Uncontrolled Rectifier - 1 (PE_rectifier_1.sqproj)

Question: For the circuit shown in Figure 1,

(a) Find the average output voltage V_{out}.

(b) Find the average current through the circuit I .

(Solving by numerical method, the extinction angle, β is found to be 272.8° in the above case)

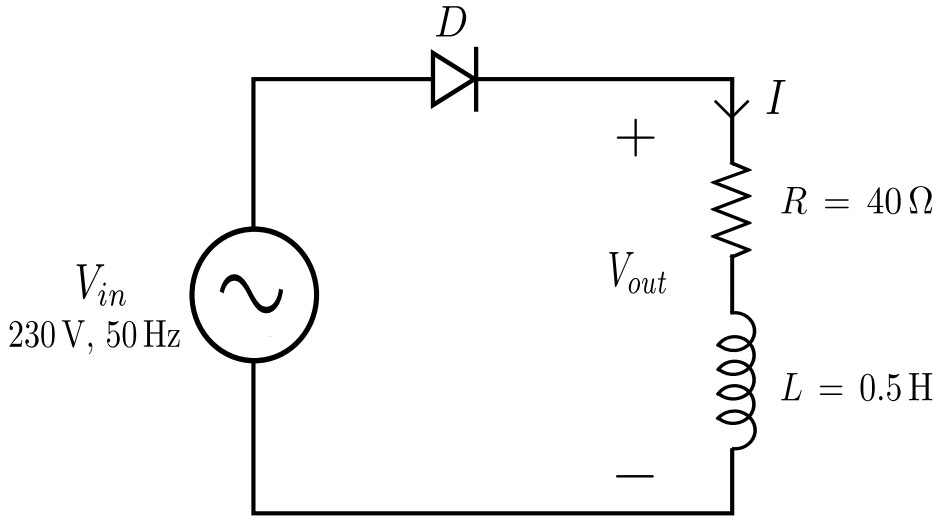

Figure 1: Half wave diode rectifier with RL load.

Solution:

(a) The extinction angle is given as $\beta = 272.8°$. This means the diode, D conducts until 272.8° in a complete cycle. By solving KVL, output voltage V_{out} is identical to V_{in} until 272.8° and is zero from 272.8° to 360° (see Fig. 2).

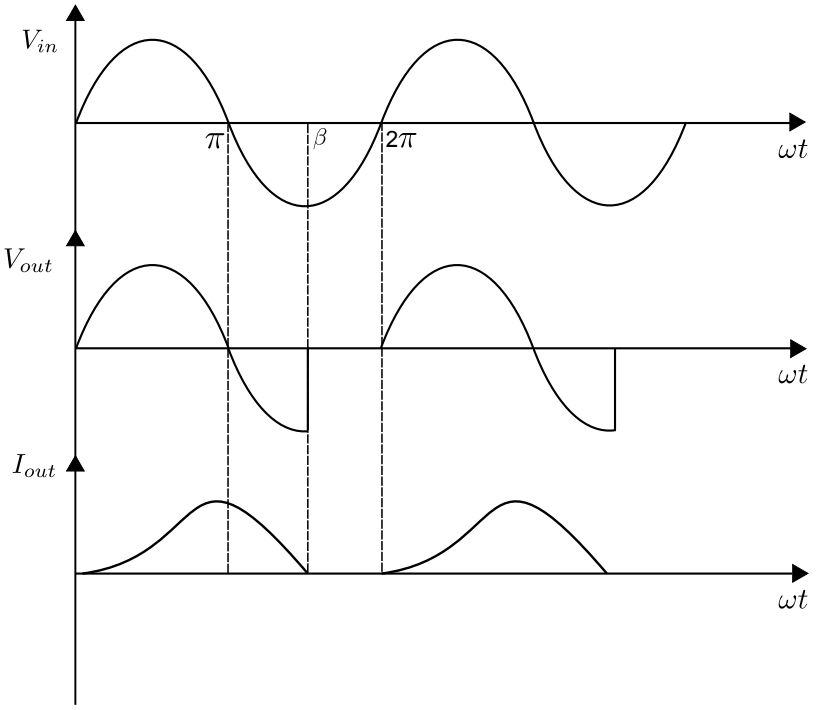

Figure 2: Plot of V_{in}, V_{out}, I vs ωt

The average value of output voltage,

$$V_{out} = \frac{1}{2\pi} \int_0^{272.8} 230\sqrt{2}\,\sin(\omega t)\,d(\omega t) \tag{1}$$

$$V_{out} = \frac{1}{2\pi} \left[230\sqrt{2}\,(1 - \cos(272.8^\circ))\right] = 49.4\,\mathrm{V} \tag{2}$$

(b) The average value of voltage across inductor is zero in a complete cycle.

$$V_{out} = IR \tag{3}$$

So the average value of current,

$$I = \frac{V_{out}}{R} = 1.23\,\mathrm{A} \tag{4}$$

SequelApp Exercises:

Find the average output voltage V_{out} and the average circuit current I for each of the following cases (with other component values as shown in Fig. 1).

1. $L = 0.5\,\mathrm{H}$, $R = 20\,\Omega$. (Extinction angle $\beta = 294.3°$)
2. $L = 0.25\,\mathrm{H}$, $R = 40\,\Omega$. (Extinction angle $\beta = 249.3°$).

Verify your results using SequelApp.