Protocol Laboratory: Electrical Engineering #3

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Group:	C
Faculty:	Communication and Environment
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Table of Contents

Challenge #1

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Resistor No.	Colour Code	Resistance from colour code [Ω]	Resistance measured [Ω]
1	red red yellow gold	220k	209.5k
2	brown black yellow gold	100k	97.9k
3	brown black green gold	1000k	1006k
4	red red red gold	2.2k	2.158k
5	brown green brown gold	150	146.8
6	brown black red gold	1k	0.96k
7	yellow violet brown gold	0.470k	0.459k
8	orange orange brown gold	330	324.6

Challenge #2

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Does this setup meet the requirements of the resistor? Why or why not?

The power rating is below the power measured. Prolonged use can overheat the resistor and lead to damage.

Resistance [Ω]	Voltage [V]	Current [A]	Power Dissipation calculated [mW]	Power Rating of Resistor [mW]	OK [Y/N]
470	5.02	10.81	54.26	25	N

Challenge #3

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Resistance [Ω]	**Maximum Voltage across Resistor [V]**
1Ω	0.5
100Ω	5
4.7kΩ	34.27
68kΩ	130.38
1MΩ	500

Challenge #4

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Task	Remark	Value
1	Typical lux value inside buildings from internet research	1500 to 2000 Lux
2	Expected resistance from datasheet for lux value from task 1	400 Ω
3	Measured resistance of LDR with standard light	455.2 Ω
4	Measured resistance of LDR shadowed by hand	6.36 kΩ
5	Measured resistance of LDR irradiated with magnifier lamp	100 Ω
Question a)	Measured lux value for work place	1346 Lux
Question b)	Measured lux value with magnifier lamp of work place	10000 Lux

Challenge #5

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Task	Remark	Value
1	NTC resistance at room temperature	2.43 kΩ
2	NTC resistance at body temperature	1.88 kΩ
3	PTC resistance at room temperature	12.5 Ω
4	PTC resistance at body temperature	13.5 Ω
5	room temperature	31.44 °C
6	body temperature	37.55 °C

Challenge #6

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Description	Value Measured	Value Calculated
I1	1.47 mA	1.5 mA
I2	1.47 mA	1.5 mA
I3	1.47 mA	1.5 mA
I4	1.47 mA	1.5 mA
Iges	1.47 mA	1.5 mA
V1	3.2 V	3.3 V
V2	7.13 V	7.05 V
V3	1.49 V	1.5 V
V4	0.14 V	0.15 V
Vges	11.96V	12V
P(R1)	X	4.95×10^{-3} W
P(R2)	X	1.0575×10^{-2} W
P(R3)	X	2.25×10^{-3} W
P(R4)	X	2.25×10^{-4} W

Challenge #7

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

Description	Value Measured	Value Calculated
I1	0.00545 A	5.45454×10^{-3} A
I2	0.00249 A	2.55319×10^{-3} A
I3	0.00117 A	1.2×10^{-3} A
I4	0.00025 A	2.55319×10^{-4} A
Iges	0.00936 A	9.463×10^{-3} A
V1	11.99 V	12 V
V2	11.703 V	12 V
V3	11.7 V	12 V
V4	11.75 V	12 V
Vges	11.78V	12 V
P(R1)	X	0.0650 W
P(R2)	X	0.0306 W
P(R3)	X	0.0144 W
P(R4)	X	0.0030 W

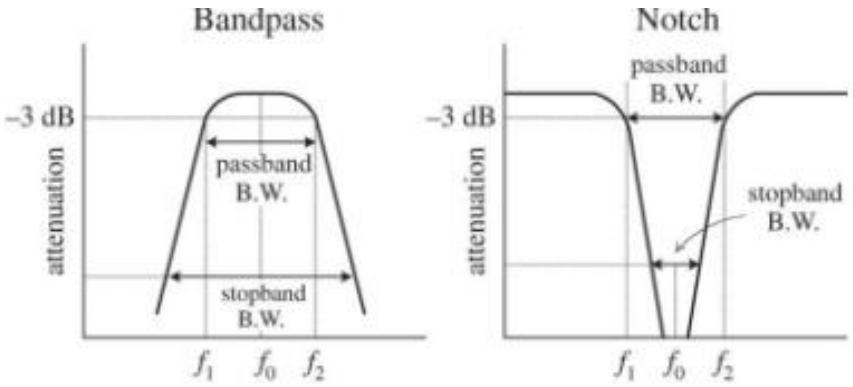
Challenge #8

Abstract:

Our group start searching the internet in order to answer the questions.

Results:

Sketch the attenuation versus frequency graph for a bandpass and a notch filter.



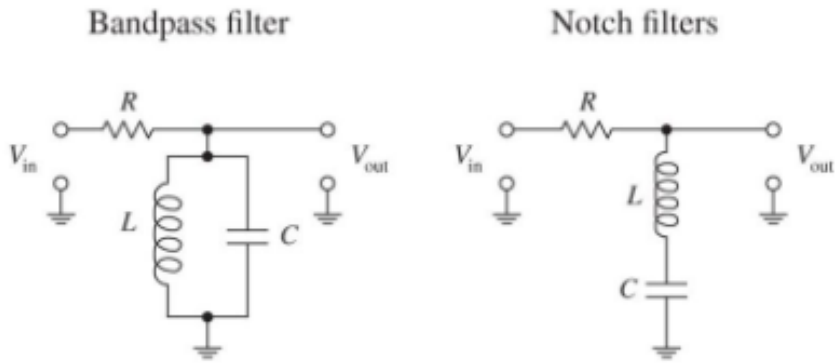
Source: https://publicism.info/science/electronics/10.html (figure 9.2).

What might be a use case for a notch filter?

"…A notch filter […] is used to remove a specific interfering frequency. This is a technique used with radio receivers that are so close to a transmitter that it swamps all other signals…"

(Carr, Joseph J. (2001), *The technician's radio receiver handbook: Wireless and telecommunication technology*, p. 282. Newnes).

Sketch the schematic for the bandpass and notch filter.



Source: https://publicism.info/science/electronics/10.html (figure 9.3).

Write down the formula to calculate the cut-off frequency of the bandpass and notch filter.

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

Source: https://publicism.info/science/electronics/10.html (figure 9.3).

What happens if the resistor of a filter circuit (lowpass or highpass) is replaced by an inductor?

Unfortunately, our group is unable to find the answer for this question.

What is a digital filter?

A digital filter is a system that performs mathematical operations on a sampled, discrete-time signal to reduce or enhance certain aspects of that signal.

Challenge #9

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

We search the internet for the star-delta transformation formula, it is as follows:

$$R_5 = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$
$$R_6 = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$
$$R_4 = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

Using the formula, we found the new resistor values for R4, R5, R6 is 3000Ω. Following the instruction given in the booklet, we build the Delta circuit using the new resistance value 3000Ω. After that we measure the resistance between node A*&B*, A*&C*, B*&C* and got 1950Ω, the same as the initial nodes from the Star circuit.

Results:

The difference between the two circuits in the booklet is:

Star circuit:

- The circuit in Figure 3 have a common connection for all 3 nodes A, B, C.
- Amount of resistance needed is lower compared to Delta circuit.
- Voltage across the circuit is equal to 1/√3 of the line voltage.

Delta circuit:

- The circuit in Figure 4 have a common connection for only 2 nodes.
- Amount of resistance needed is higher compared to Star circuit.
- Voltage across the circuit is equal to the line voltage.

Test point	Resistance [Ω]
A&B	1950
A&C	1950
B&C	1950
A*&B*	1950
A*&C*	1950
B*&C*	1950

Challenge #10

Abstract:

Our group managed to completed the challenge by following the steps given in the Description of the Laboratory booklet.

Results:

We learned that we are able to accurately measure an unknown electrical resistance (in this case R5 and R7) by balancing two legs of a bridge circuit (adjust the variable resistor that the current becomes zero).

Resistor	Resistance [Ω]
R1	47k
R2	10k
R3	100k*
R4 (=R1)	47k
R5	71.2k
R6 (=R2)	10k
R7	17.72k

*R3 variable resistor has a total resistance of 100kΩ, but the separate resistance for two legs are different.