VE215 Lab 5

Filter Lab

Data Sheet

Name: [redacted] Student ID: [redacted]

Date: NOV. 13. WED TA's Signature: [redacted]

Note: You will get grade deductions if you violate the following rules:

1. **You are required to sign in the Logbook once you get your seat.**
2. **You are supposed to restore all the equipment and materials before you leave the lab.**
3. **You mustn't move any of the equipment and the material without TA's permission.**

Procedures:

1. According to the pre-lab assignments, you are supposed to fill in the **Expected Data columns** in the tables below before the lab.
2. During the lab:
   - i) Construct the circuit for each type of filter. Resister: **R = 982Ω**; Capacitor: **C = 0.1μF**; Inductor: **L = 1mH**.
   - ii) Set the Input Signal in the function generator to be **Sine Wave** with amplitude of **5 V_{ppk}** and **change the frequency** accordingly.
   - iii) Use the oscilloscope to detect the **amplitudes** of the **Input and Output** signals. Record them respectively in the first two column in the tables.
   - iv) Additionally for the **Band-reject Filter**, when the frequency approach the critical frequency at which the **Transfer Function Magnitude** reaches its minimum, the **Output Signal Amplitude** changes rapidly. For a more accurate result, you can (but not strictly required to) add some more rows to record the data (**Table V**).
3. After the lab, you should calculate with the experimental data for the "**Transfer function magnitude**" and "**Transfer function magnitude, in dB**" columns.

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	5.16	15.6		0.0016		-55.8048
100 kHz	5.12	110		0.0162		-35.8070
50 kHz	5.08	232		0.0374		-29.7898
10 kHz	5.08	1090		~~0.1666~~ 0.1650		-15.9184
5 kHz	5.08	1820		0.3083		-10.2191
1 kHz	5.20	4640		0.8510		-1.4010
500 Hz	5.20	5120		0.9556		-0.3948

II) High-pass Filter

Frequency	Input signal amplitude, Vppk [V]	Output signal amplitude, Vppk [V]	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	5.16	4.64		1.0000		0
100 kHz	5.12	4.60		0.9999		~~-0.0005~~ -0.0011
50 kHz	5.08	4.56		0.9995		-0.0046
10 kHz	5.08	4.40		0.9871		-0.1126
5 kHz	5.12	4.16		0.9513		-0.4535
1 kHz	5.24	1.98		0.5251		-5.5952
500 Hz	5.28	1.19		0.2948		-10.0096
100 Hz	5.28	0.258		0.0616		-24.2107

III) Band-pass Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	5.40	400		0.1545		-16.2240
500 kHz	5.40	1.48		0.2986		-10.4976
100 kHz	5.16	4.08		0.8485		-1.3100
50 kHz	5.08	4.40		0.9611		-0.3620
10 kHz	5.08	4.40		0.9752		-0.1791
1 kHz	5.24	1.98		0.5266		-5.5241
500 Hz	5.24	1.10		0.2951		-9.7111

IV) Band-reject Filter

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
1 MHz	5.28	3.52		0.9880		-0.1049
500 kHz	5.40	4.72		0.9344		-0.4056
300 kHz	5.40	4.68		0.8863		-1.0481
200 kHz	5.36	4.04		0.7800		-2.0911
100 kHz	5.16	2.46		0.5272		-5.5282
50 kHz	5.08	1.20		0.2763		-11.1721
10 kHz	5.08	744 mV		0.0976		-20.2092
5 kHz	5.08	1.68 V		0.2804		-10.38
1 kHz	5.24	4.20 V		0.8501		-1.4405
500 Hz	5.24	4.60 V		0.9555		-0.3956

Theoretically find the corresponding frequency when the output signal amplitude reaches its minimal value and fill in the following table:

V) Band-reject Filter (Not Strictly Required)

Frequency	Input signal amplitude, Vppk	Output signal amplitude, (m)Vppk	Transfer function magnitude	**Expected** transfer function magnitude	Transfer function magnitude, in dB	**Expected** transfer function magnitude, in dB
Critical:						