EE236: Electronic Devices Lab
Lab No.8

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1 Hall Effect Sensor

1.1 Aim of the experiment

1. Vary the distance between the hall sensor and the magnet, and note the output voltage at every step.
2. Determine the strength of the given bar magnet and calculate the doping concentration of the hall element in the given sensor.

1.2 Design

1. Connect the Hall Sensor to VCC=8V and GND.
2. Place the magnet 15cm away from the sensor and start moving it towards the sensor.
3. Measure the output voltage of the sensor at every 5mm till the magnet just touches the sensor.

1.3 Observation and Results:

Hall Sensor Output Voltage

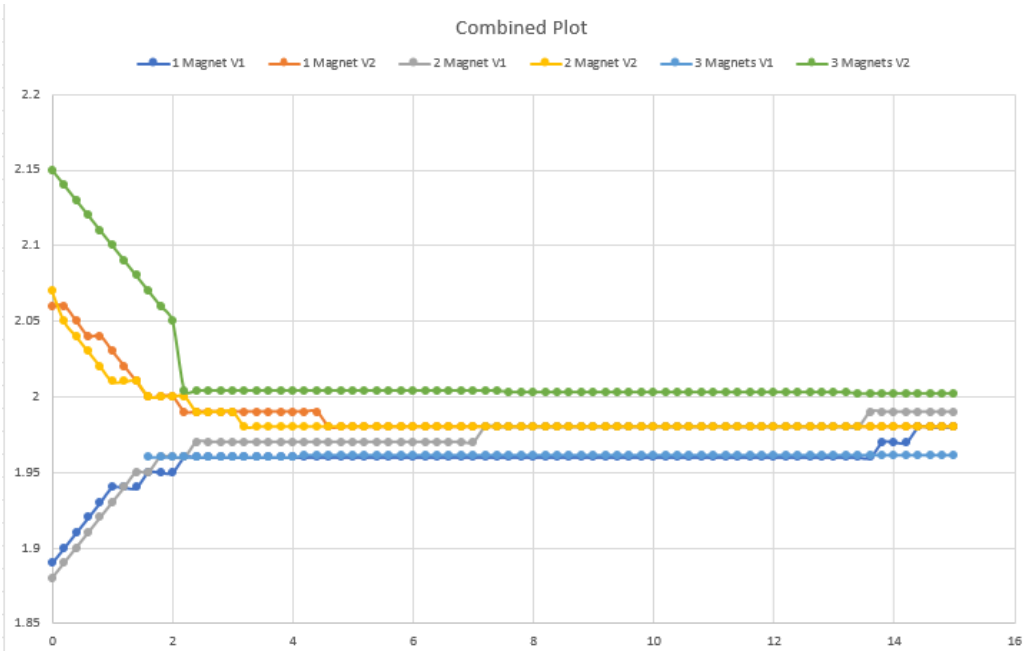

Figure 1: Voltage vs distance for 1, 2 and 3 magnets with both polarities

1.4 Calculations

$$E_{\text{long}} = \frac{V_{\text{in}}}{a} = \frac{8V}{0.53mm} = 15094V/mm$$

$$E_{\text{lat}} = \frac{|V_{\text{out},0} - V_{\text{out,max}}|}{a} = \frac{|1.01V - 1.94V|}{0.53mm} = 1754.71V/mm$$

$$E_{\text{lat}} = 3B \cdot \mu \cdot E_{\text{long}}$$
$$B = 0.04895T$$

$$R_H = \frac{V_{\text{out,max}} \cdot t}{I_{\text{in}} \cdot B} = \frac{1.94V * 0.053mm}{2.56mA * 0.04895T} = 0.8205 \text{ m}^3/A - s$$

$$e = 1.6 \times 10^{-19} \text{ C}$$
$$N = \frac{1}{R_H \cdot e} = \frac{1}{0.8205 * 1.6 * 10^{-19}} = 7.617 * 10^{18} m^{-3}$$

1.5 Conclusions:

1. The output voltage of Hall sensor increases/decreases as we move the magnet towards it depending on its polarity
2. The doping concentration of the hall sensor is found to be

$$N = 7.617 * 10^{18} m^{-3}$$

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Distance (cm)	Voltage (V1)	Voltage (V2)	Current (A)
15	1.98	1.98	2.65 mA
14.8	1.98	1.98	
14.6	1.98	1.98	
14.4	1.98	1.98	
14.2	1.97	1.98	
14	1.97	1.98	
13.8	1.97	1.98	
13.6	1.96	1.98	
13.4	1.96	1.98	
13.2	1.96	1.98	
13	1.96	1.98	
12.8	1.96	1.98	
12.6	1.96	1.98	
12.4	1.96	1.98	
12.2	1.96	1.98	
12	1.96	1.98	
11.8	1.96	1.98	
11.6	1.96	1.98	
11.4	1.96	1.98	
11.2	1.96	1.98	
11	1.96	1.98	
10.8	1.96	1.98	
10.6	1.96	1.98	
10.4	1.96	1.98	
10.2	1.96	1.98	
10	1.96	1.98	
9.8	1.96	1.98	
9.6	1.96	1.98	
9.4	1.96	1.98	
9.2	1.96	1.98	
9	1.96	1.98	
8.8	1.96	1.98	
8.6	1.96	1.98	
8.4	1.96	1.98	
8.2	1.96	1.98	
8	1.96	1.98	
7.8	1.96	1.98	
7.6	1.96	1.98	
7.4	1.96	1.98	
7.2	1.96	1.98	
7	1.96	1.98	
6.8	1.96	1.98	

Table 1: Distance vs Voltage and Current Readings for 1 Magnet

Distance (cm)	**Voltage (V1)**	**Voltage (V2)**	**Current (A)**
6.6	1.96	1.98	
6.4	1.96	1.98	
6.2	1.96	1.98	
6	1.96	1.98	
5.8	1.96	1.98	
5.6	1.96	1.98	
5.4	1.96	1.98	
5.2	1.96	1.98	
5	1.96	1.98	
4.8	1.96	1.98	
4.6	1.96	1.98	
4.4	1.96	1.99	
4.2	1.96	1.99	
4	1.96	1.99	
3.8	1.96	1.99	
3.6	1.96	1.99	
3.4	1.96	1.99	
3.2	1.96	1.99	
3	1.96	1.99	
2.8	1.96	1.99	
2.6	1.96	1.99	
2.4	1.96	1.99	
2.2	1.96	1.99	
2	1.95	2	
1.8	1.95	2	
1.6	1.95	2	
1.4	1.94	2.01	
1.2	1.94	2.02	
1	1.94	2.03	
0.8	1.93	2.04	
0.6	1.92	2.04	
0.4	1.91	2.05	
0.2	1.9	2.06	
0	1.89	2.06	

Table 2: Distance vs Voltage and Current Readings for 1 Magnet

Distance (cm)	**Voltage (V1)**	**Voltage (V2)**
15	1.99	1.98
14.8	1.99	1.98
14.6	1.99	1.98
14.4	1.99	1.98
14.2	1.99	1.98
14	1.99	1.98
13.8	1.99	1.98
13.6	1.99	1.98
13.4	1.98	1.98
13.2	1.98	1.98
13	1.98	1.98
12.8	1.98	1.98
12.6	1.98	1.98
12.4	1.98	1.98
12.2	1.98	1.98
12	1.98	1.98
11.8	1.98	1.98
11.6	1.98	1.98
11.4	1.98	1.98
11.2	1.98	1.98
11	1.98	1.98
10.8	1.98	1.98
10.6	1.98	1.98
10.4	1.98	1.98
10.2	1.98	1.98
10	1.98	1.98
9.8	1.98	1.98
9.6	1.98	1.98
9.4	1.98	1.98
9.2	1.98	1.98
9	1.98	1.98
8.8	1.98	1.98
8.6	1.98	1.98
8.4	1.98	1.98
8.2	1.98	1.98
8	1.98	1.98
7.8	1.98	1.98
7.6	1.98	1.98
7.4	1.98	1.98
7.2	1.98	1.98
7	1.97	1.98
6.8	1.97	1.98

Table 3: Distance vs Voltage Readings for 2 Magnets

Distance (cm)	**Voltage (V1)**	**Voltage (V2)**
6.6	1.97	1.98
6.4	1.97	1.98
6.2	1.97	1.98
6	1.97	1.98
5.8	1.97	1.98
5.6	1.97	1.98
5.4	1.97	1.98
5.2	1.97	1.98
5	1.97	1.98
4.8	1.97	1.98
4.6	1.97	1.98
4.4	1.97	1.98
4.2	1.97	1.98
4	1.97	1.98
3.8	1.97	1.98
3.6	1.97	1.98
3.4	1.97	1.98
3.2	1.97	1.98
3	1.97	1.99
2.8	1.97	1.99
2.6	1.97	1.99
2.4	1.97	1.99
2.2	1.96	2
2	1.96	2
1.8	1.96	2
1.6	1.95	2
1.4	1.95	2.01
1.2	1.94	2.01
1	1.93	2.01
0.8	1.92	2.02
0.6	1.91	2.03
0.4	1.9	2.04
0.2	1.89	2.05
0	1.88	2.07

Table 4: Distance vs Voltage Readings for 2 Magnets

3 Ms	Distance (in cm)	Voltage (V1)	Voltage (V2)
	15	1.961	2.002
	14.8	1.961	2.002
	14.6	1.961	2.002
	14.4	1.961	2.002
	14.2	1.961	2.002
	14	1.961	2.002
	13.8	1.961	2.002
	13.6	1.961	2.002
	13.4	1.961	2.002
	13.2	1.961	2.003
	13	1.961	2.003
	12.8	1.961	2.003
	12.6	1.961	2.003
	12.4	1.961	2.003
	12.2	1.961	2.003
	12	1.961	2.003
	11.8	1.961	2.003
	11.6	1.961	2.003
	11.4	1.961	2.003
	11.2	1.961	2.003
	11	1.961	2.003
	10.8	1.961	2.003
	10.6	1.961	2.003
	10.4	1.961	2.003
	10.2	1.961	2.003
	10	1.961	2.003
	9.8	1.961	2.003
	9.6	1.961	2.003
	9.4	1.961	2.003
	9.2	1.961	2.003
	9	1.961	2.003
	8.8	1.961	2.003
	8.6	1.961	2.003
	8.4	1.961	2.003
	8.2	1.961	2.003
	8	1.961	2.003
	7.8	1.961	2.003
	7.6	8 1.961	2.003
	7.4	1.961	2.004
	7.2	1.961	2.004
	7	1.961	2.004
	6.8	1.961	2.004

Table 5: Voltage readings for 3 Magnets at various distances

3 Ms	Distance (in cm)	Voltage (V1)	Voltage (V2)
	6.6	1.961	2.004
	6.4	1.961	2.004
	6.2	1.961	2.004
	6	1.961	2.004
	5.8	1.961	2.004
	5.6	1.961	2.004
	5.4	1.961	2.004
	5.2	1.961	2.004
	5	1.961	2.004
	4.8	1.961	2.004
	4.6	1.961	2.004
	4.4	1.961	2.004
	4.2	1.961	2.004
	4	1.96	2.004
	3.8	1.96	2.004
	3.6	1.96	2.004
	3.4	1.96	2.004
	3.2	1.96	2.004
	3	1.96	2.004
	2.8	1.96	2.004
	2.6	1.96	2.004
	2.4	1.96	2.004
	2.2	1.96	2.004
	2	1.96	2.05
	1.8	1.96	2.06
	1.6	1.96	2.07
	1.4	1.95	2.08
	1.2	1.95	2.09
	1	1.95	2.1
	0.8	1.94	2.11
	0.6	1.93	2.12
	0.4	1.92	2.13
	0.2	1.91	2.14
	0	1.9	2.15

Table 6: Voltage readings for 3 Magnets at various distances