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 = 200V peak, f = 50 Hz, $R_1 = 120\Omega$ using LT spice. 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

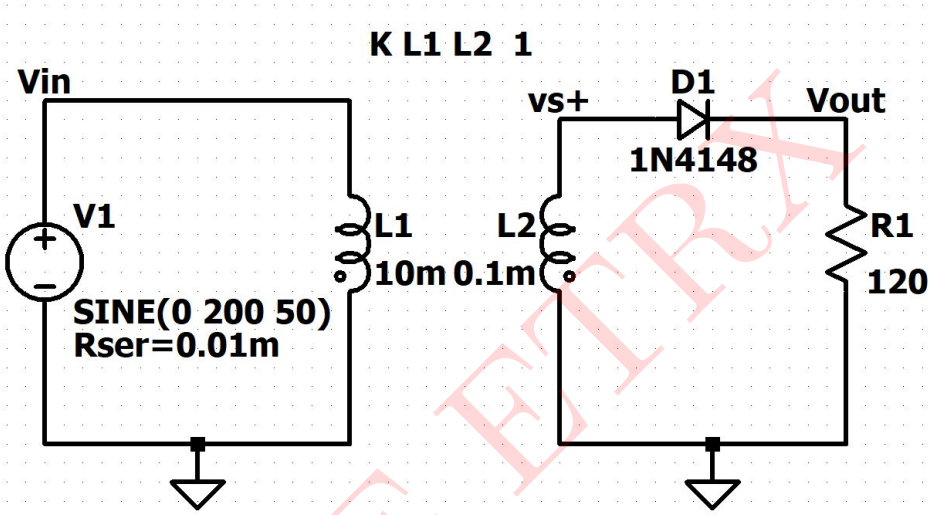

Figure 1: Circuit 1

Solution:

$$\frac{V_m}{V_1} = \frac{N_2}{N_1}$$

$$V_m = \frac{1}{10} \times 200$$

$$\therefore \mathbf{V_m = 20V}$$

$$P_{dc} = \frac{(V_m)^2}{(\pi)^2 \times R_1} = \frac{(20)^2}{(3.14)^2 \times 120}$$

$$\therefore \mathbf{P_{dc} = 0.3377W}$$

$$P_{ac} = \frac{(V_m)^2}{4 \times (R_s + R_1)} = \frac{(20)^2}{4 \times (0.01 \times 10^{-3} + 120)}$$

$$\therefore \mathbf{P_{ac} = 0.833W}$$

$$\text{Efficiency} = \frac{P_{dc}}{P_{ac}} \times 100 = 40.54$$

$$\therefore \eta = \mathbf{40.54\%}$$

$$\mathrm{I_m} = \frac{V_\mathrm{m}}{(R_\mathrm{s} + R_1)} = \frac{20}{(0.01 \times 10^{-3} + 120)}$$

$\therefore \mathbf{I_m = 0.116A}$

$\mathrm{PIV} = -\mathrm{V_m} = -20\mathrm{V}$

SIMULATED RESULTS:

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

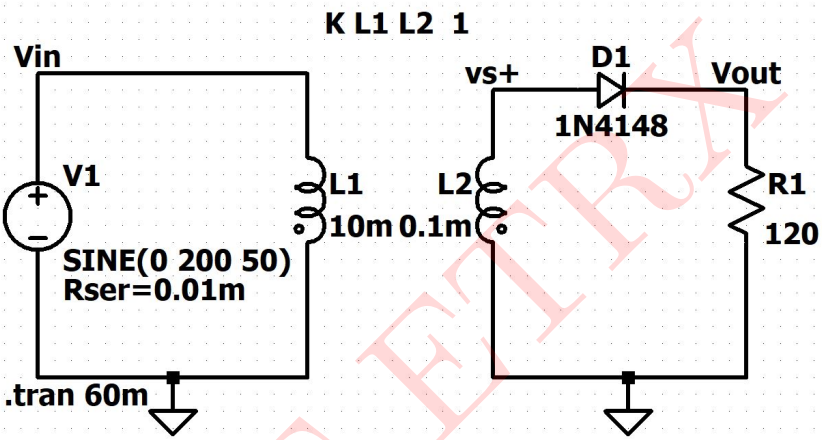

Figure 2: Circuit schematic for circuit 1

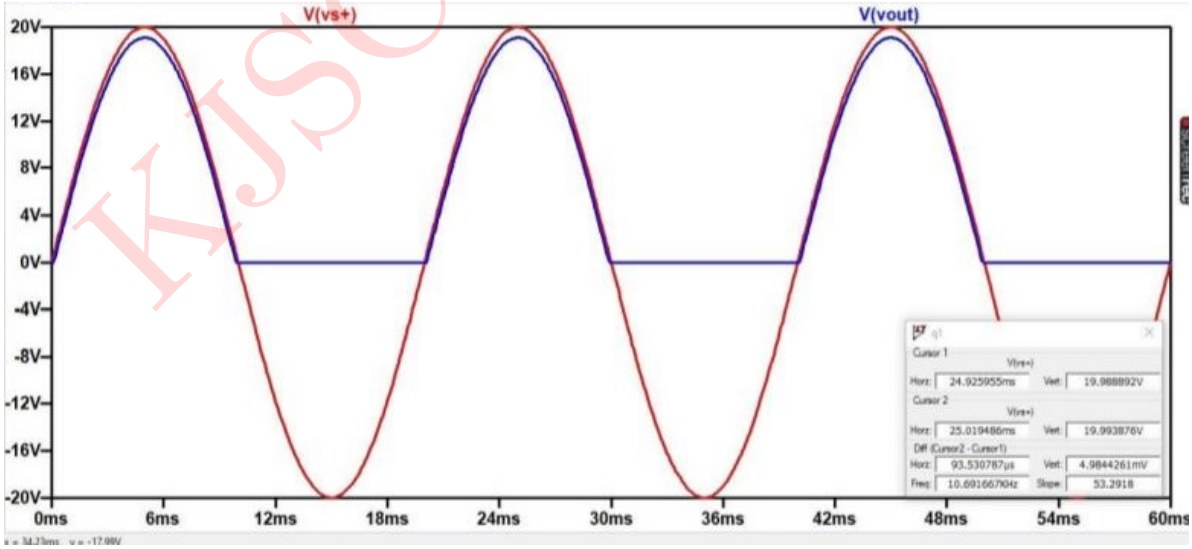

Figure 3: Peak value of $\mathrm{V_m}$

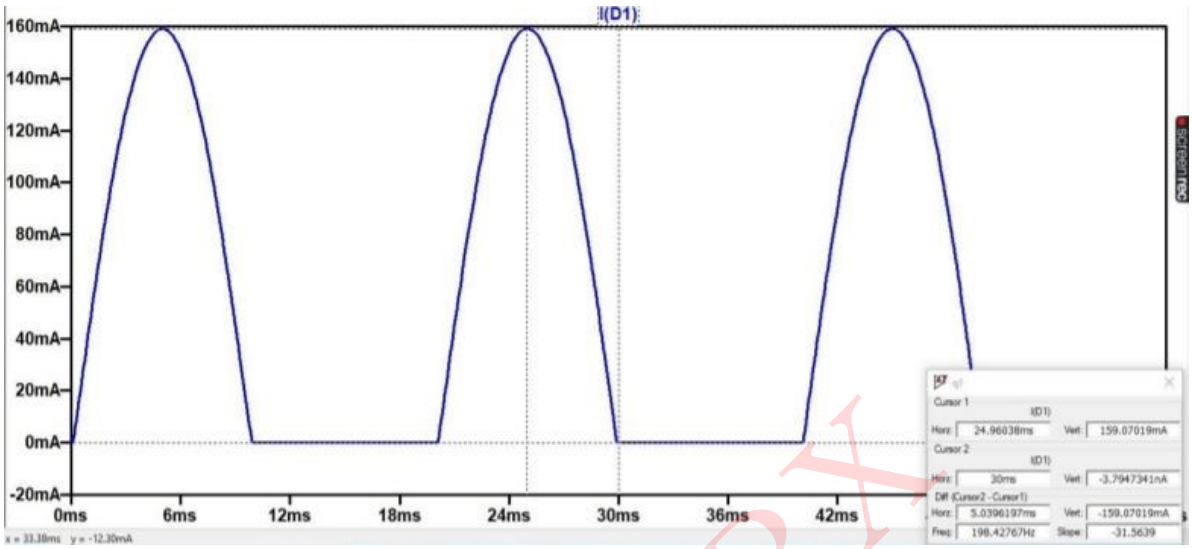

Figure 4: Peak value of I_m

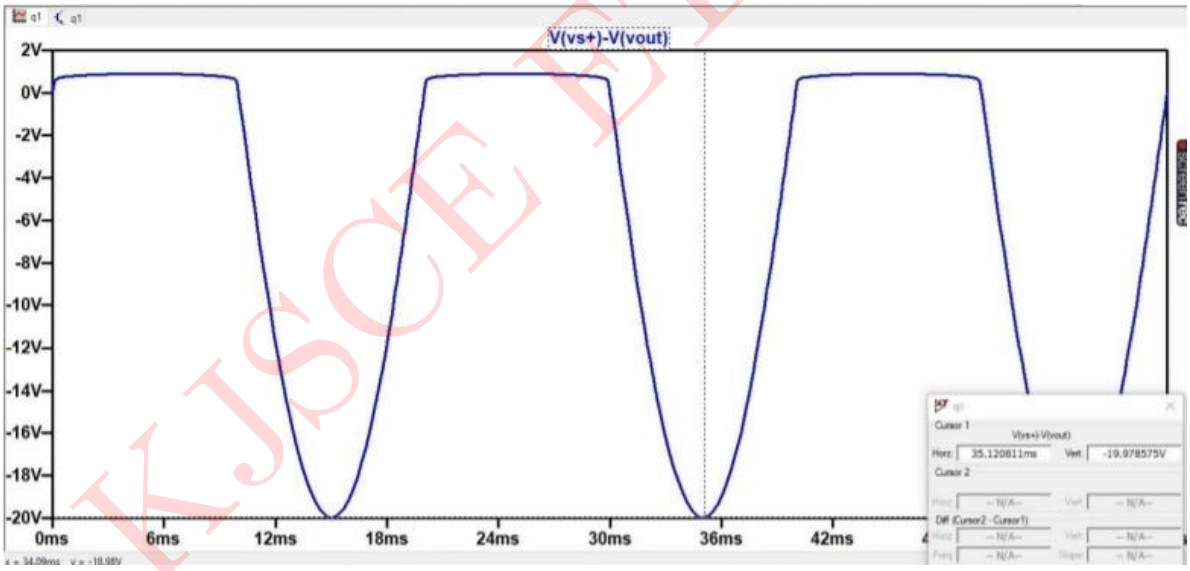

Figure 5: P_{IV} rating

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Output peak V_m	20V	19.983V
Output peak I_m	0.166A	0.159A
AC power	0.833W	0.758W
DC power	0.337W	0.3047W
Efficiency	40.54%	40.19%
PIV	−20V	−19.983V

Numerical 2:
Simulate a Full wave rectifier circuit with input Amplitude = 200V peak, f = 50 Hz, and $R_1 = 120\Omega$ using LT spice. 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 diode
e) Current flowing through the diode
f) Current flowing through the circuit

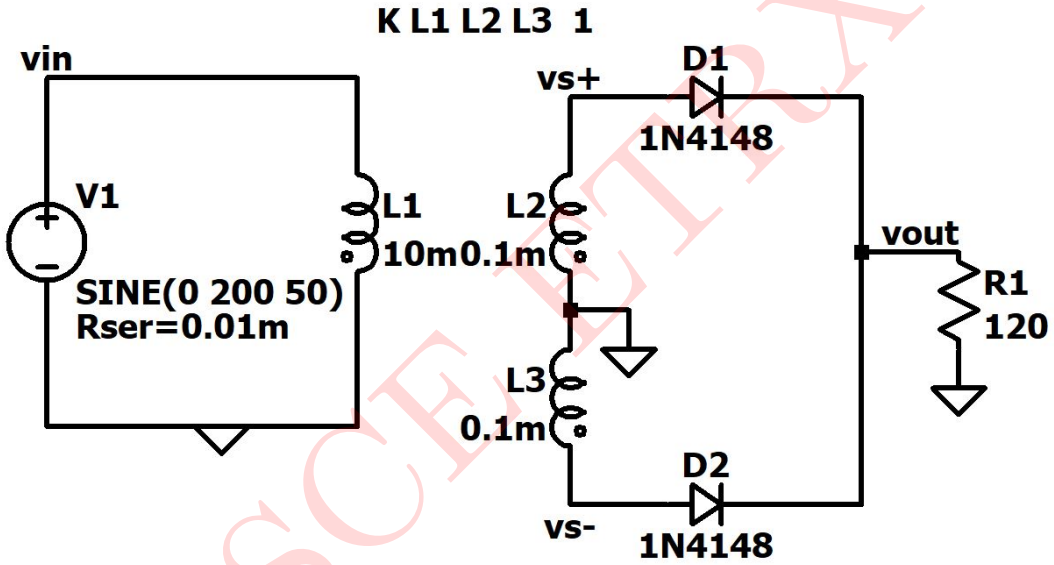

Figure 6: Circuit 2

Solution:

$$\frac{V_{\mathrm{m}}}{V_1} = \frac{N_2}{N_1}$$

$\therefore \mathbf{V_m = 20V}$

$$\mathrm{I_m} = \frac{V_{\mathrm{m}}}{(R_{\mathrm{s}} + R_1)} = \frac{20}{(0.01 \times 10^{-3} + 120)}$$

$\therefore \mathbf{I_m = 0.116A}$

$$\mathrm{P_{dc}} = \frac{4 \times (I_{\mathrm{m}})^2}{(\pi)^2} \times R_1 = \frac{4 \times (0.166)^2}{(3.14)^2} \times 120$$

$\therefore \mathbf{P_{dc} = 1.34016W}$

$$\mathrm{P_{ac}} = \frac{(I_{\mathrm{m}})^2}{2} \times (R_{\mathrm{s}} + R_1) = \frac{(0.166)^2}{2} \times (0.01 \times 10^{-3} + 120)$$

$\therefore \mathbf{P_{ac} = 1.656W}$

PIV $= -2 \times V_{\mathrm{m}}$ =-40V

Efficiency $= \dfrac{P_{\mathrm{dc}}}{P_{\mathrm{ac}}} \times 100 = 80.977\%$

$\therefore \eta = \mathbf{80.977\%}$

SIMULATED RESULTS:

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

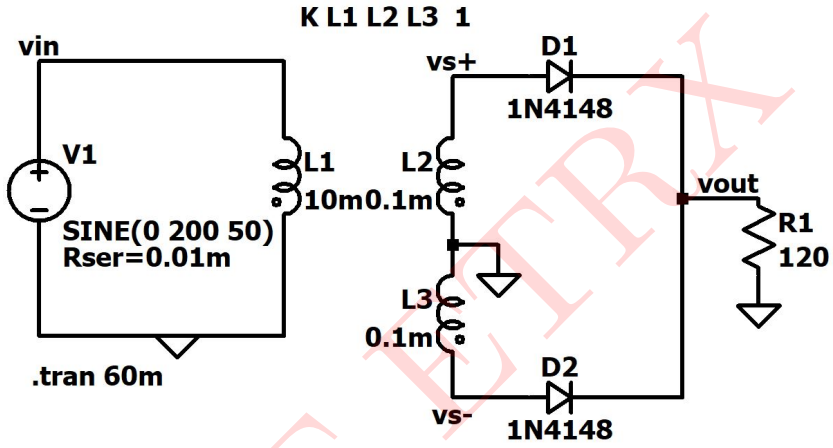

Figure 7: Circuit schematic for circuit 2

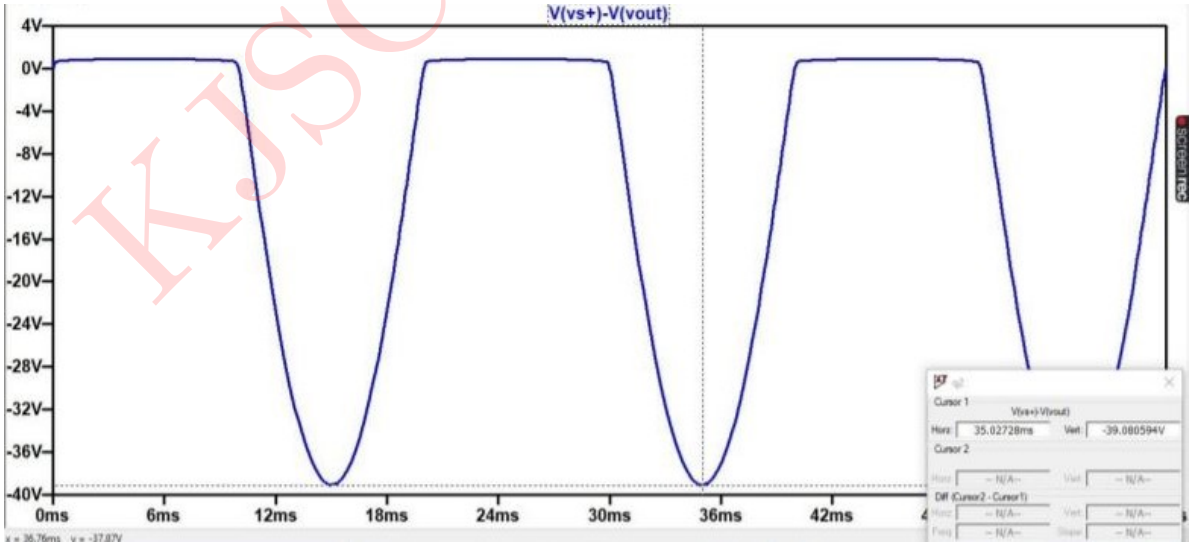

Figure 8: $\mathrm{P_{IV}}$ rating

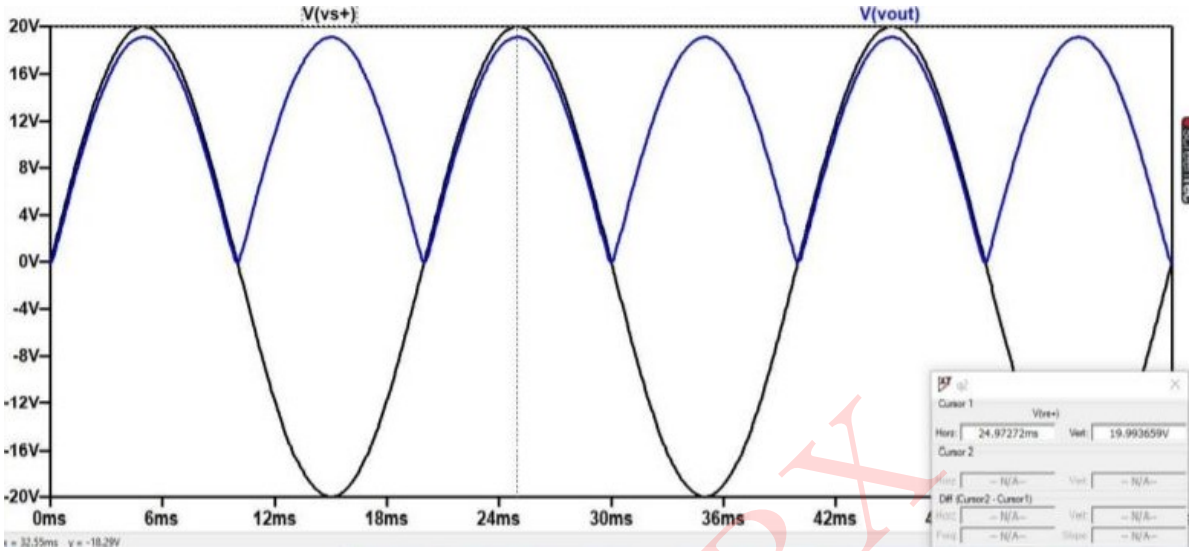

Figure 9: Peak value of V_m

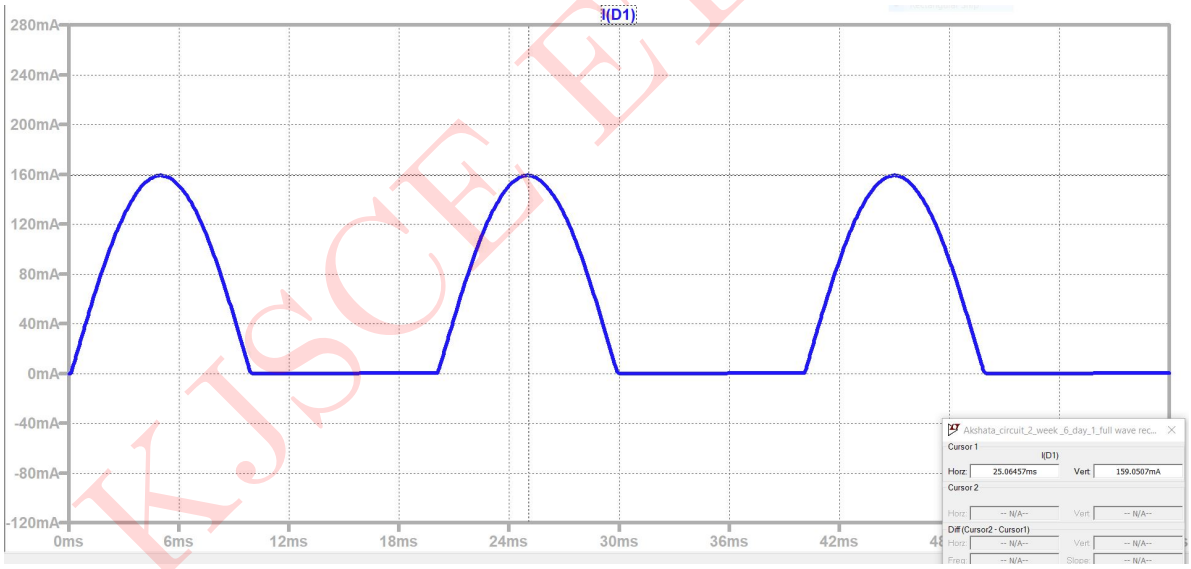

Figure 10: Peak value of I_m

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Output peak V_m	20V	19.983V
Output peak I_m	0.166A	0.159A
AC power	1.65W	1.516W
DC power	1.34W	1.229W
Efficiency	80.977%	81.06%
PIV rating	−40V	−39.083V