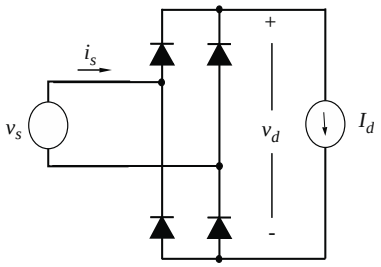
1- Consider an ideal diode bride rectifier with a dc current source, I_d, at the output stage. The input voltage source is $v_s(t) = \sqrt{2}V_s \sin(\omega t)$. Find the following quantities:

a) The dc magnitude of the output voltage, v_d.

b) The total harmonic distortion of the input line current, i_s.



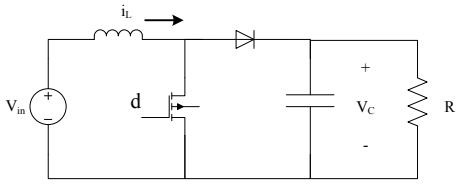
Solution:

a) $V_d = \frac{2}{\pi}\sqrt{2}V_s$

b) THD= 48.43%.

2- Find the value of load resistance, R, for which the boost converter is in the boundary between the continuous and discontinuous conduction modes. The load value, R, should be function of circuit components (L, C), switching interval T_s, and the control variable, D.

Hint:
In the boundary conduction mode, the dc value of the inductor current, I_L, and its ripple magnitude, Δi_L, are equal.



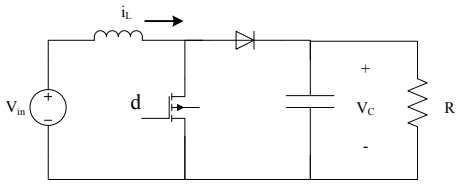
Solution:

$$R = \frac{2L}{D(1-D)^2 T_s}$$

3- Following ideal boost converter is working with an open control loop, and associated waveforms have constant nominal values in steady state. This converter is in discontinuous conduction mode and, thus, there are three subintervals in a prototypical switching cycle. Find the duty cycle for the second subinterval, d_2, also known as the duty ratio constraint. Find d_2 for two following two models:

a) **Reduced-order** model, where the d_2 is a function of the average value of the **slow** state variable, $\overline{v}_C$.

b) **Full-order** model, where the d_2 is a function of the average value of the **fast** state variable, $\overline{i}_L$.



Solution:

a) $$d_2 = \frac{v_{in}}{\overline{v}_C - v_{in}} d_1$$

b) $$d_2 = \frac{2L\overline{i}_L}{d_1 T_s V_{in}} - d_1$$