Exercise 1

In continuous conduction mode, obtain the power ratio P_o/P_T of the buck, boost, buck-boost, Cùk and full-bridge converter. The ratio can be expressed as

$$\frac{P_o}{P_T} = \frac{U_o I_o}{U_T I_T} \tag{1}$$

where U_T is the maximal voltage over the switch, and I_T the maximal current in the switch. It is assumed that the current in the choke does not have ripple, i.e. $i_L(t) = I_L$ =constant

Exercise 2

Obtain the current i_L and the voltage v_C in the figure 1. At $t = t_0$ the current in the choke is I_{L0} and the voltage in the capacitor is V_{C0}.

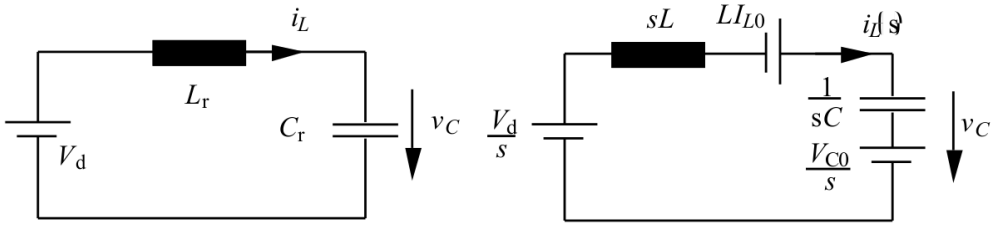

Figure 1: LC circuit and its Laplace equivalent.

The resonance frequency is

$$\omega_0 = 2\pi f_0 = \frac{1}{\sqrt{LC}} \tag{2}$$

and the impedance

$$Z_0 = \sqrt{\frac{L}{C}} \tag{3}$$

Following are the useful Laplace-transformations for this exercise.

$$\frac{s}{s^2 + a^2} \rightarrow \cos(at) \tag{4}$$

$$\frac{a}{s^2 + a^2} \rightarrow \sin(at) \tag{5}$$

$$\frac{a^2}{s(s^2 + a^2)} \rightarrow (1 - \cos(at)) \tag{6}$$

$$\frac{1}{s} \rightarrow 1 \tag{7}$$

Exercise 3

A symmetrical square-wave is fed to the RLC of the figure 2. The frequency of the signal is $f_s = f_0 = 50$kHz and the amplitude varies between $\pm V_d/2$ with $V_d = 20$V. The quality factor of the circuit is $Q = 7$ and the components are chosen so that the current component at the fundamental frequency f_0 has a peak value of 5A. What is the value of the lowest current harmonic when the resistance R can be about zero at the harmonic frequencies, i.e.when the harmonic number $n > 1$. What happens to the current component when the frequency of the input signal rises to 55kHz?

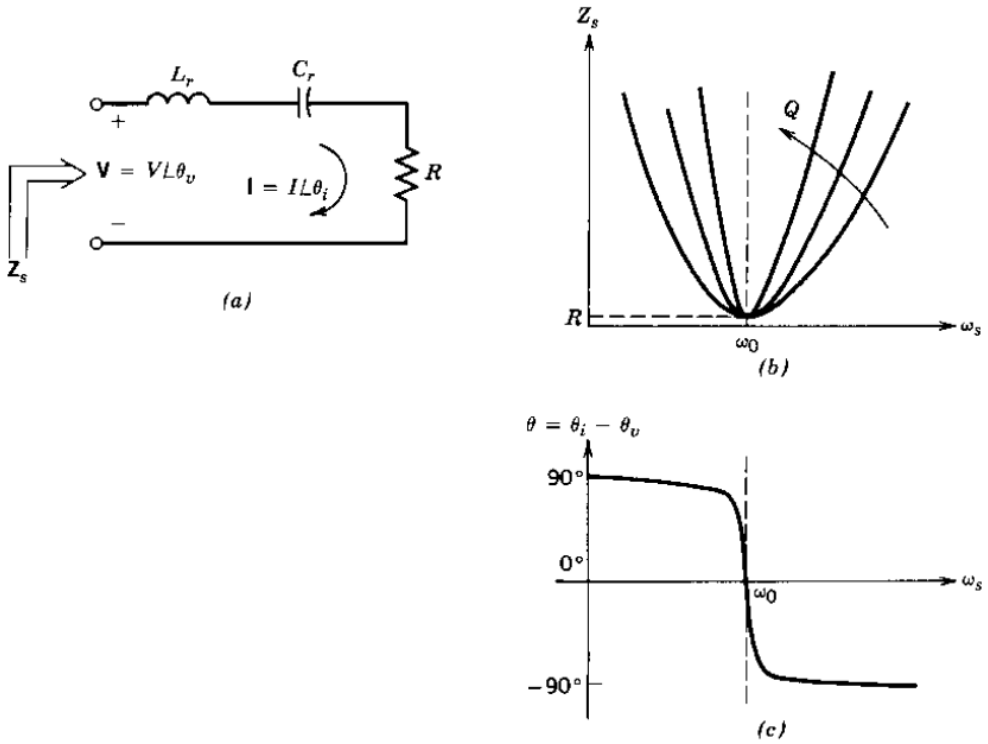

Figure 2: RLC circuit.

The quality factor of the circuit is $Q = \frac{\omega_0 L_r}{R} = \frac{1}{\omega_0 C_r R} = \frac{Z_0}{R}$.