Demonstration 10

Equations used from previous lectures

RMS value of a function

$$F_{rms} = \sqrt{\frac{1}{T}\int_0^T f(t)^2\,dt}$$

Average value of a function

$$F_{avg} = \frac{1}{T}\int_0^T f(t)dt$$

Literature: Undeland book Chapter 5

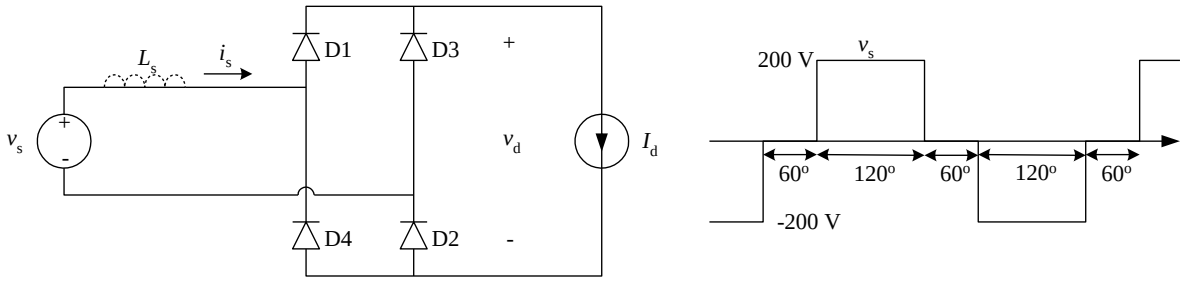
Tutorial exercises

Problem 1 (P5-4 in Undeland book)

A single-phase rectifier is operating without grid inductance (L_s) loaded with a constant dc- current of 10A.

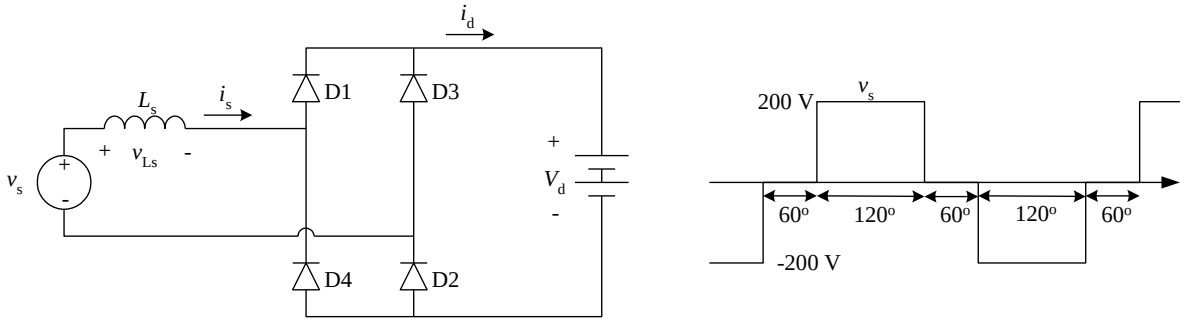
a) Calculate the average power supplied to the load if the supply voltage (v_s) is a sinusoidal voltage with $V_s = 120V$ at 60Hz

b) Calculate the average power delivered to the load if the supply voltage (v_s) has the pulses waveform shown below



Problem 2 (P5-10 in Undeland book)

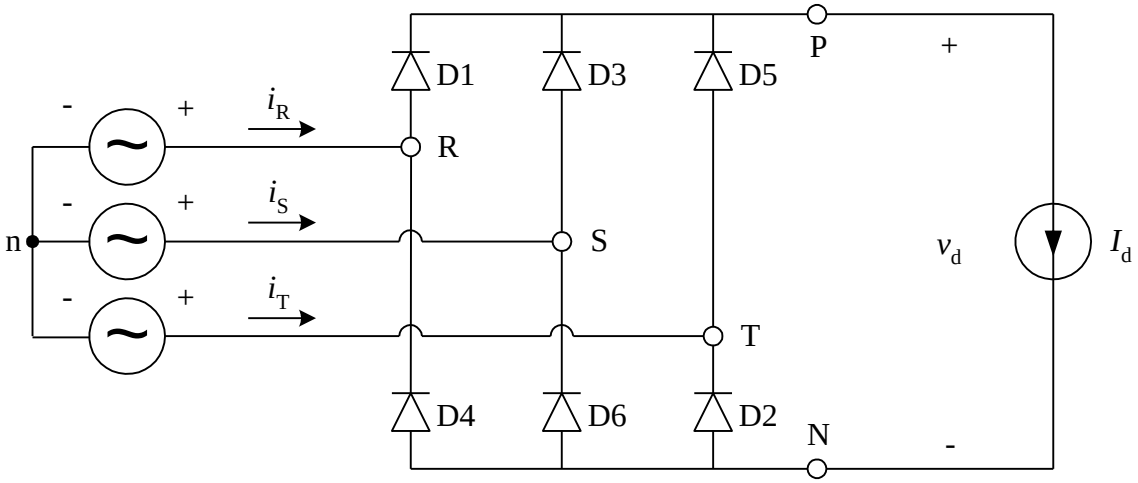
In a single phase rectifier the line inductance is $L_s = 10mH$ and the DC-voltage is $V_d = 160V$. The input voltage is a pulsed voltage shown below



Plot i_d and i_s waveforms. Hint: these currents flow discontinuously.

Problem 3 (P5-23 in Undeland book)

In the three-phase rectifier depicted below, calculate the average and the RMS-values of the current through each diode as a ratio of the dc-side current (I_d).



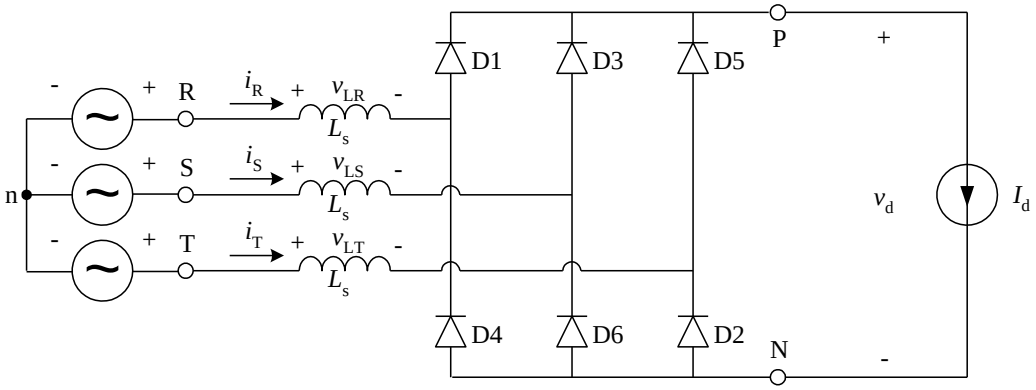
Problem 4

Calculate the average output voltage for the previous task (problem 3) if the input phase voltages are symmetrical and 220V.

Problem 5 (P5-24 in Undeland book)

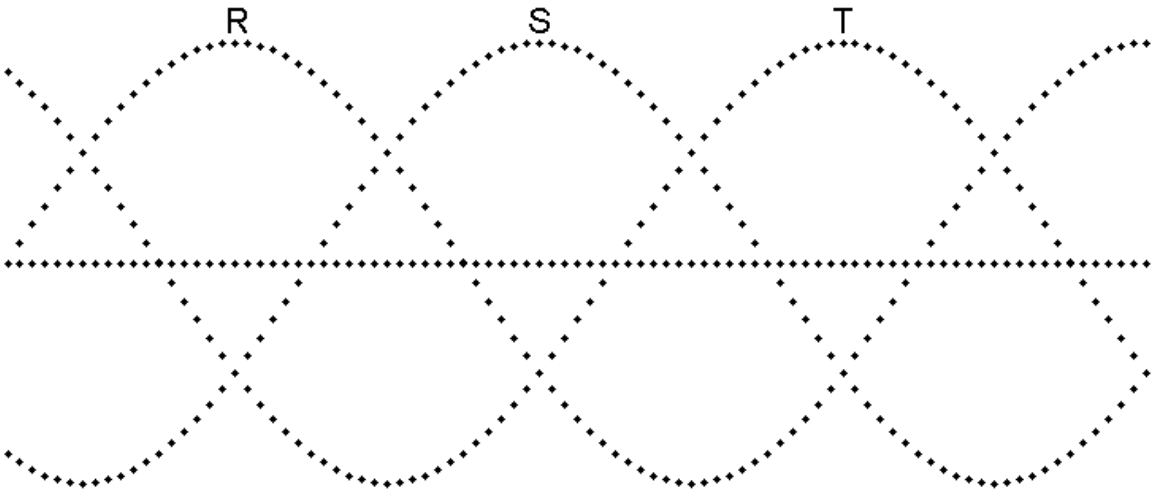
We have the following Three-phase rectifier with finite line impedance and a constant DC-side current. For simplification in the three-phase rectifier circuit, assume that the commutation voltage increases linearly instead of sinusoidal.

a) Obtain the expression for the commutation angle u
b) For $V_{LL} = 208V@60Hz$, $L_s = 2mH$ and $I_d = 10A$, compare the results in task (a) with the more realistic case where a sinusoidal commutation voltage occurs.



Self-study exercises

From Undeland book:
P5-5, P5-6, P5-7, P5-8, P5-22, P5-26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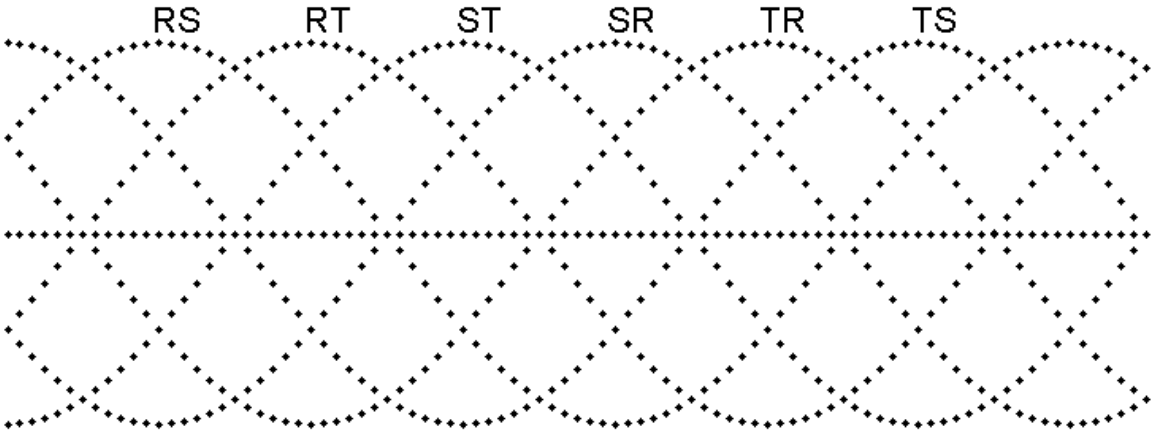
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