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ELECTRONIC CIRCUITS
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Numerical 1: Simulate a half wave rectifier circuit with input amplitude = 180V peak, f = 50Hz, $R_1 = 80$ using LTspice select diode as 1N4148 use 10:1 stepdown Transformer plot the following using LTspice:
a) Primary peak voltage

b) Secondary peak voltage

c) Output voltage across the resister

d) Output voltage across diode

e) Current flowing through the circuit

Also calculate the efficiency of the half wave rectifier circuit.

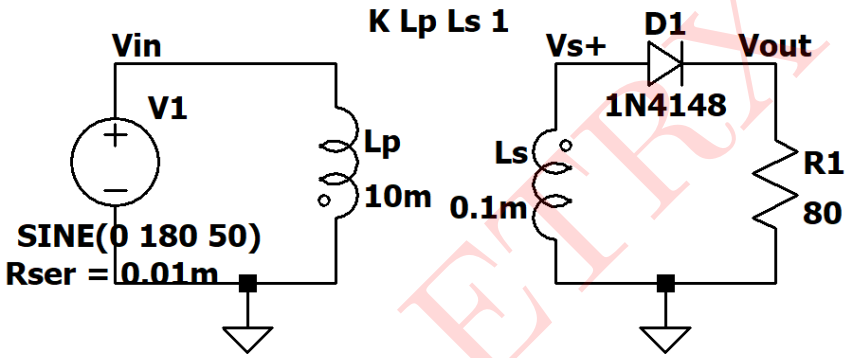

Figure 1: Circuit 1

Solution:

$$I_m = \frac{V_m}{R_1}$$

Since, $V_m = \frac{180}{10} = 18V$

$$\therefore I_m = \frac{18}{80} = 0.225A$$

$$DC_{power} = P_{dc} = \frac{I_m^2}{\pi^2} \times R_1$$

$$DC_{power} = \frac{V_m^2}{\pi^2 \times R_1} = 0.41035W \ .....(I_m = \frac{V_m}{R_1})$$

$$AC_{power} = P_{ac} = \frac{V_m^2}{4(R_1 + Rs)}$$

$$AC_{power} = \frac{18^2}{320.04} = 1.01237W$$

Efficiency $(\eta) = \dfrac{P_{dc}}{P_{ac}} \times 100$

$\eta = \dfrac{0.41035}{1.01237} \times 100$

$\therefore \eta = 40.5336\%$

Peak inverse voltage(PIV) $= -V_m = -18V$

SIMULATED RESULTS:

Above circuit is simulated in LTspice. The results are presented below:

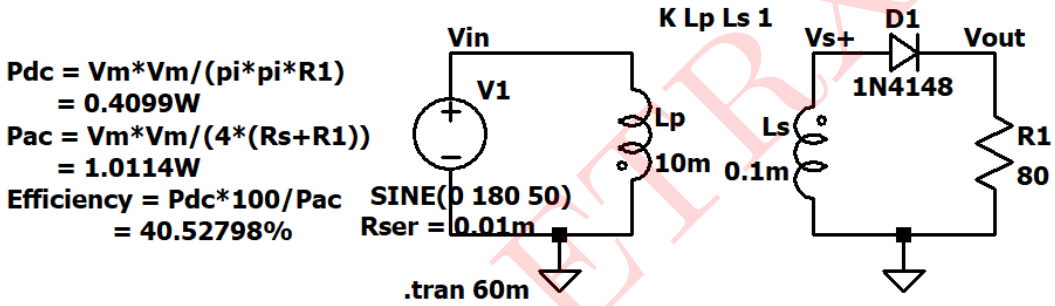

Figure 2: Circuit Schematic and simulated results

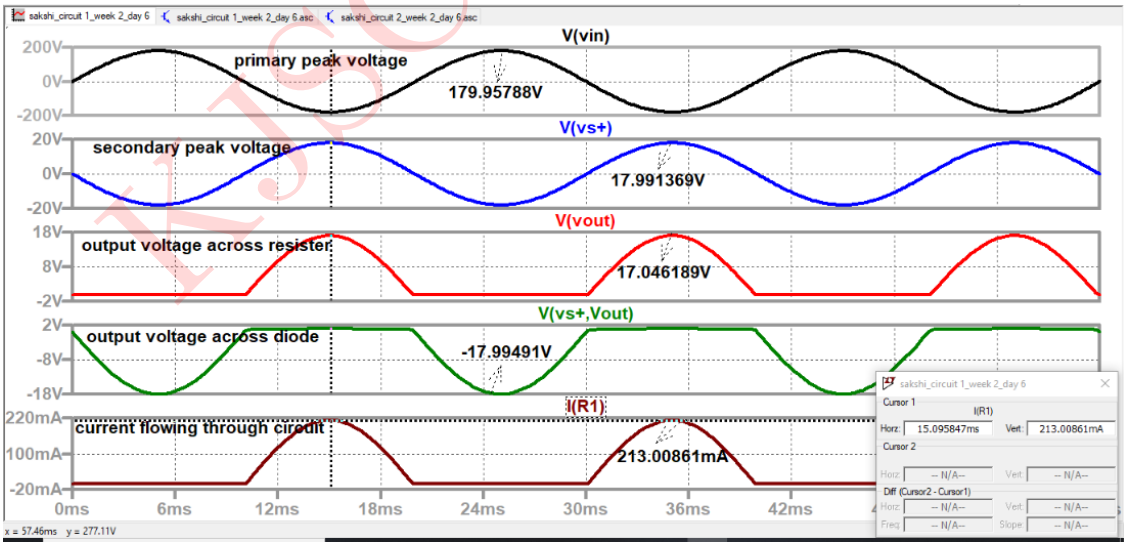

Figure 3: Plots in LTspice

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Input peak voltage V_m	$18V$	$17.046189V$
Output peak voltage I_m	$0.22A$	$0.2130086A$
AC_{power}	$1.01237W$	$1.0114W$
DC_{power}	$0.41035W$	$0.4099W$
Efficiency	40.5336%	40.52798%
PIV rating	$-18V$	$-17.99491V$

Numerical 2: Simulate a full wave rectifier circuit with input amplitude = 150V peak, f = 50Hz, $R_1 = 60$ using LTspice select diode as 1N4148 use 10:1 stepdown Transformer plot the following using LTspice:

a) Primary peak voltage

b) Secondary peak voltage

c) Output voltage across the resister

d) Output voltage across diode

e) Current flowing through the diode

f) Current flowing through the circuit

Also find the efficiency of the full wave centre tapped rectifier circuit.

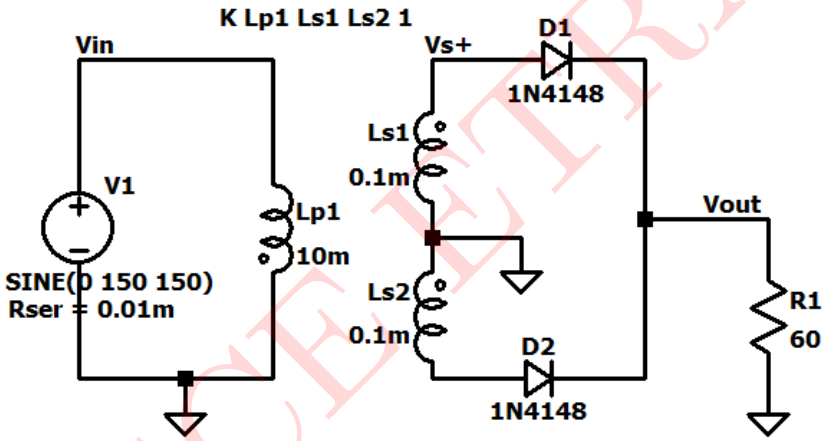

Figure 4: Circuit 2

Solution:

$$I_m = \frac{V_m}{R_1}$$

Since, $V_m = \frac{150}{10} = 15V$

$$\therefore I_m = \frac{15}{60} = 0.25A$$

$$DC_{power} = P_{dc} = \frac{2I_m^2}{\pi^2} \times R_1$$

$$DC_{power} = \frac{0.25^2 \times 4 \times 60}{\pi^2} = 1.51981775W$$

$$AC_{power} = P_{ac} = \frac{I_m^2(R_1 + Rs)}{2}$$

$$P_{ac} = \frac{0.25^2(60 + 0.01)}{2} = 1.8753125W$$

Efficiency $(\eta) = \dfrac{P_{dc}}{P_{ac}} \times 100$

$\eta = \dfrac{1.51981775}{1.8753125} \times 100$

$\therefore \eta = 81.04344\%$

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

SIMULATED RESULTS:

Above circuit is simulated in LTspice. The results are presented below:

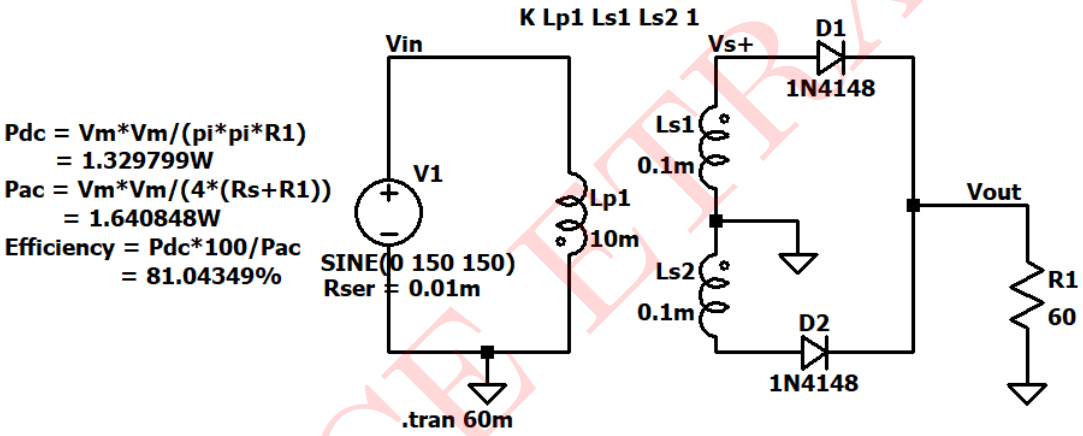

Figure 5: Circuit Schematic and simulated results

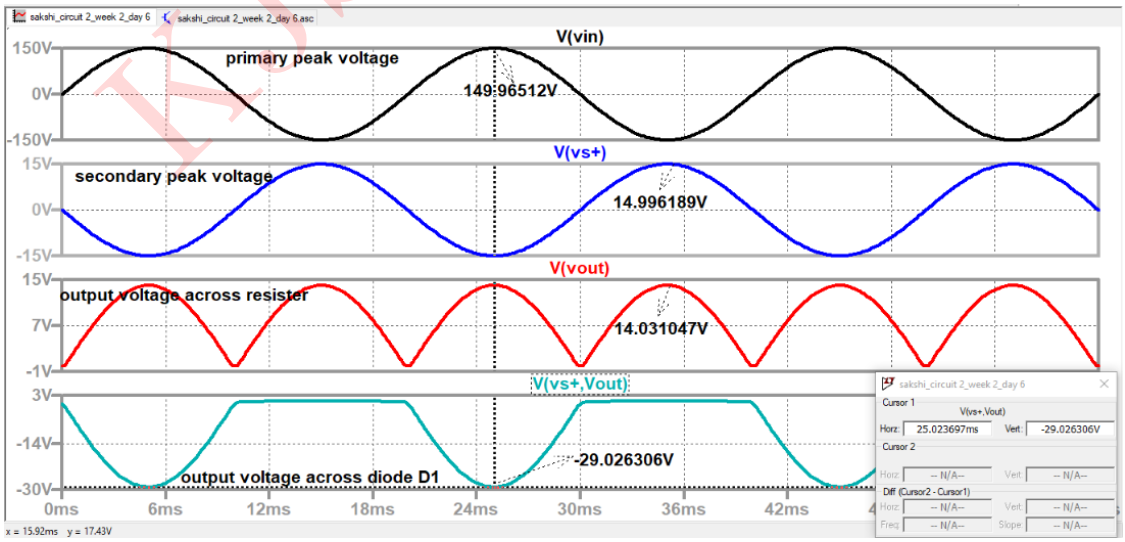

Figure 6: Plots in LTspice(i)

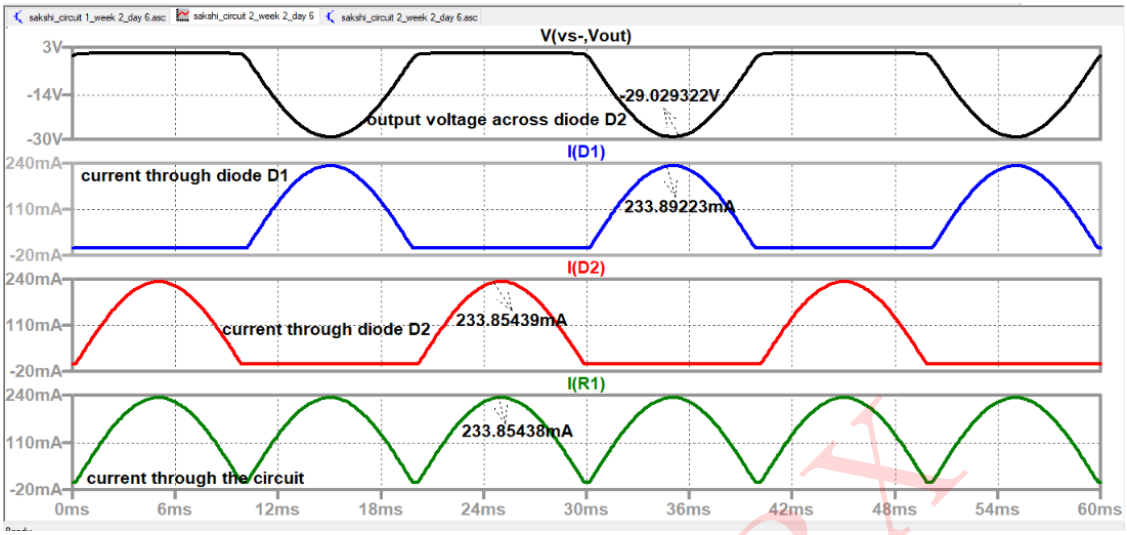

Figure 7: Plots in LTspice(ii)

Comparison of theoretical and simulated values:

Parameters	Theoretical Values	Simulated Values
Input peak voltage V_m	$15V$	$14.031047V$
Output peak voltage I_m	$0.25A$	$0.23385A$
AC_{power}	$1.8753125W$	$1.640848W$
DC_{power}	$1.519817W$	$1.329799W$
Efficiency	81.04344%	81.04349%
PIV rating	$-30V$	$-29.029322V$

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