Introduction to Electrical and Electronic Circuits

LAB. 5

Passive filters and resonance

Problems:

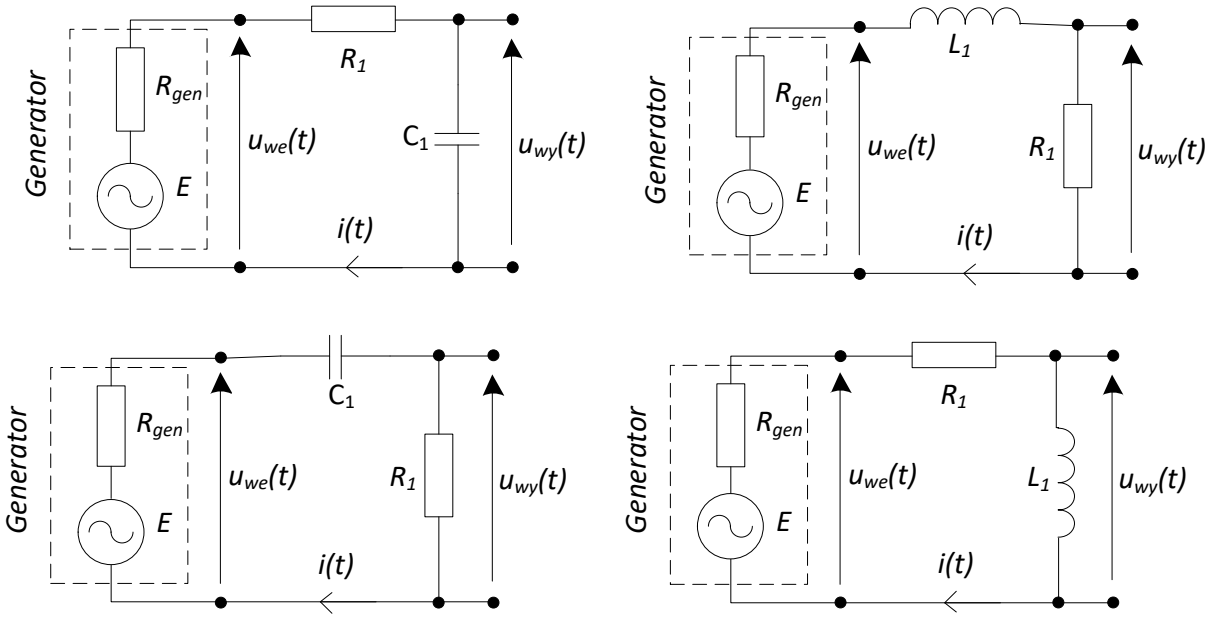
1. What is the relationship between the time constant of RC and RL in time domain and its frequency in the frequency domain?
2. Determine transmittance of RC and RL. Turn them into a frequency domain,
3. When a resonance phenomenon occurs for a serial/parallel RLC circuit? Determine the resonant frequency. Which of the resonances is called resonance of currents, and which resonance of voltage?
4. What is the methodology of determination of the resonance frequency for any circuit with a single capacitor and a single coil.

Programme

Part 1

Table 1

Section 1/7	Section 2/8	Section 3/9	Section 4/10	Section 5/11	Section 6/12
$R_1=R_{dod}=740\ \Omega$	$R_1=R_{dod}=130\ \Omega$	$R_1=R_{dod}=730\ \Omega$	$R_1=R_{dod}=125\ \Omega$	$R_1=R_{dod}=700\ \Omega$	$R_1=R_{dod}=120\ \Omega$
$L_1=133$ mH	$L_1=34$ mH	$L_1=130$ mH	$L_1=39$ mH	$L_1=130$ mH	$L_1=34$ mH
$R_{L1}=212\ \Omega$	$R_{L1}=93\ \Omega$	$R_{L1}=211\ \Omega$	$R_{L1}=108\ \Omega$	$R_{L1}=211\ \Omega$	$R_{L1}=93\ \Omega$
$C_1=146$ nF	$C_1=690$ nF	$C_1=147$ nF	$C_1=720$ nF	$C_1=157$ nF	$C_1=749$ nF



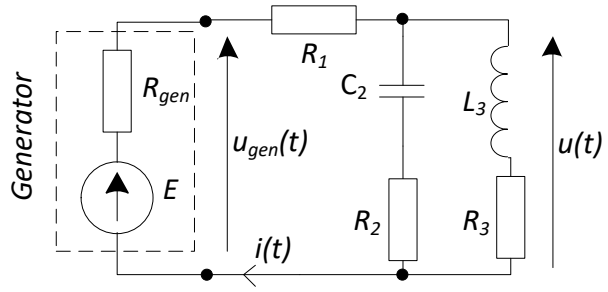
1. Assemble the passive filter indicated by the teacher from above, taking into account the data contained in Tab . 1. Put a sine wave from a generator (R_{Gen}= 50 Ω) to the mounted circuit . Check $u_{we}(t)$ (channel 1) and $u_{wy}(t)$ (channel 2) using oscilloscope.
2. Changing the frequency of the wave on the generator in the range of 20 Hz to 20 kHz read the indication of the effective voltmeter values at the input and output of the filter. Check this for up to 20 frequencies in this range, so that in each decade was equal (comparable) number of measurements. The protocol should contains noted frequencies and U_{we} i U_{wy}.

   What is the difference between a phase and an amplitude of the U_{we} and U_{wy}.
3. Assemble the second filter indicated by the teacher and repeat above.

Part 2

Table 2

Section 1/7	Section 2/8	Section 3/9		Section 4/10	Section 5/11	Section 6/12
$R_1=R_{dod}$=3 kΩ	$R_1=R_{dod}$=3 kΩ	$R_1=R_{dod}$=3 kΩ		$R_1=R_{dod}$=3 kΩ	$R_1=R_{dod}$=3 kΩ	$R_1=R_{dod}$=3 kΩ
L_3=133 mH	L_3=130 mH	L_3=130 mH		L_3=140 mH	L_3=130 mH	L_3=130 mH
R_3=212 Ω	R_3=211 Ω	R_3=211 Ω		R_3=227 Ω	R_3=211 Ω	R_3=211 Ω
C_2=146 nF	C_2=151 nF	C_2=147 nF		C_2=150 nF	C_2=157 nF	C_2=149 nF



1. Create a resonance filter according to figure above and tab. 2. Set R_{gen}= 600 Ω.
2. Find the frequency for which the voltage $U_{gen}(t)$ will be in phase with the current i(t). Tip: Use resistor R_1. The measurement should be carried out for the resistor value R_2=0 .
3. Repeat the measurements for R_2= 300 Ω.

Report

Part 1

1. Draw the amplitude for filters studied at the laboratory in the following composition and lach: linear (axis gain and frequency on a linear scale), semi-logarithmic (axis gain in the linear scale and frequency on a logarithmic scale) and logarithmic (axles gain and frequency for per-forming scales logarithmic).
2. Perform a simulation of the tested filters (eg in the program PSpice) and draw a characteristic: amplitude and phase in linear and logarithmic scales.
3. If on the input of both circuits a sinusoidal signal with amplitude A and phase shift φ appears, how will the signal look on the output of this filter ? Perform the analysis for f ≈ 0, f = $f_{boundary}$ and f >> f gr (f → ∞) . Save the results in analytical form.

Part 2

1. Calculate the goodness Q of the circuit for both values of the R_2 resistor.
2. What is the condition to determine the resonance frequency with the equation: $\frac{1}{2\pi\sqrt{LC}}$?
3. Simulate the resonance circuit (eg in the program PSpice) in the frequency range from 1Hz to 100kHz.
4. Draw the current flows through the capacitor and coil (semi-logarithmic scale for the current and logarithmic scale for the frequency).
5. Draw the amplitude and phase characteristic of the $\frac{U(j\omega)}{U_{gen}(j\omega)}$.