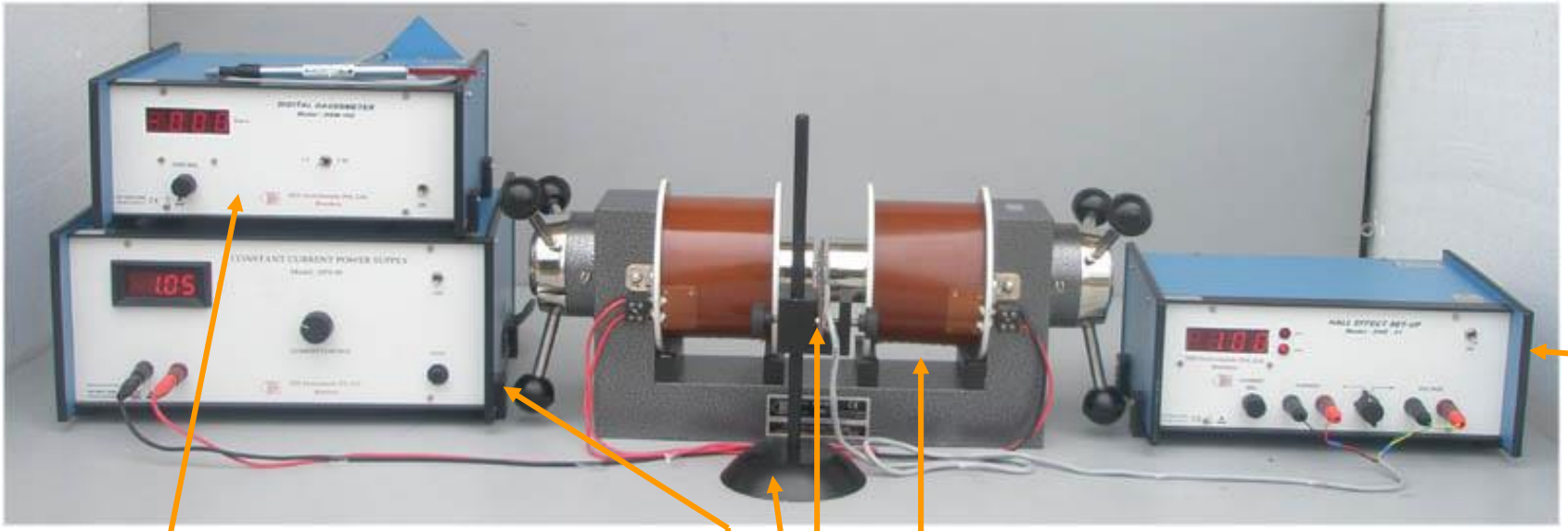
HALL EFFECT EXPERIMENT

HEX-21

OPERATION GUIDE

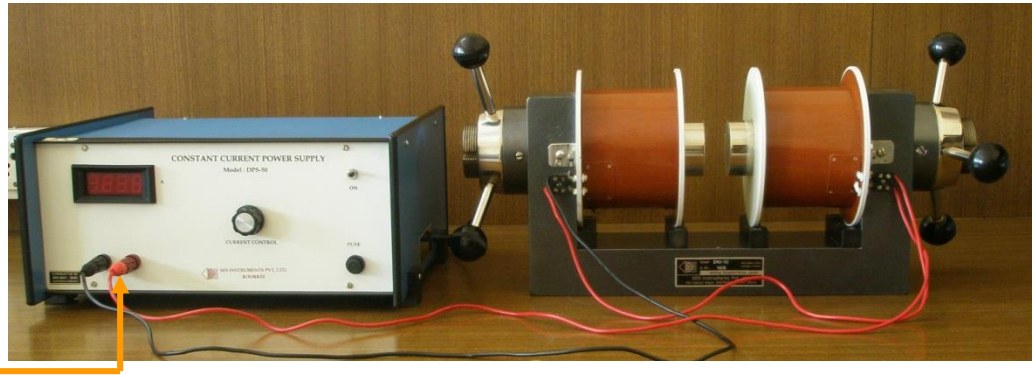
Unpack and check the following



- Digital Gauss meter, DGM-102 (Gauss probe located in the back chamber of DGM-102)
- Constant Current Power Supply, DPS-50
- Electromagnet, EMU-50V
- Hall Probe Stand
- Hall effect set-up, HEX-21
- Hall effect probe arrangement with Sample: (Ge: p-type)

Connection

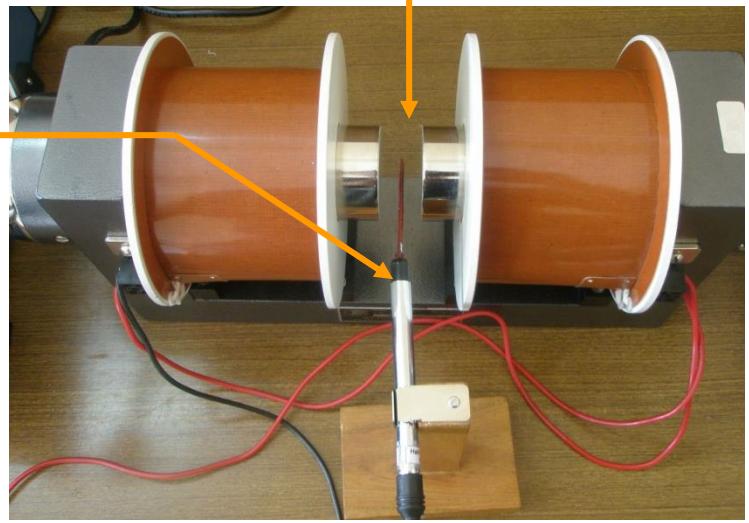
- Connect the leads of Electromagnet (EMU-50) to the Constant Current Supply (DPS-50), matching the color of terminals



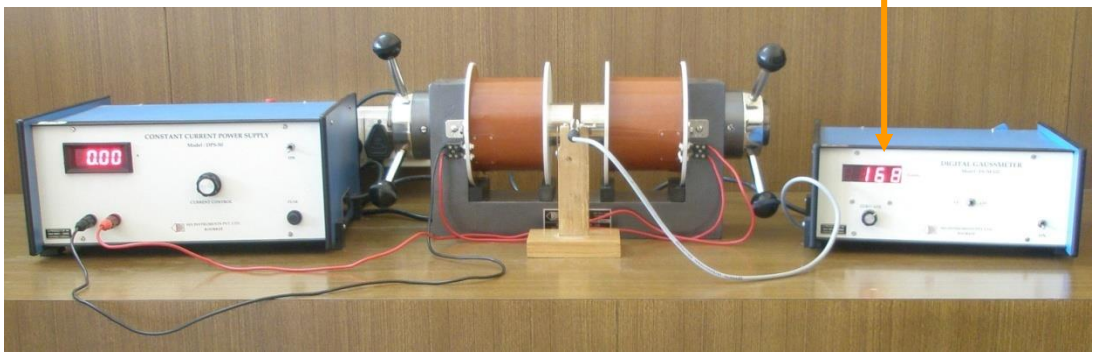
- Connect the Hall Probe to the main unit of DHE-21. It consist of four leads Red and Black for Current and other Yellow and Green for Voltage.

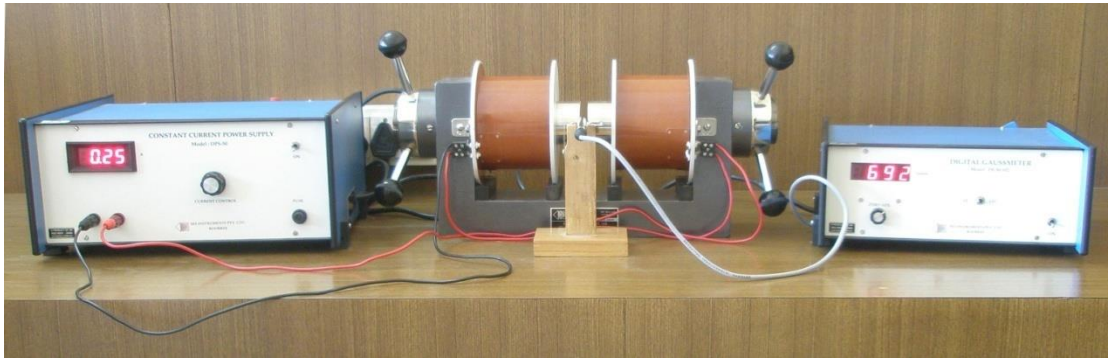
Calibration of EMU-50 with Gauss meter

- Before measurement, adjust zero of DGM-102, keeping the probe outside the magnet
- Adjust the air gap in EMU-50 such that there would be a sufficient airgap (15 mm approx.) in pole pieces to place the probe
- Keep the Gauss Probe of DGM-102 in the middle of two poles of the Electromagnet
- That should be perpendicular to the magnetic field and should also be centered



- Measure the residual magnetic field at Zero Current
- Now increase current of Constant Current Power Supply (DPS-50) in proper intervals (say 0.00, 0.25, 0.50, 0.75 ….. 4.00 A). Measure the corresponding magnetic field at different intervals using DGM-102
- Refer to Table 1

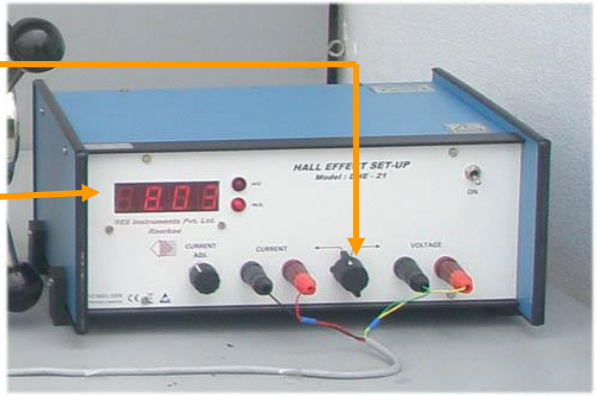


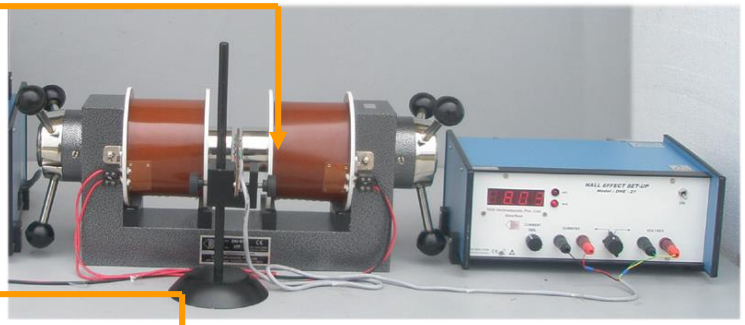


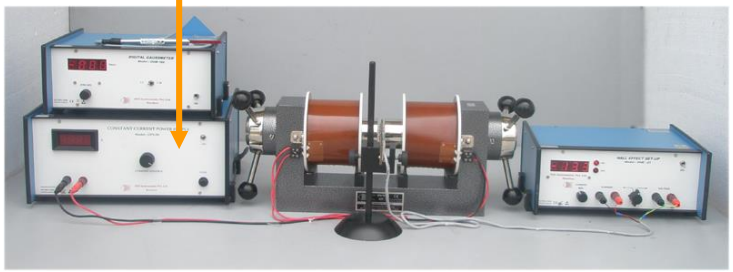
Hall effect in semiconductors

A) Keep the Hall probe (Ge crystal) current constant and varying magnetic field

- Keep the Selector Knob of DHE-21 towards the current side
- Set the probe current at any value (say 8.00 mA)
- Now place Hall probe perpendicular to the magnetic field and at the center of the two poles of the electromagnet
- Next turn the Selector Knob of DHE-21 towards the voltage side and read the Hall voltage
- Now switch OFF, DPS-50 to read offset voltage of the Hall Probe.
- Change the magnetic field from minimum to the maximum by varying the DPS-50 current to the magnet EMU-50
- Refer to Table 2

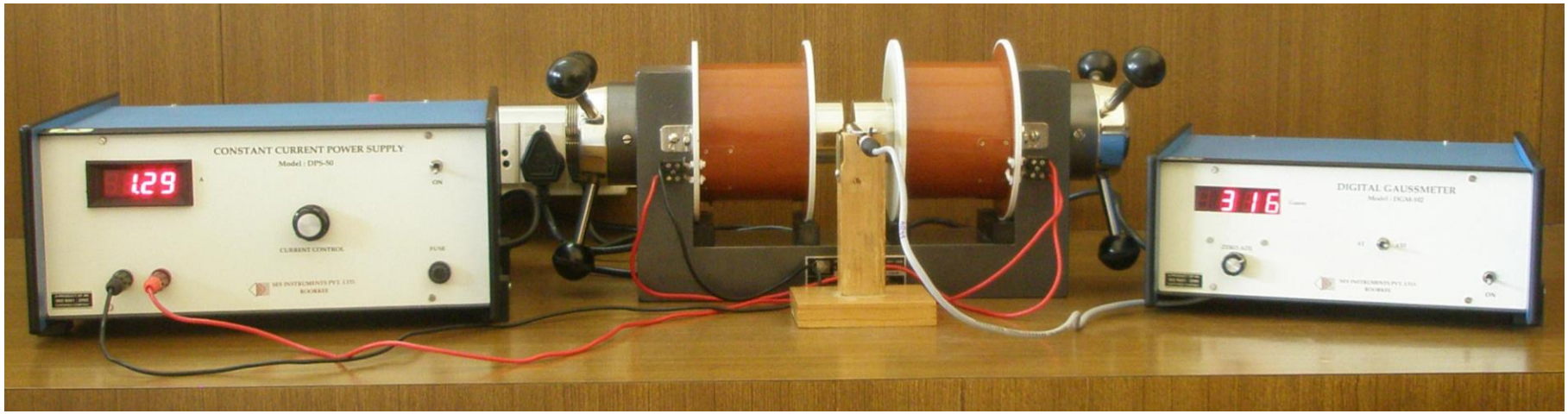




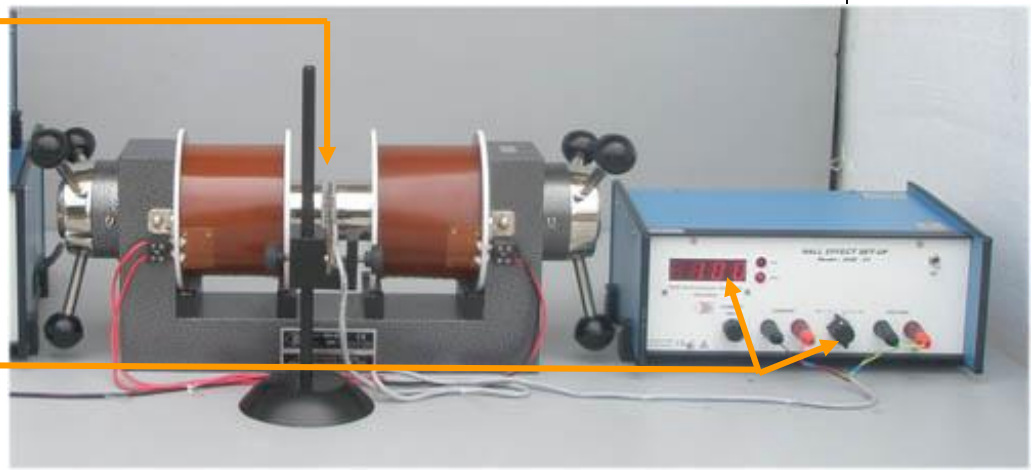


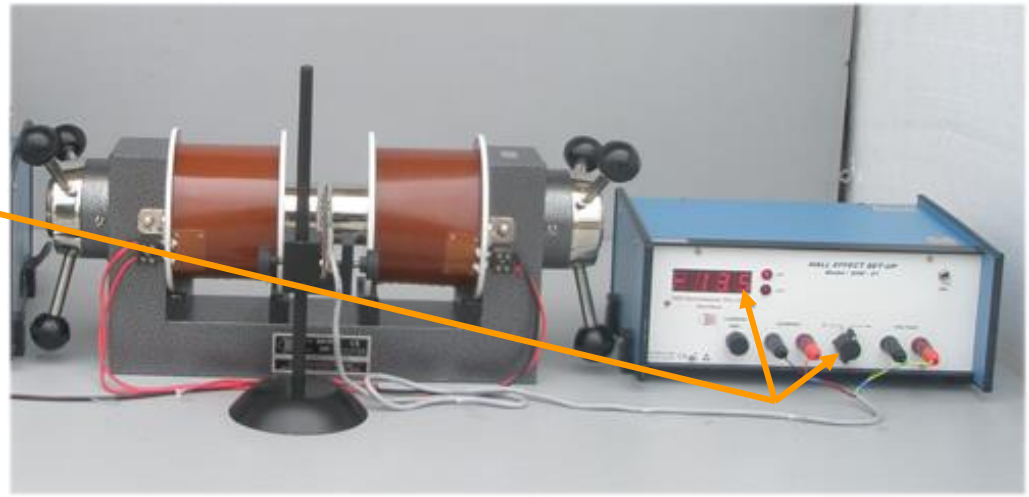
B) Keep magnetic field constant and vary probe current

Fix the magnetic field constant say at 3 KG by adjusting DPS-50



- Now place the Hall Probe in the middle of electromagnet
- First, set the selector switch towards the current side of DHE-21and set different probe current (say 1, 2, 3, 4, …….mA) using current varying knob.
- Now change the selector switch position towards the voltage side and get the hall voltage reading corresponding to the probe current
- Measure offset voltage as previously described
- Refer to Table 3





Observation

Sample Set of Readings

Calibration of EMU-50 with Gauss meter

Table 1

S.No.	*E.M. Power Supply Current (A)*	*Magnetic Field (KG)*
1	Min	0.168
2	0.25	0.692
3	0.50	1.203
4	0.75	1.779
5	1.00	2.36
6	1.50	3.56
7	2.00	4.63
8	2.50	5.69
9	3.00	6.56
10	3.5	7.23
11	4	7.73

I) Keeping the Probe Current Constant vary magnetic field (Probe current=8mA)

Table 2

E.M.Power Supply Current (A)	*Magnetic Field (KG)*	*Hall Voltage (V)*	*Offset*	*Corrected Hall Voltage (V)*
0	0.168	9.7	4.2	5.6
0.25	0.692	25.4	4.2	21.5
0.5	1.203	42.3	4.1	38.2
0.75	1.779	55.1	4.1	51
1	2.36	71.1	4.1	67
1.5	3.56	96.4	3.9	92.5
2	4.63	118.9	4.0	114.9
2.5	5.69	136.8	4.0	132.8
3	6.56	151.4	4.0	147.4
3.5	7.23	158.1	3.9	158.1
4	7.73	165.6	4.2	165.6

II) Keeping the magnetic field constant vary the Probe Current

Table 3

S.No.	Current (mA)	Hall voltage (mV)	Offset (mV)	Corrected Hall Voltage (mV)
1	0	0.00	0.00	0
2	1	11.3	0.7	10.6
3	2	22.4	1.5	20.9
4	3	33.4	2.3	31.1
5	4	44.4	3.2	41.2
6	5	55.5	3.2	52.3
7	6	66	3.7	62.3
8	7	76. 7	3.8	72.9
9	8	87.3	4.0	83.3
10	9	98.1	4.3	93.8
11	10	108.1	4.5	103.6
12	11	118.2	5.6	112.6
13	12	128.0	6.2	122.2
14	13	138	6.2	132.2
15	14	146.6	6.2	140.4
16	15	155.3	6.7	149.6
17	16	163.5	6.4	157.1
18	17	171.5	6.4	165.1
19	18	178.4	6.4	172

Calculation

Hall effect in Ge-crystal

Hall Coefficient $$R = \frac{V_h . Z}{I H}$$

where V_h = Hall voltage
z = thickness of Ge crystal
I = Hall current
H = Magnetic field

Carrier Density $$R = \frac{1}{nq}$$ or $$n = \frac{1}{Rq}$$

Where q=charge of electron

Carrier Mobility $$\mu = R\sigma$$

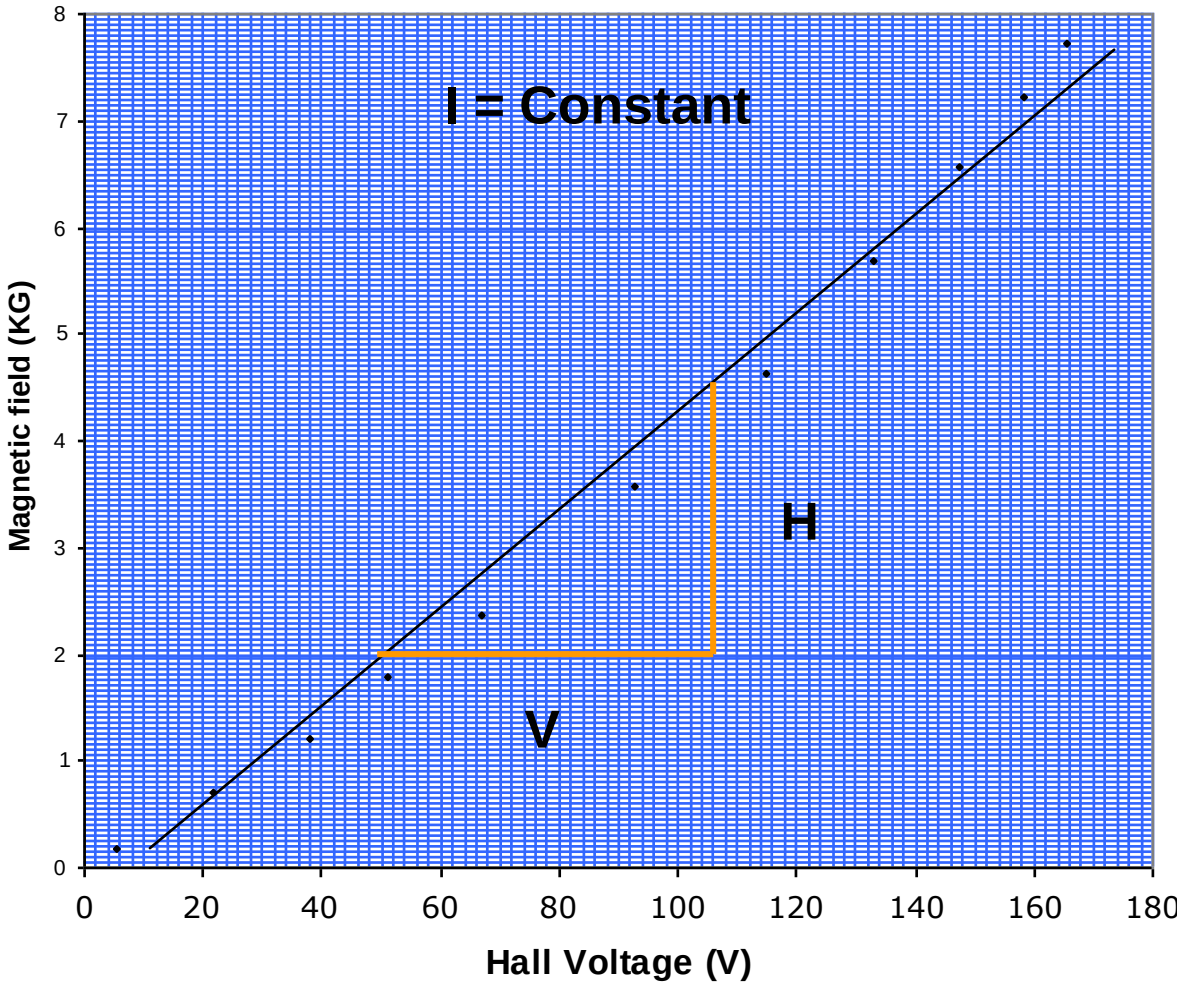
σ = conductivity (refer to app. Of manual)

Refer Manual and Test Result for details of Calculation

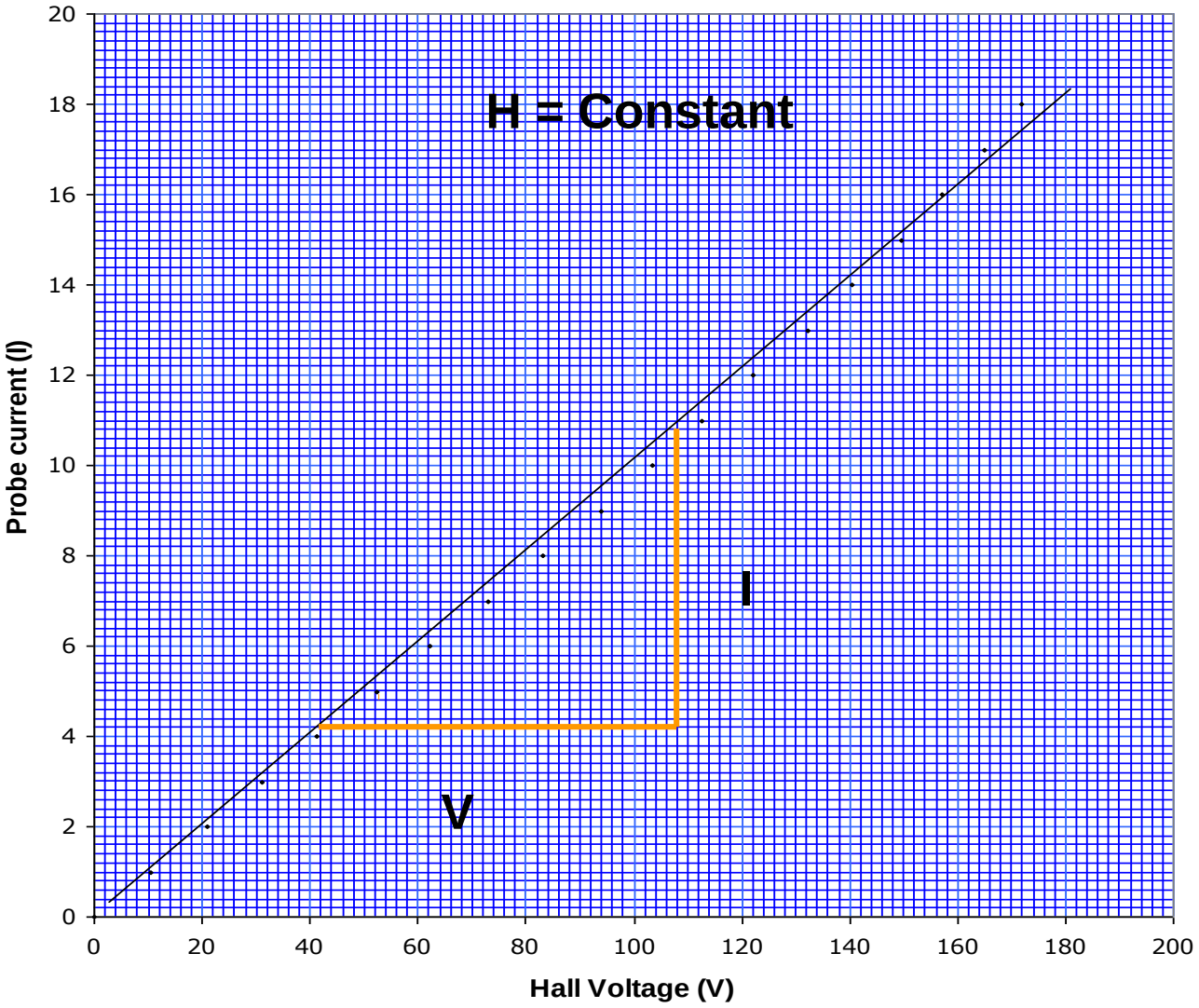
Graph

Hall Effect Experiment ,HEX-21

Probe Current=8mA (Constant for whole set of readings)



Hall Effect Experiment ,HEX-21
Magnetic Field =3KG (Constant for whole set of readings)



Calculate Hall coefficient

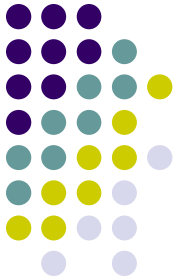
$$R = \frac{V_h Z}{I H}$$

H = Mag. Field
Z= Sample Thickness
I = Probe Current
V = Hall Voltage

Result

Crystal	:	p/ n-type
Hall Coefficient	:	As Per calculation
Carrier Mobility	:	As Per calculation
Carrier density	:	As Per calculation

Measure the experimental values and compare with test result



Thanks