Seminar – 9$^{\text{th}}$ week
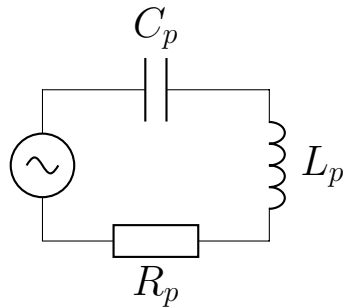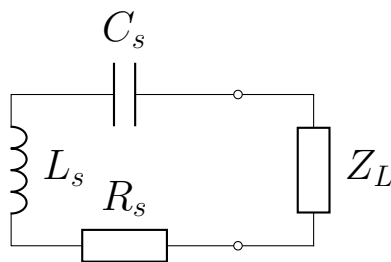
1. The Power Transmitter of the Qi wireless charger can be modeled by the simplified model according to the circuit diagram:

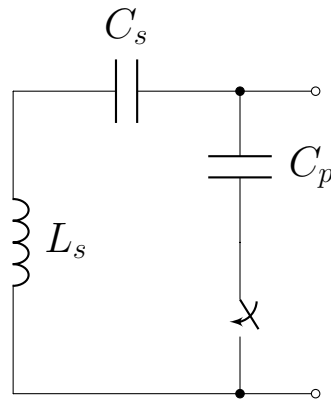The inductance is L_p = 25 µH and resonant frequency f_p = 100 kHz. The Quality factor of the circuit is Q = 100. Calculate values of capacitance C_p and resistance R_p.

2. At start-up, the voltage source in the Qi Power Transmitter from previous task has the voltage v_{ping} = 24 V with frequency f_{ping} = 175 kHz. Calculate voltage on inductor v_L. Calculate voltage on inductor v_L, which would be at resonant frequency f_p = 100 kHz assuming the Transmitter is not coupled with Receiver. Calculate the current in the circuit in such a case (note that the current limit is 3 A).

3. The Power Receiver of the Qi wireless charger can be modeled by the simplified model according to the circuit diagram:

The inductance is L_s = 35 µH and resonant frequency f_s = 100 kHz. The Quality factor of the circuit (without load impedance Z_L) is Q_s =
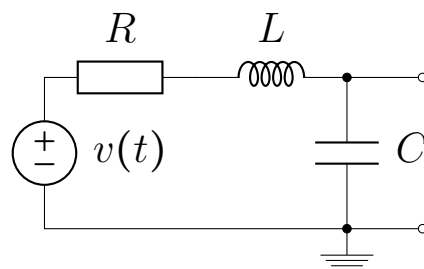
40. Calculate values of capacitance C_s and resistance R_s.

In the detection phase is in the Receiver connected parallel capacitor C_p, according to the figure below.

The parallel resonant frequency is $f_d = 1\,\text{MHz}$. Calculate capacitance of capacitor C_p.

4. The circuit below is supplied from sinusoidal voltage source $v(t) = 1\sin\omega t$. The inductance $L = 10\,\text{mH}$ and resistance $R = 1\,\Omega$. Angular frequency $\omega = 10\,000\,\text{rad s}^{-1}$. The circuit is in the resonance. Calculate:

   a) Capacitance C
   b) Magnitude of capacitor voltage V_C
   c) Draw magnitude frequency response (Bode plot) for the capacitor voltage.

5. Parallel RLC resonant circuit is supplied by the sinusoidal current source with magnitude $10\,\text{mA}$. $C = 1\,\mu\text{F}$, $L = 0.1\,\text{H}$, $R = 10\,\Omega$.

   a) Calculate resonant frequency.
   b) Calculate impedance of the circuit in resonance, source voltage and current in capacitor.

c) What is the quality factor of the circuit?