

Engineering Physics Laboratory

(Course Code : PHY119)

Experiment - 3

AIM: To determine the Hall voltage and Hall coefficient by using Hall effect.

Learning Objectives

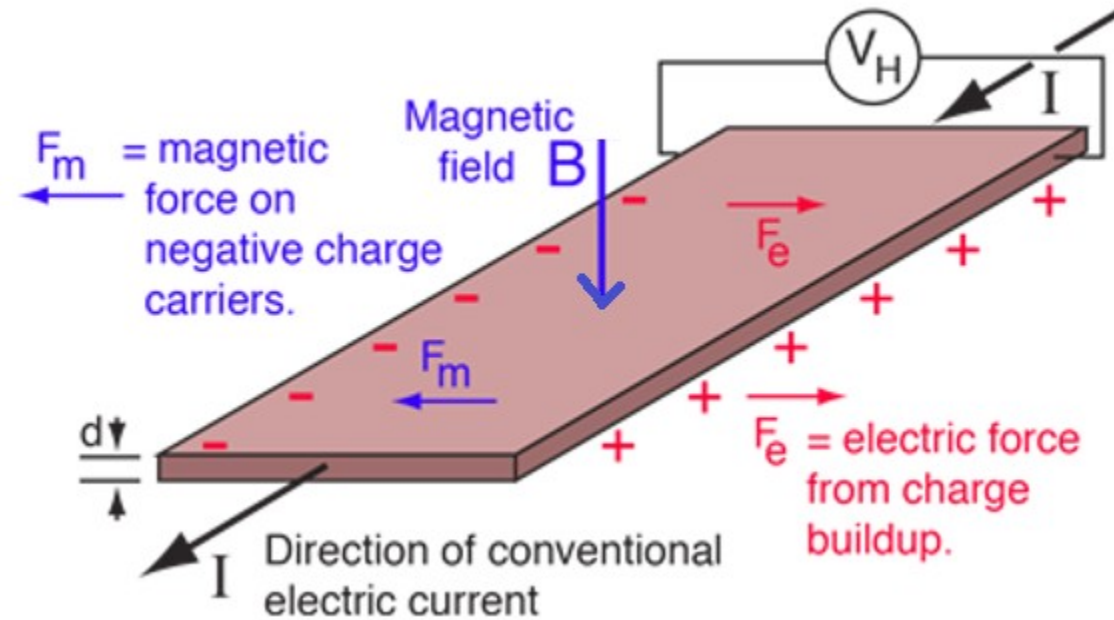
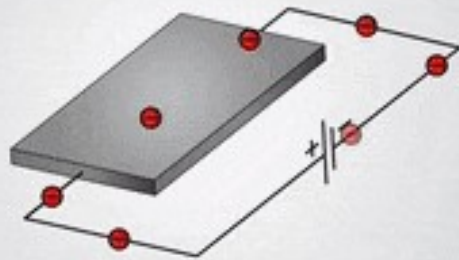
1. To understand new phenomenon called Hall effect.
2. Variation of Hall voltage with magnetic field keeping current through specimen fixed and vice-versa.
3. To calculate various parameters of the given material like number density, mobility etc.

LET US START

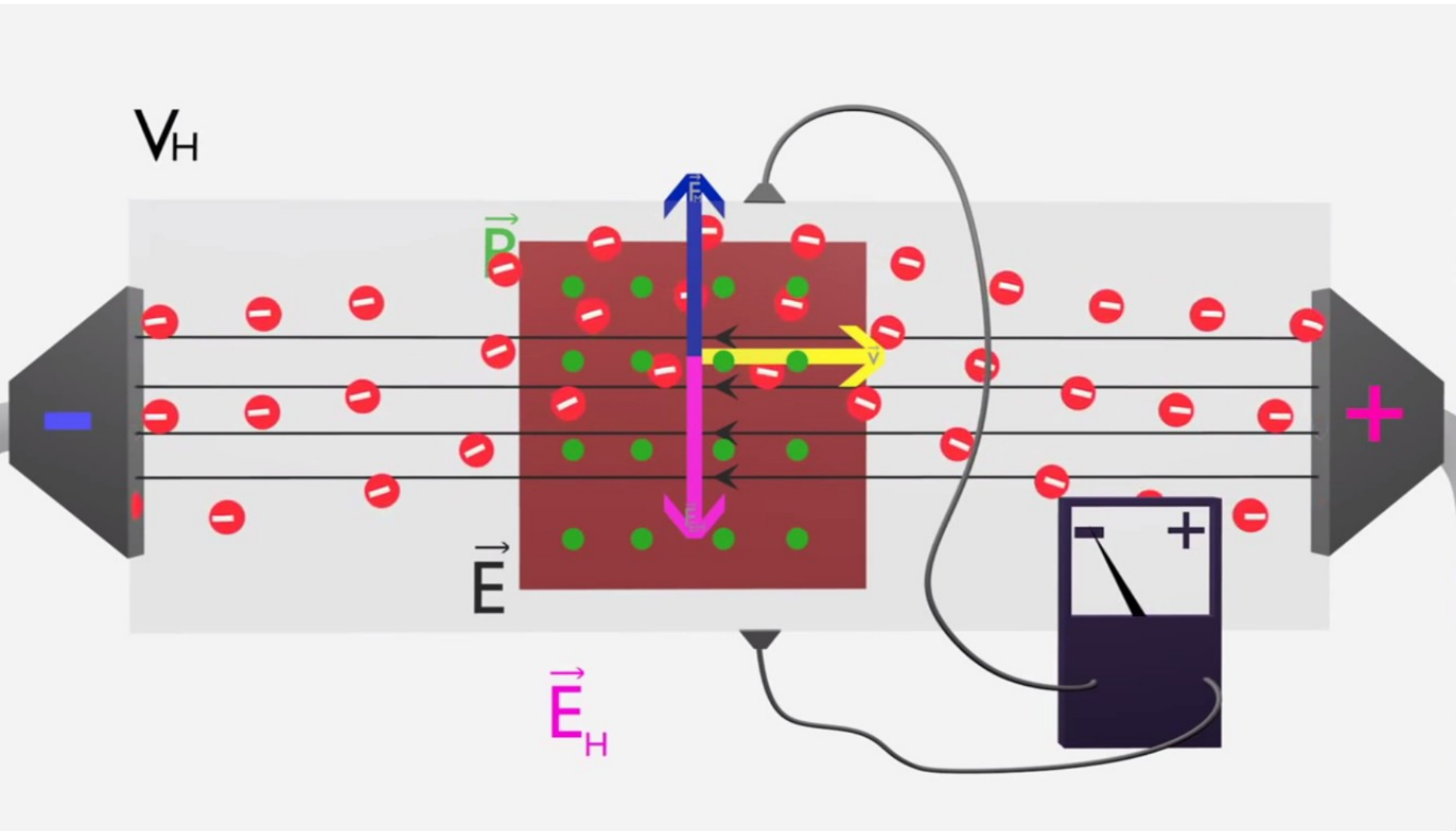


HALL EFFECT

Hall Effect



LORENTZ FORCE (Click)



$$F_B = Bqv$$

$$F_E = Eq$$

$$\text{but } E = \frac{V_H}{d}$$

$$F_E = \frac{V_H q}{d}$$

So if $F_B = F_E$

$$Bqv = \frac{V_H q}{d}$$

$$V_H = Bvd = \text{Hall Voltage}$$

Hall effect is a very useful phenomenon and helps to

- ✓ Determine the Type of Semiconductor

By knowing the direction of the Hall Voltage, one can determine that the given sample is whether n-type semiconductor or p-type semiconductor. This is because Hall coefficient is negative for n-type semiconductor while the same is positive in the case of p-type semiconductor.

- ✓ Calculate the Carrier Concentration

The expressions for the carrier concentrations of electrons (n) and holes (p) in terms of Hall coefficient are given by

$$n = \frac{1}{qR_H} \quad \text{and} \quad p = \frac{1}{qR_H}$$

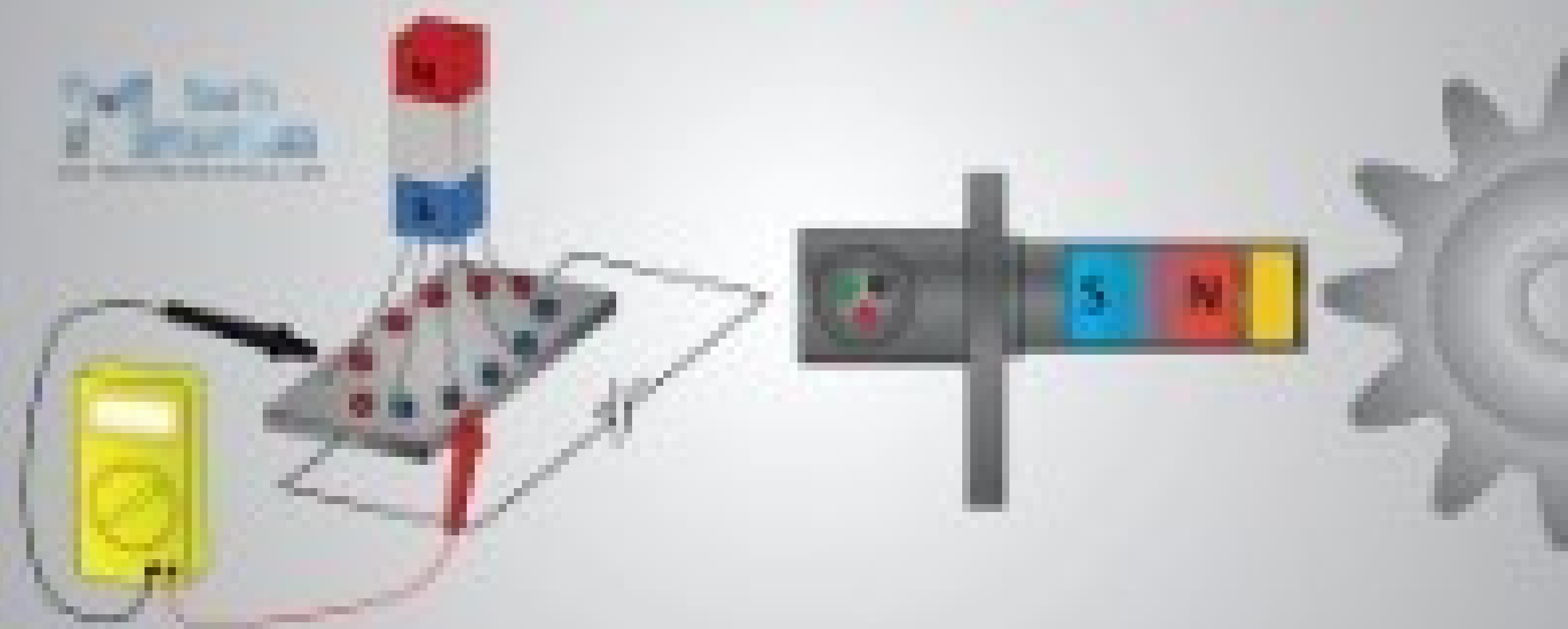
- ✓ Determine the Mobility (Hall Mobility)

Mobility expression for the electrons (μ_n) and the holes (μ_p), expressed in terms of Hall coefficient is given by,

$$\mu_n = \sigma_n R_H \quad \text{and} \quad \mu_p = \sigma_p R_H$$

A video illustrating Hall effect and its applications

Hall Effect



**Check your
understanding**

Check your understanding

Q

Q3.1: In the Hall Effect, the directions of electric field and magnetic field are parallel to each other.

The above statement is

a) True

b) False

Q3.2 : Which of the following parameters can be found with Hall Effect?

- a) Polarity (n or p-type)
- b) Conductivity
- c) Carrier concentration
- d) All of these.

Check your understanding

Q

Q3.3: In the Hall Effect, the electric field is in x direction and the velocity is in y direction. What is the direction of the magnetic field?

- a) X
- b) Y
- c) Z
- d) XY plane

Q3.4: In Hall effect, the force responsible for the separation of charge carriers which results in Hall voltage is

- a) Coulomb force
- b) Gravitational force
- c) Lorentz force
- d) Nuclear force

Q3.5: In Hall Effect, the electric field applied is perpendicular to both current and magnetic field?

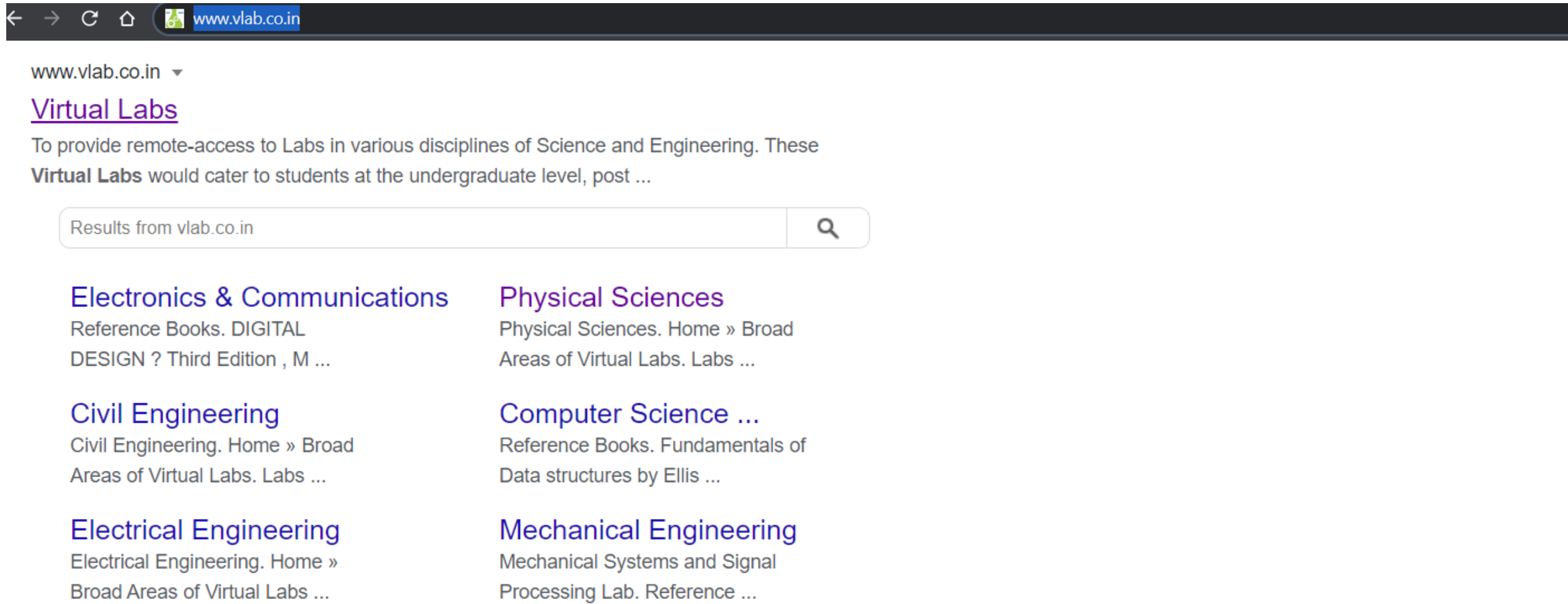
a) True

b) False

Step by Step guide to perform the experiment in Virtual lab

Follow the slides below.

Type this link on the address bar or Click on this link : <https://www.vlab.co.in/>



The screenshot shows a web browser window with the address bar displaying www.vlab.co.in. The page content includes a header with the site name and a description of the Virtual Labs. Below this is a search bar with the text "Results from vlab.co.in" and a magnifying glass icon. The main content area is organized into two columns, each with four links to different engineering disciplines. The links are: Electronics & Communications, Civil Engineering, Electrical Engineering, and Mechanical Engineering in the left column; and Physical Sciences, Computer Science, and Mechanical Engineering in the right column. Each link is followed by a brief description of the resources available in that category.

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Click on the simulator

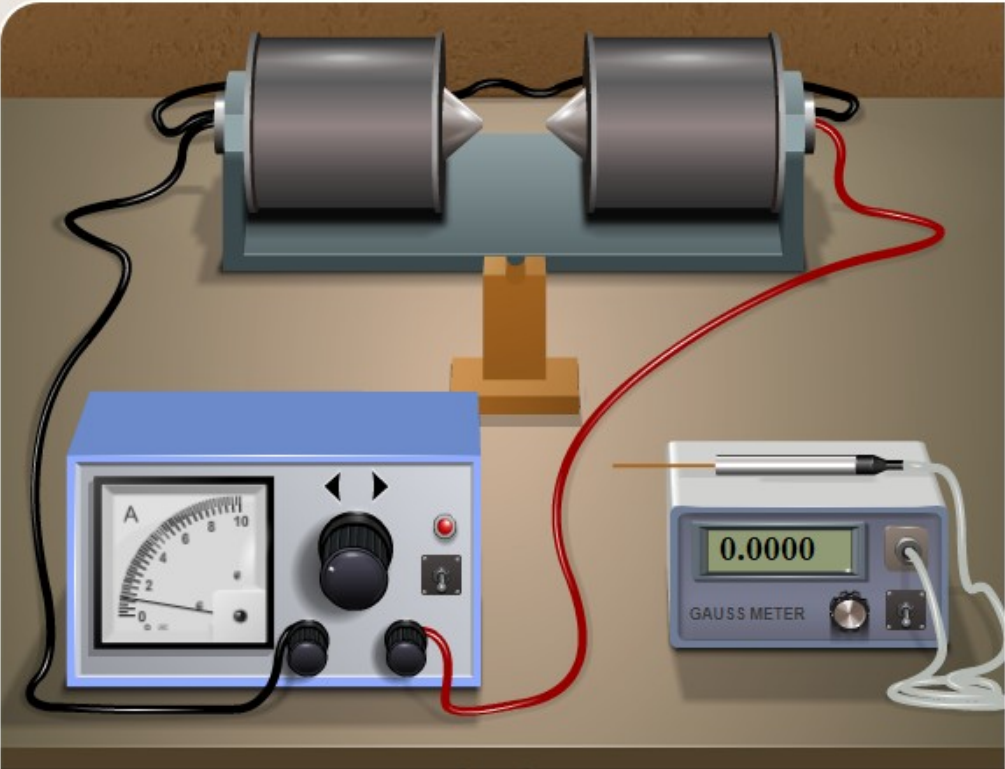
you are here->home->physical sciences->solid state physics virtual lab->hall effect experiment:- determination of charge carrier density

You are logged in as bharpur singh || Help || Log out

Hall effect experiment:- Determination of charge carrier density

Theoretical Procedure Self Evaluation Simulator Assignment Reference Feedback

Hall Effect



Variables

Select Procedure
Magnetic field Vs Current

Insert Probe

Current : 1 A

Select Material
Germanium

Thickness : 0.0001 m

Hall Current : 1 mA

Show Voltage

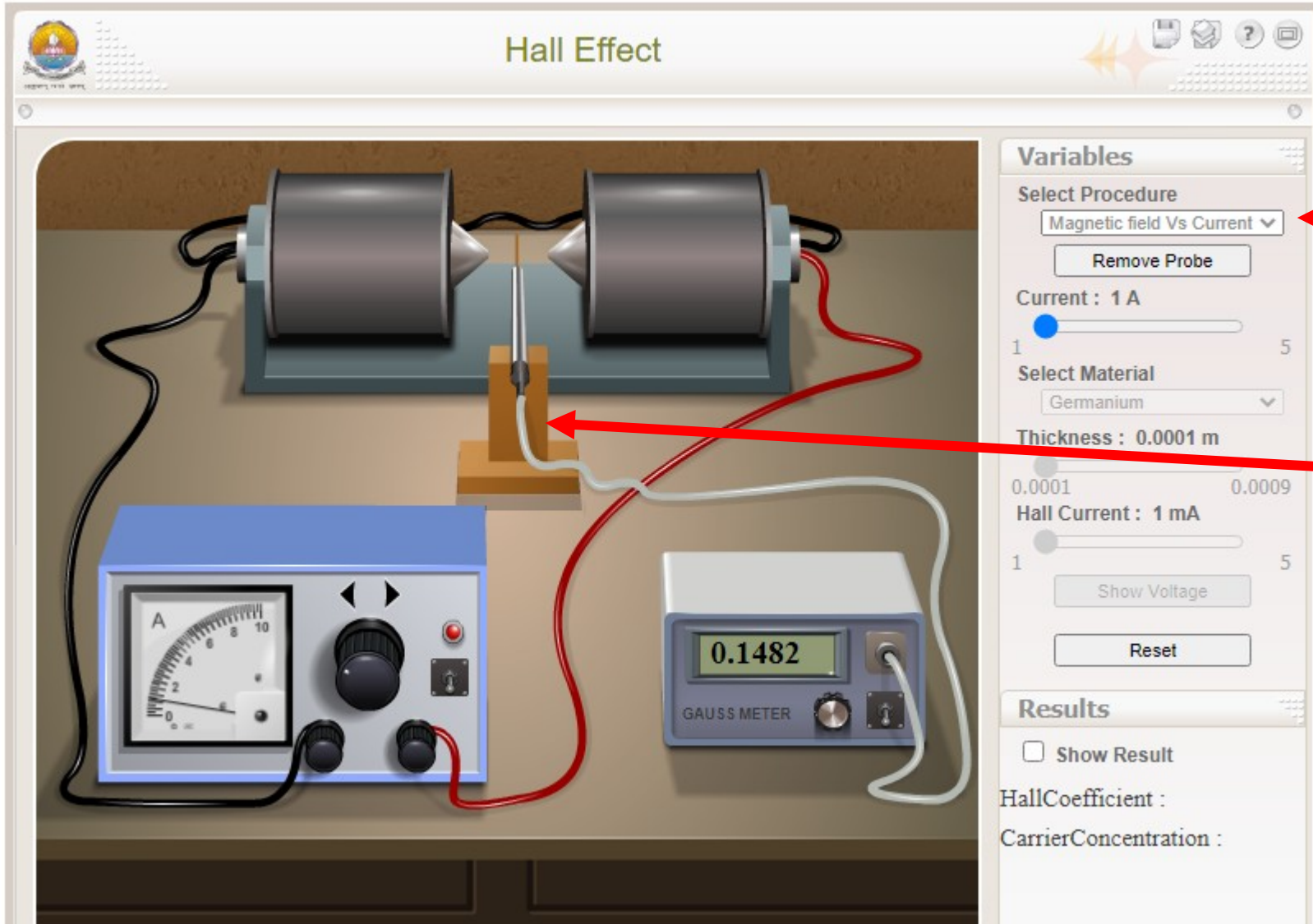
Reset

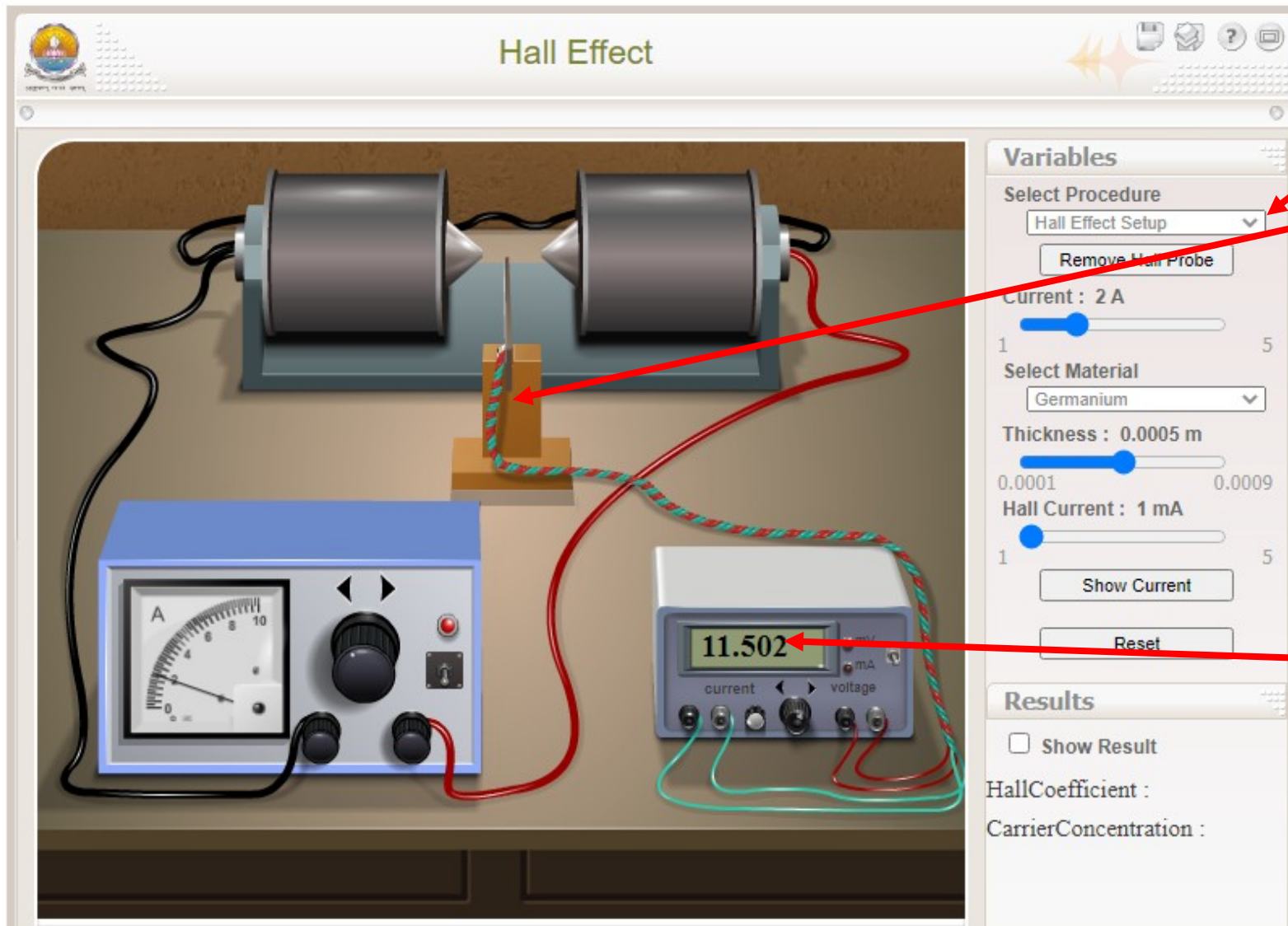
Results

☐ Show Result

HallCoefficient :

CarrierConcentration :





Activity Based Polling

**while the students perform the experiment in
virtual lab**

A3.1: Measured value of the magnetic field when current of 3.5 amperes passes through the electromagnet is

- a) 0.5188 Tesla
- b) 34.507 Tesla
- c) 5.188 Tesla
- d) 0.34507 Tesla

A3.2: Measured value of the Hall voltage for germanium sample, when a current of 2 mA passes through it and placed in perpendicular magnetic field of 0.4447 Tesla. Take thickness of the specimen to be 0.5 mm.

a) 22.607 mV

b) 34.507 mV

c) 2.2607 mV

d) 3.4507 mV

A3.3. Calculate the carrier concentration for semiconductor (Ge) of thickness 0.3mm. (As per simulator)

- a) 3.22×10^{20}
- b) 4.55×10^{20}
- c) 6.55×10^{20}
- d) 2.46×10^{20}

Q3.4: Calculate manually the Hall Effect coefficient when number of electrons in a semiconductor is 10^{20} .

- a) 0.625
- b) 0.0625
- c) 6.25
- d) 62.5