ELEC-E8422 An Introduction to Electric Energy

Exercise Session 5: Converters

EX 1: Buck-Converter

The dc input voltage of a buck (step-down) converter is 24 V and the desired dc output voltage is 16.8 V. Assume the converter lossless and omit the ripple in the output voltage (i.e., large filter capacitance)

a) Draw the circuit diagram of the converter
b) Draw the waveforms of the inductor voltage, the inductor current, and the input current below each other
c) Calculate the IGBT duty ratio, the average input current, the average output current, and the peak-to-peak ripple in the inductor current. The inductance is 0.1 mH, the output power is 28 W, and the switching frequency is 200 kHz.

EX 2: Boost-Converter

The supply voltage of a step-up converter is 25 V and the output voltage is 40 V. The switching frequency is 1 kHz and the load resistance 100 Ω. Calculate

a) The peak-to-peak change in the inductor current when L = 30 mH
b) The average of the load current
c) The power of the load

EX 3 & 4 DC-AC-Converter

A three-phase dc/ac converter is used to supply a star-connected load, where each phase has a 10 Ω resistance. The dc-voltage is 540 V and the inverter works under full control producing the maximum output voltage. This means that each phase is connected half of the time to the positive dc-bus and half of the time to the negative bus. There is 120 degrees phase shift between the phases

a) Draw the status of the switches in the converter and under these the waveforms of the line currents and phase voltages
b) Draw the waveform of the line-to-line voltage
c) The value of the current taken from the dc-bus
d) The rms value of the phase current
e) The rms values of the phase and line-to-line voltages