \frac{V_m}{R_f + R_L} = \frac{21.3}{95.7} = 222.57mA$$

$$P_{ac} = \frac{V_m^2}{4(R_f + R_L)} = \frac{(21.3)^2}{4 \times 95.7} = 1.185W$$

$$P_{dc} = \frac{V_m^2}{\pi^2 \times R_L} = \frac{(21.3)^2}{\pi^2 \times 95.7} = 0.4839W$$

$$\eta(\%) = \frac{P_{dc}}{P_{ac} \times 100} = 40.833\%$$

$$PIV = -V_m = -21.3V$$

Graphs :

a) Input voltage

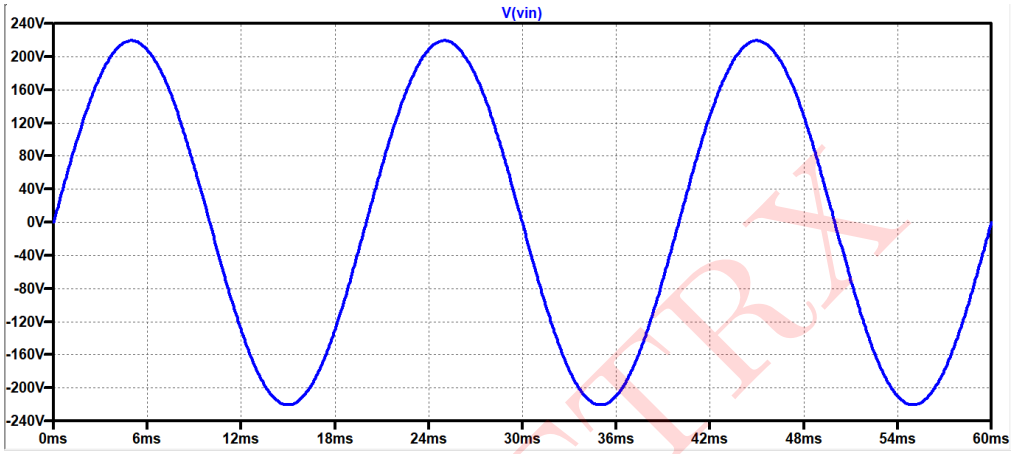

Figure 2: Input voltage

b) Current in Rectifier

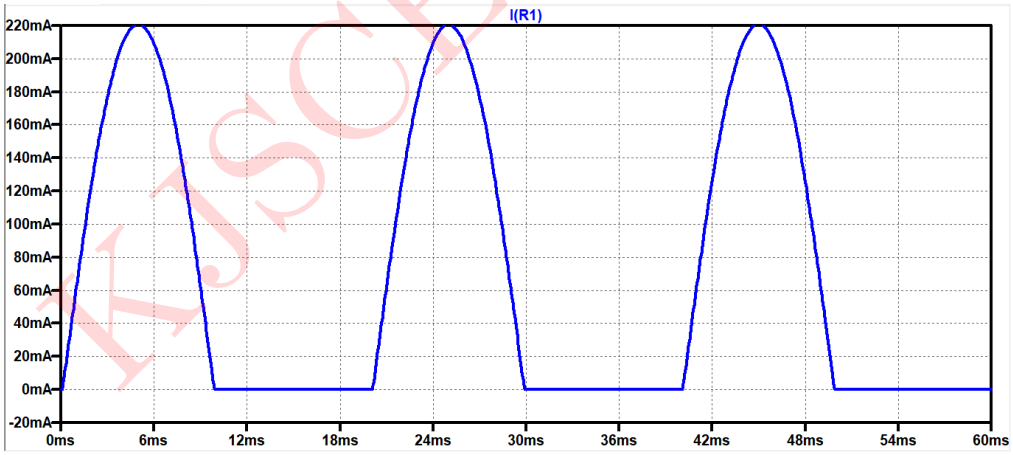

Figure 3: Current in Rectifier

c) Voltage across resistor

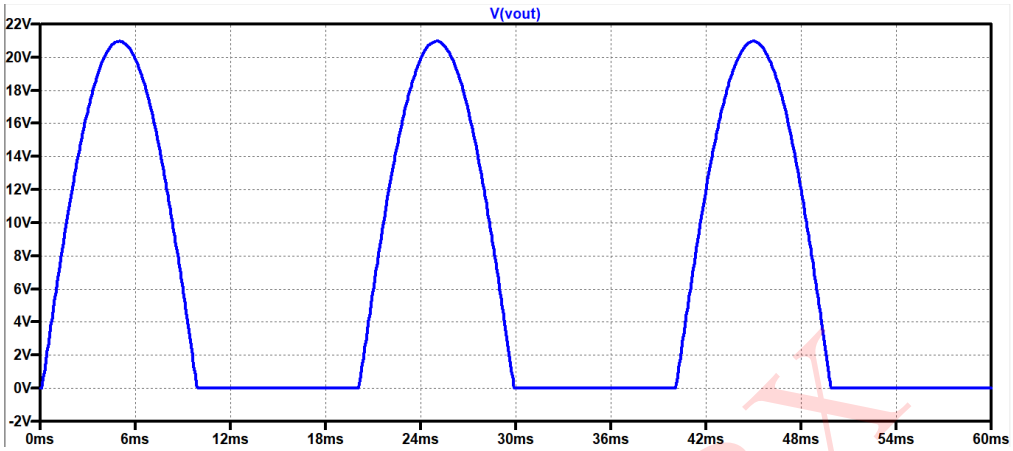

Figure 4: Voltage across resistor

d) Voltage across Diodes

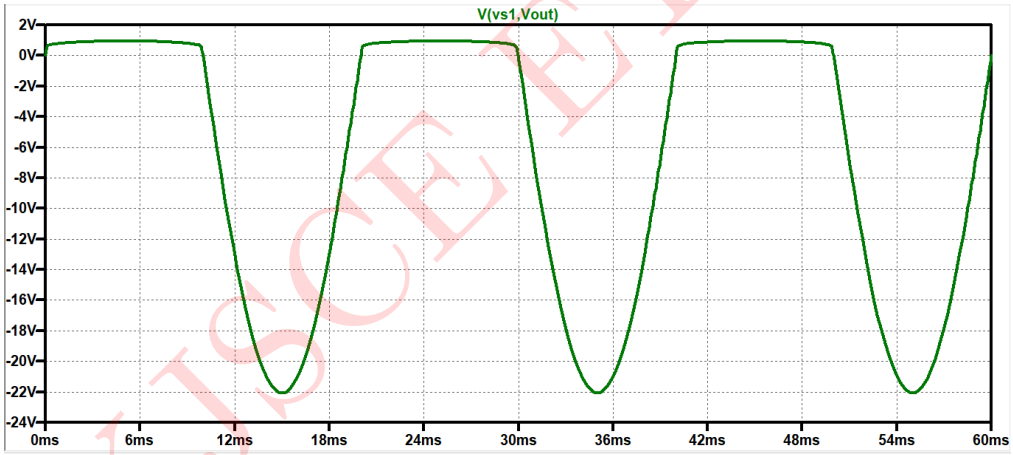

Figure 5: Voltage across Diodes

SIMULATED RESULTS:

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

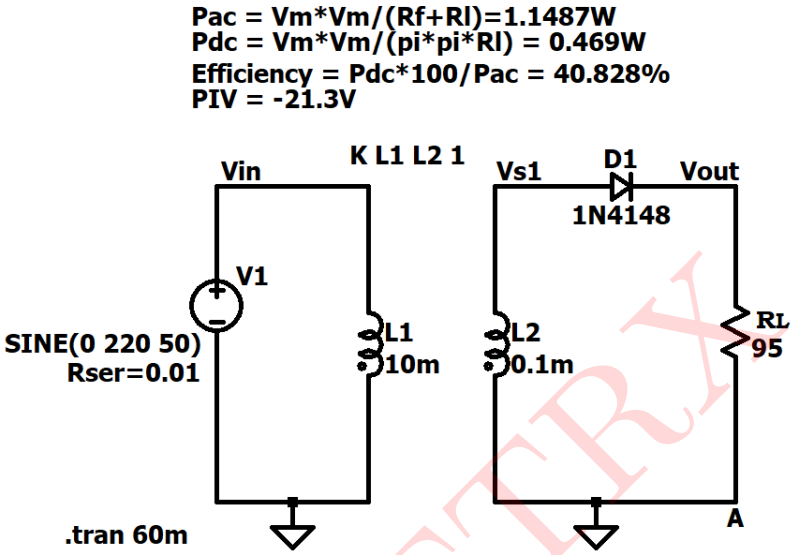

Figure 6: Circuit schematic and simulated results

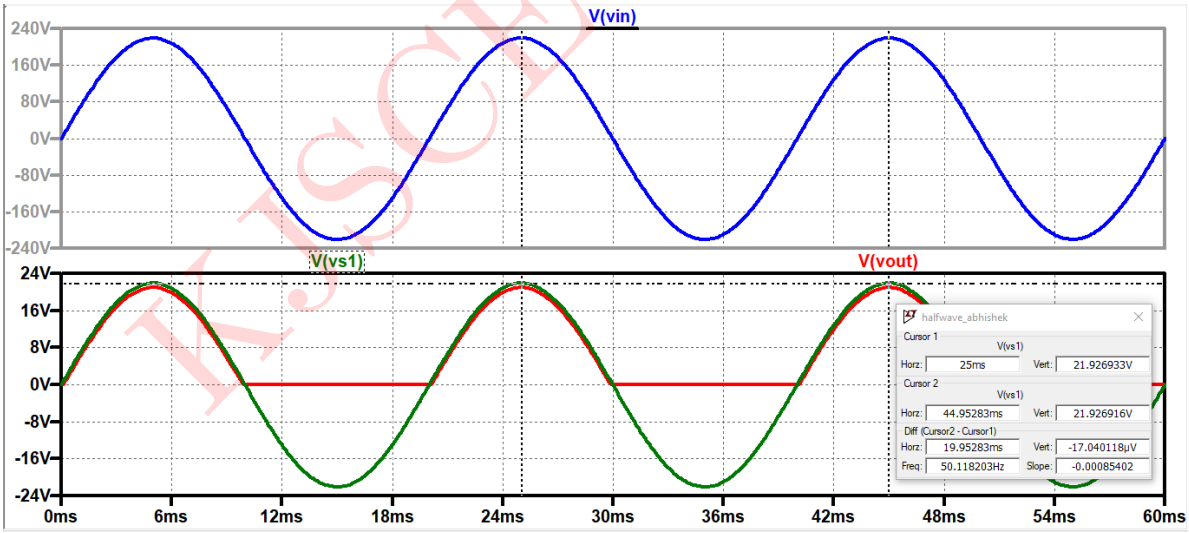

Figure 7: Simulated results for Primary and Secondary voltages

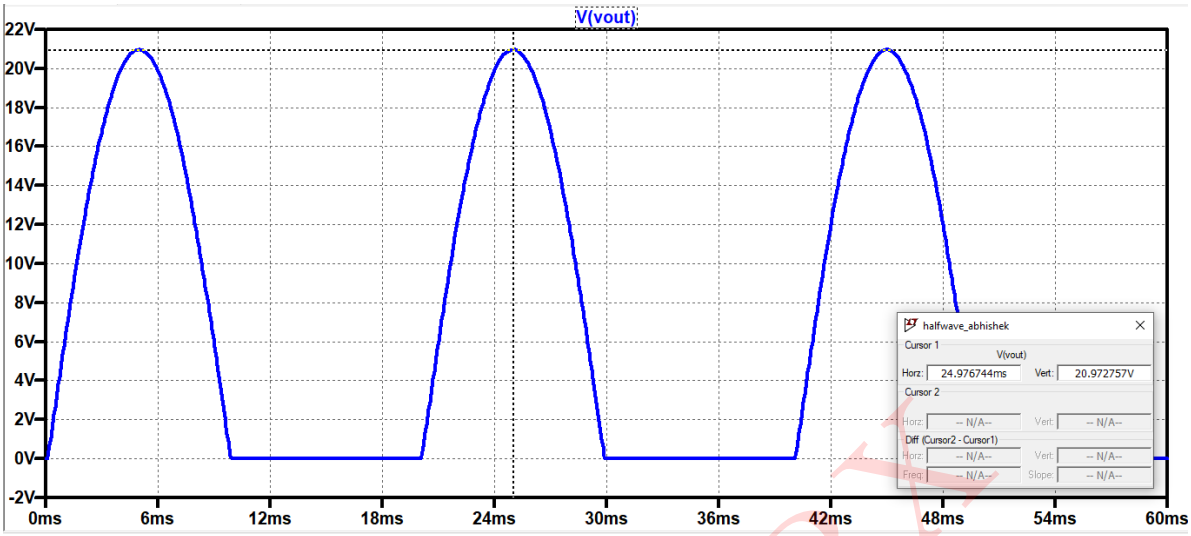

Figure 8: Simulated results for Output peak voltage

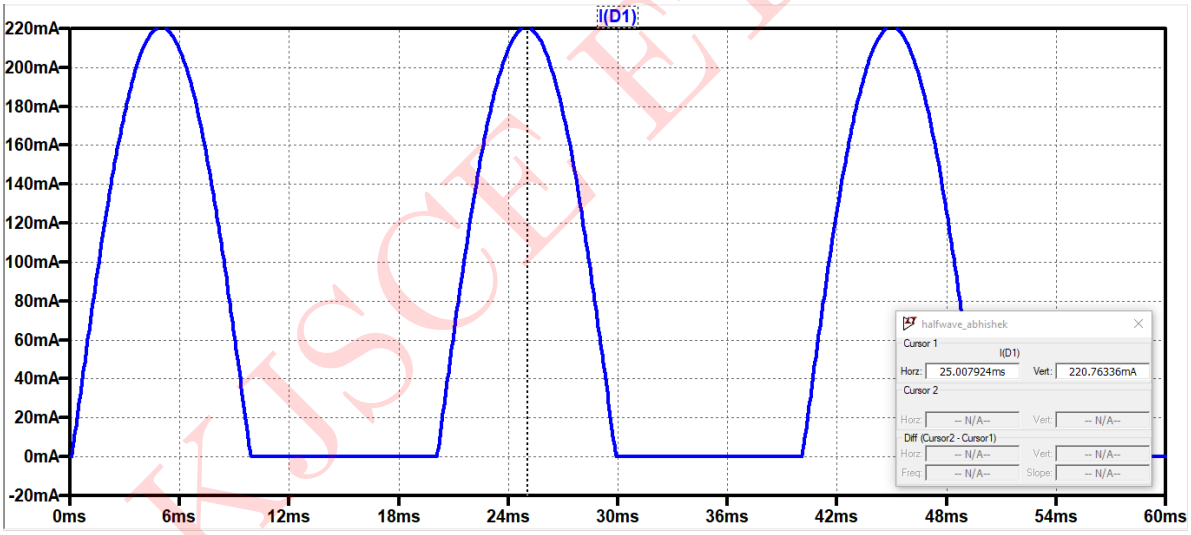

Figure 9: Simulated results for Output peak current

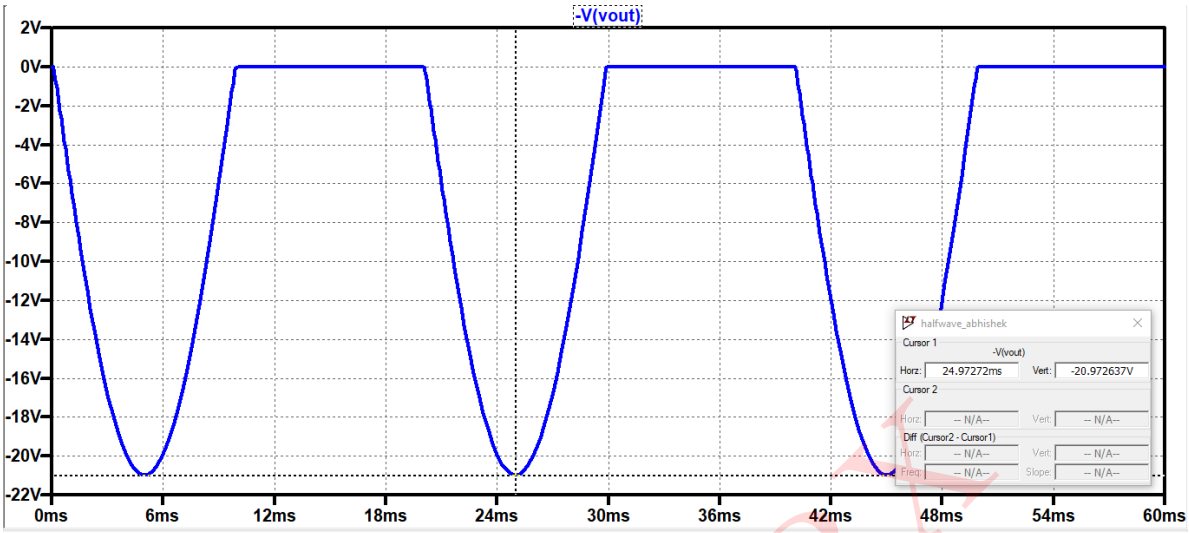

Figure 10: Simulated results for PIV rating

Comparison of theoretical and simulated values:

Parameters	**Theoretical Values**	**Simulated Values**
Output peak value(V_m)	21.30V	20.97V
Output peak current(I_m)	222.57mA	220.76mA
Ac power	1.185W	1.1487W
Dc power	0.4839W	0.4839W
Efficiency	40.833%	40.828%
PIV rating	−21.39V	−20.97V

Table 1: Numerical 1

Numerical 2: Simulate a Full wave rectifier circuit with input Amplitude = 220V peak, f = 50Hz, $R_L = 90\Omega$ using LT spice. Select diode as IN41481. 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.

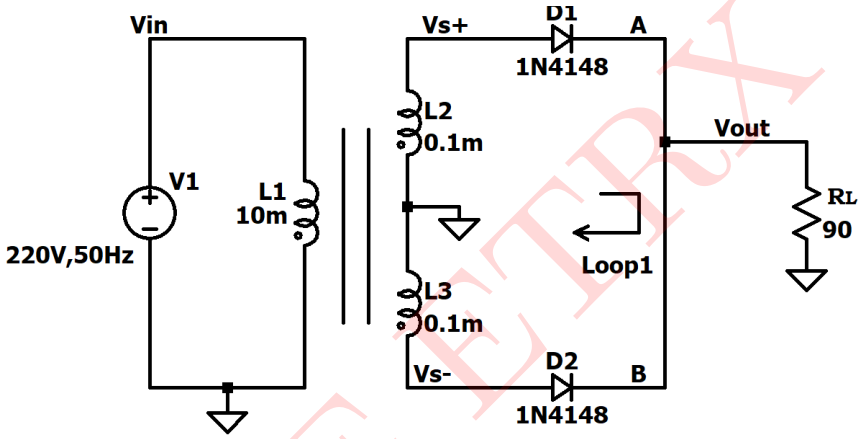

Figure 11: Circuit 2

Solution:

Since the circuit is a step down transformer with step voltage ratio $= \frac{N_2}{N_1} = \frac{1}{10}$, hence,

$$\frac{V_2}{V_1} = \frac{1}{10}$$
$$\frac{V_S}{220} = \frac{1}{10}$$
$$\therefore V_S = 22V$$

Applying KVL to the loop1

$$V_S - V_{D_{ON}} - V_{out} = 0$$
$$V_m = V_{out} = 22 - 0.7 = 21.3V$$

$$I_m = \frac{V_m}{R_f + R_L} = \frac{21.3}{90.7} = 234.84mA$$

$$P_{ac} = \frac{I_m^2}{2}(R_f + R_L) = \frac{(234.84 \times 10^{-3})^2}{2} \times 90.7 = 2.5010W$$
$$P_{dc} = \frac{2I_m^2}{\pi^2} \times R_L = \frac{(2 \times 234.84 \times 10^{-3})^2}{\pi^2} \times 90.7 = 2.0116W$$
$$\eta(\%) = \frac{P_{dc}}{P_{ac} \times 100} = 80.43\%$$
$$PIV = 2 \times (V_{out}) = 2(-21.3) = -42.6V$$

Graphs :

a) Input voltage

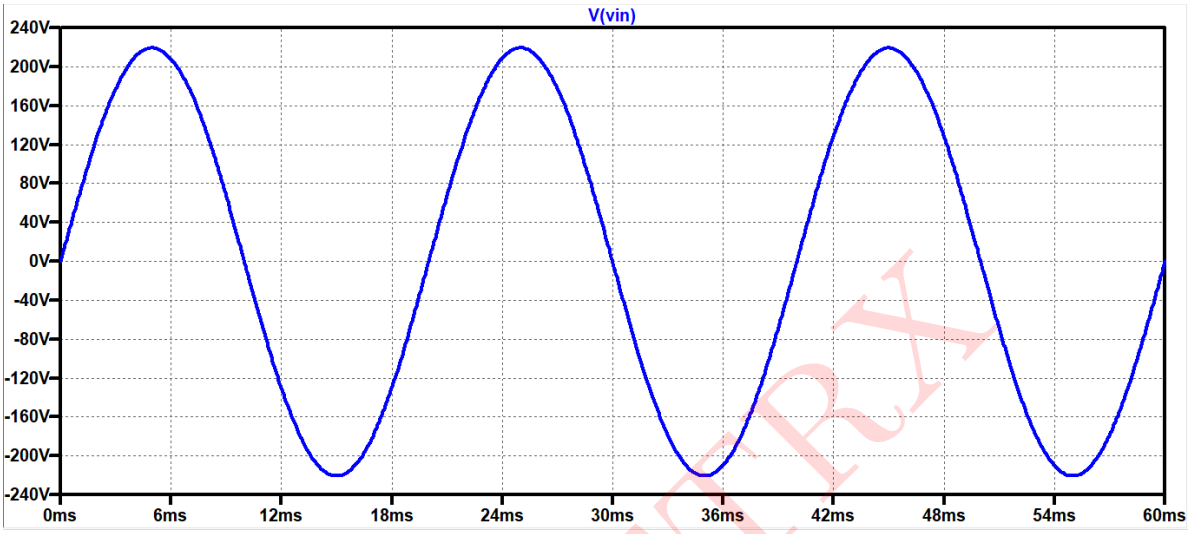

Figure 12: Input voltage

b) Output Voltage

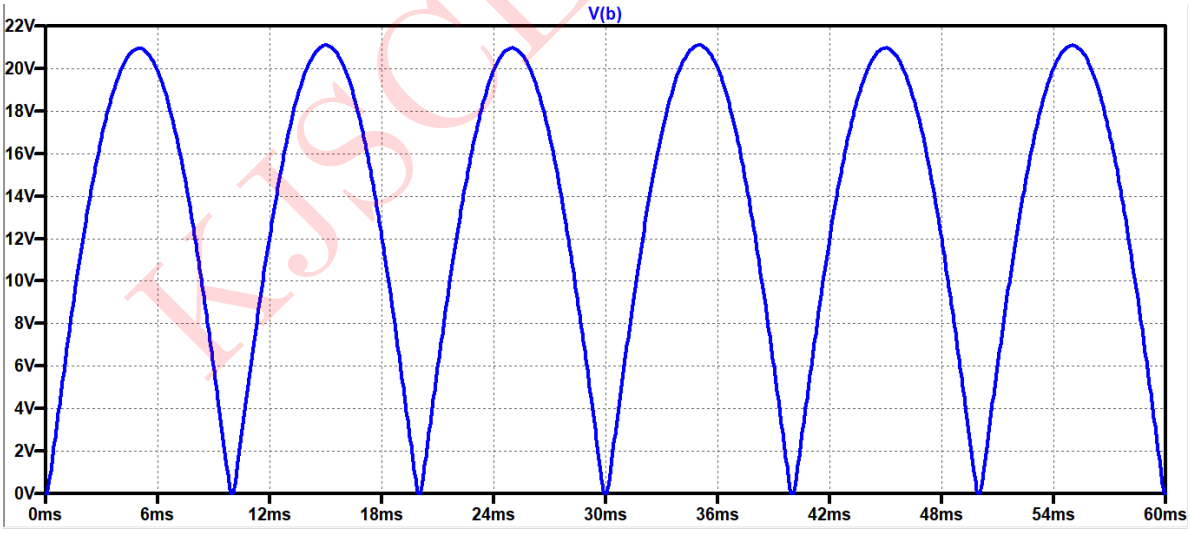

Figure 13: Output Voltage

c) Diode voltages

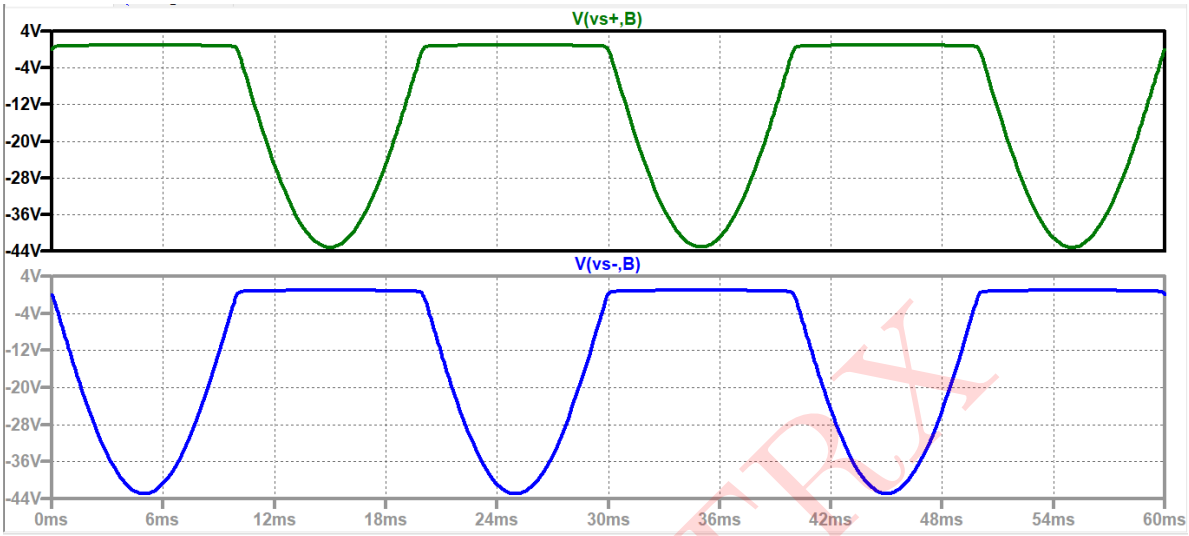

Figure 14: Diode voltages

d) Current across Diodes

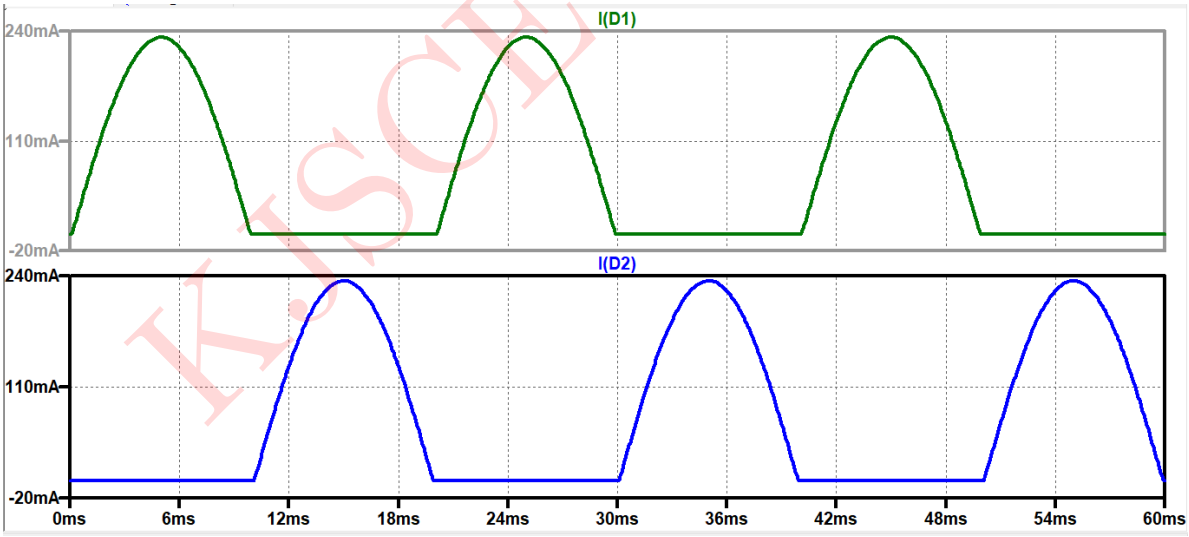

Figure 15: Current across Diodes

e)Total Current through circuit

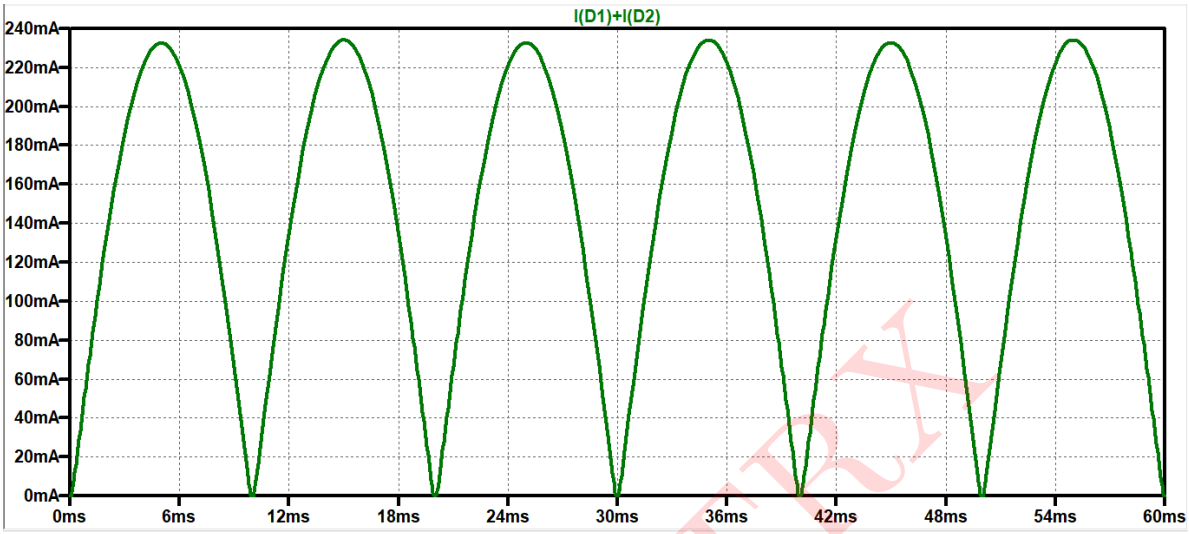

Figure 16: Total Current through circuit

SIMULATED RESULTS:

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

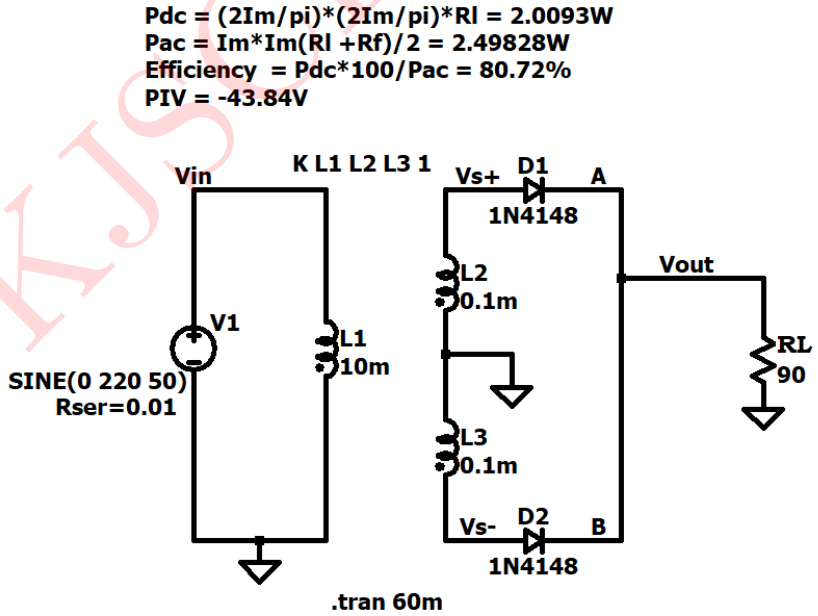

Figure 17: Circuit schematic

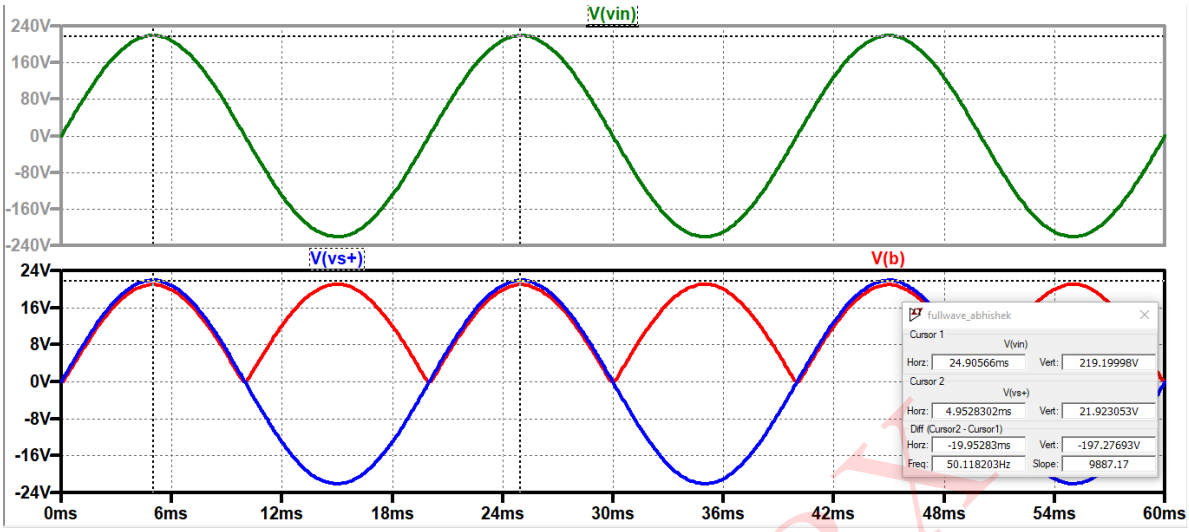

Figure 18: Simulated results for Primary and Secondary voltages

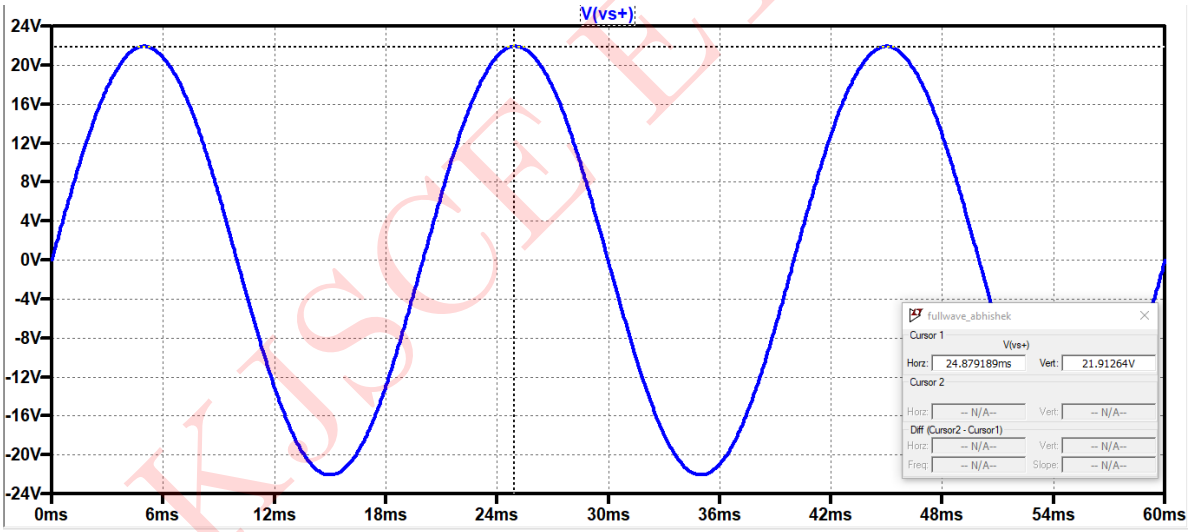

Figure 19: Simulated results for Output peak voltage

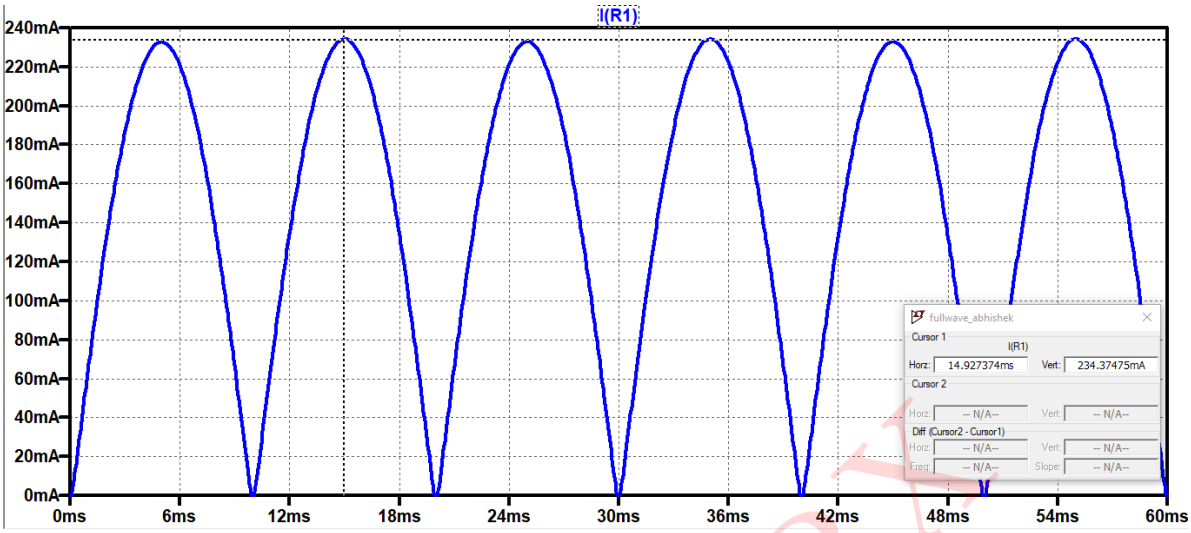

Figure 20: Simulated results for Output peak current

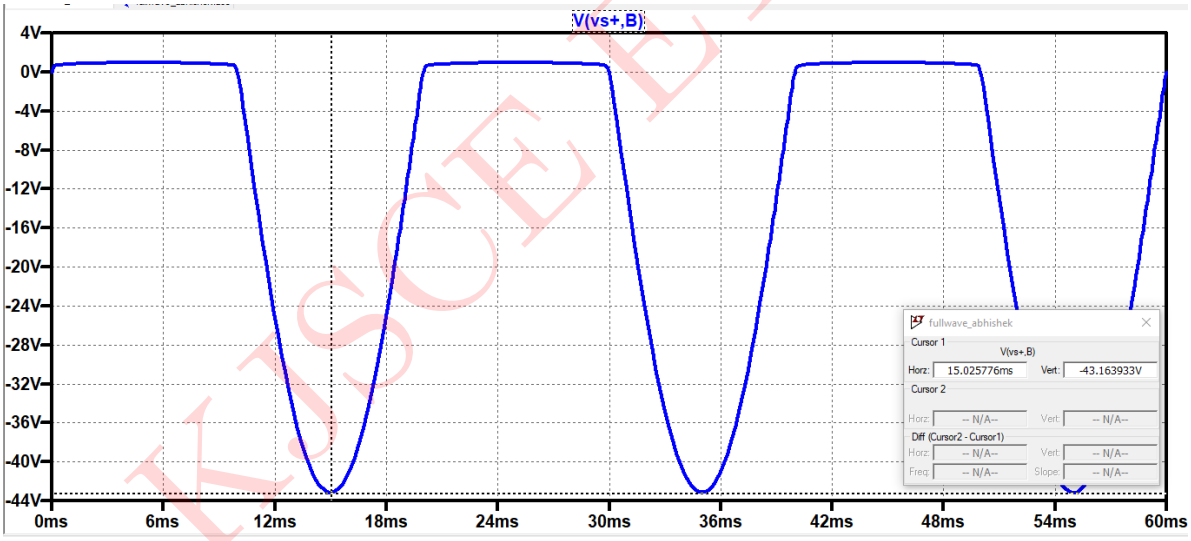

Figure 21: Simulated results for PIV rating

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Output peak value(V_m)	21.3V	21.92V
Output peak current(I_m)	234.84mA	234.71mA
Ac power	2.5010W	2.4982W
Dc power	2.0116W	2.0093W
Efficiency	80.43%	80.72%
PIV rating	−42.6V	−43.84V

Table 2: Numerical 2

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