Dr. Ambedkar Institute of Technology

Electronics Devices (19EC31)

Class 7

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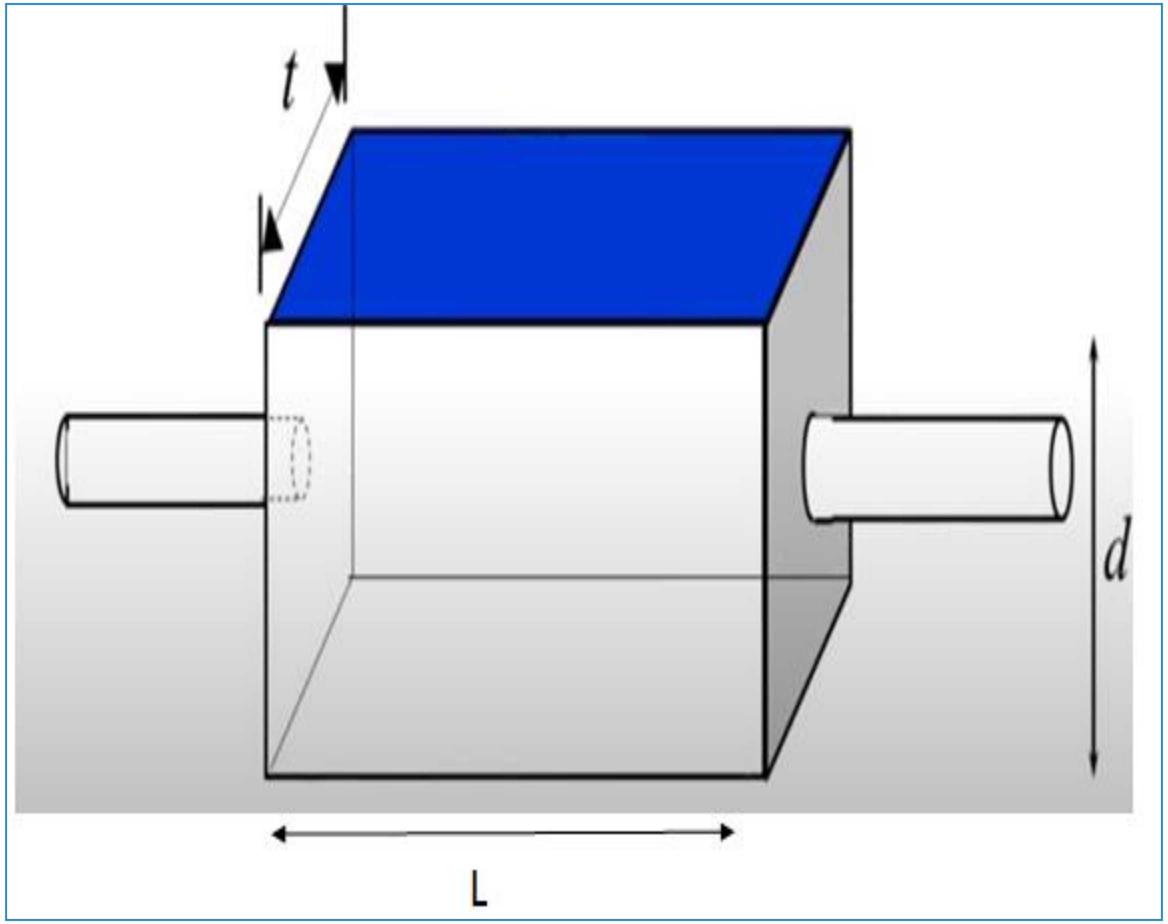
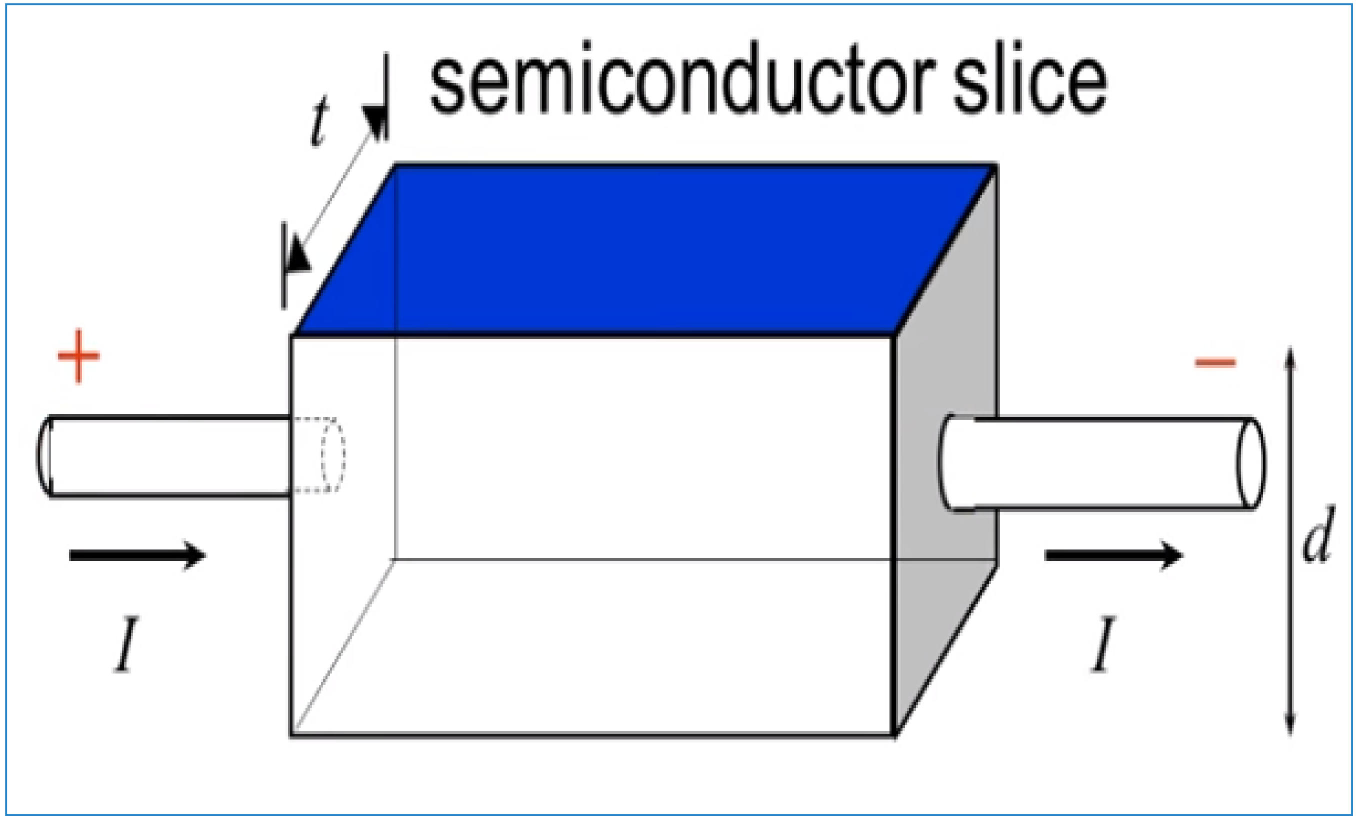
Hall Effect



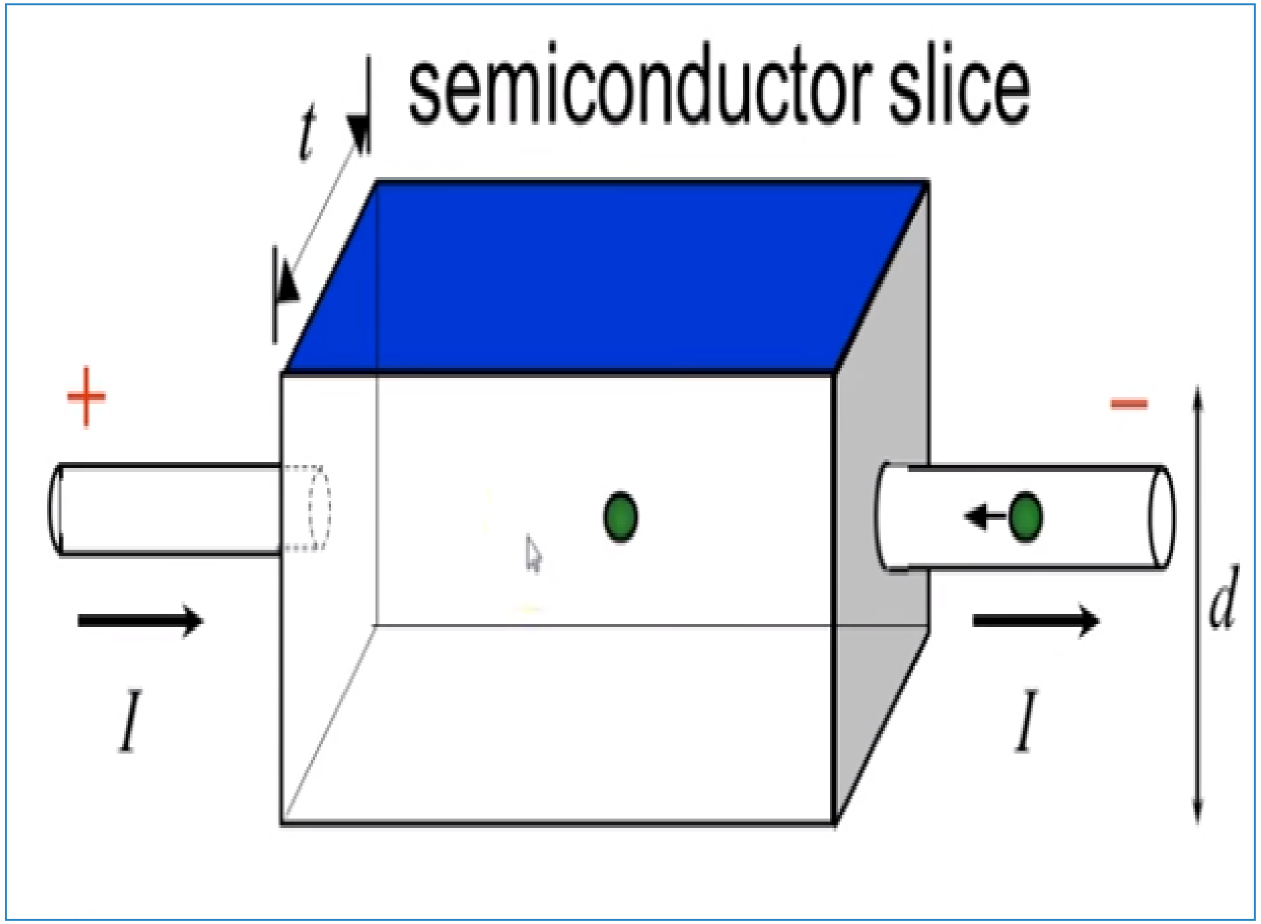
- t = thickness of the semiconductor sample.
- d = width of the semiconductor sample.
- L = Length of the semiconductor sample

Hall Effect



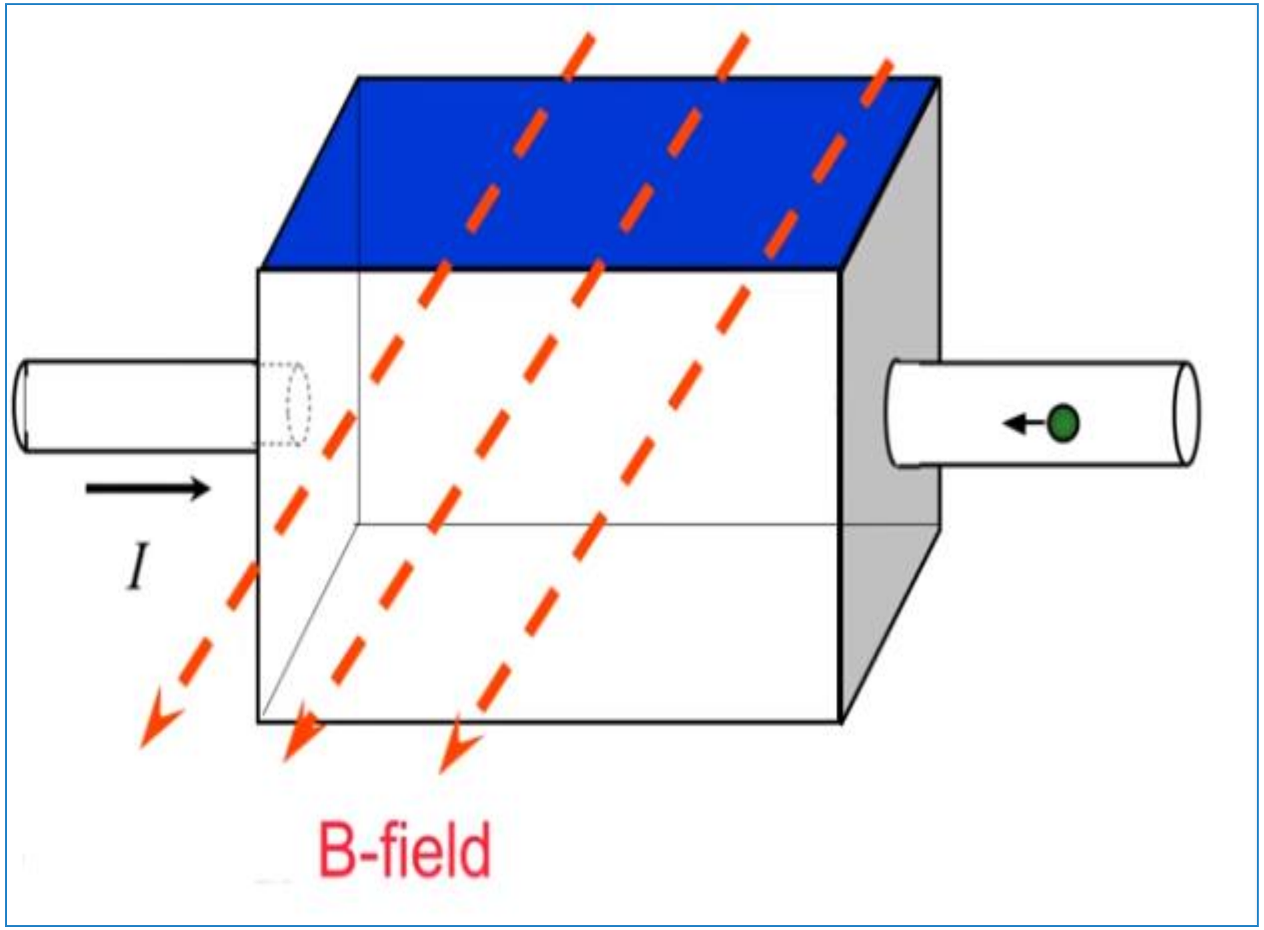
- Connecting to the battery
- The current I_x flows in ‘X’ direction

Hall Effect



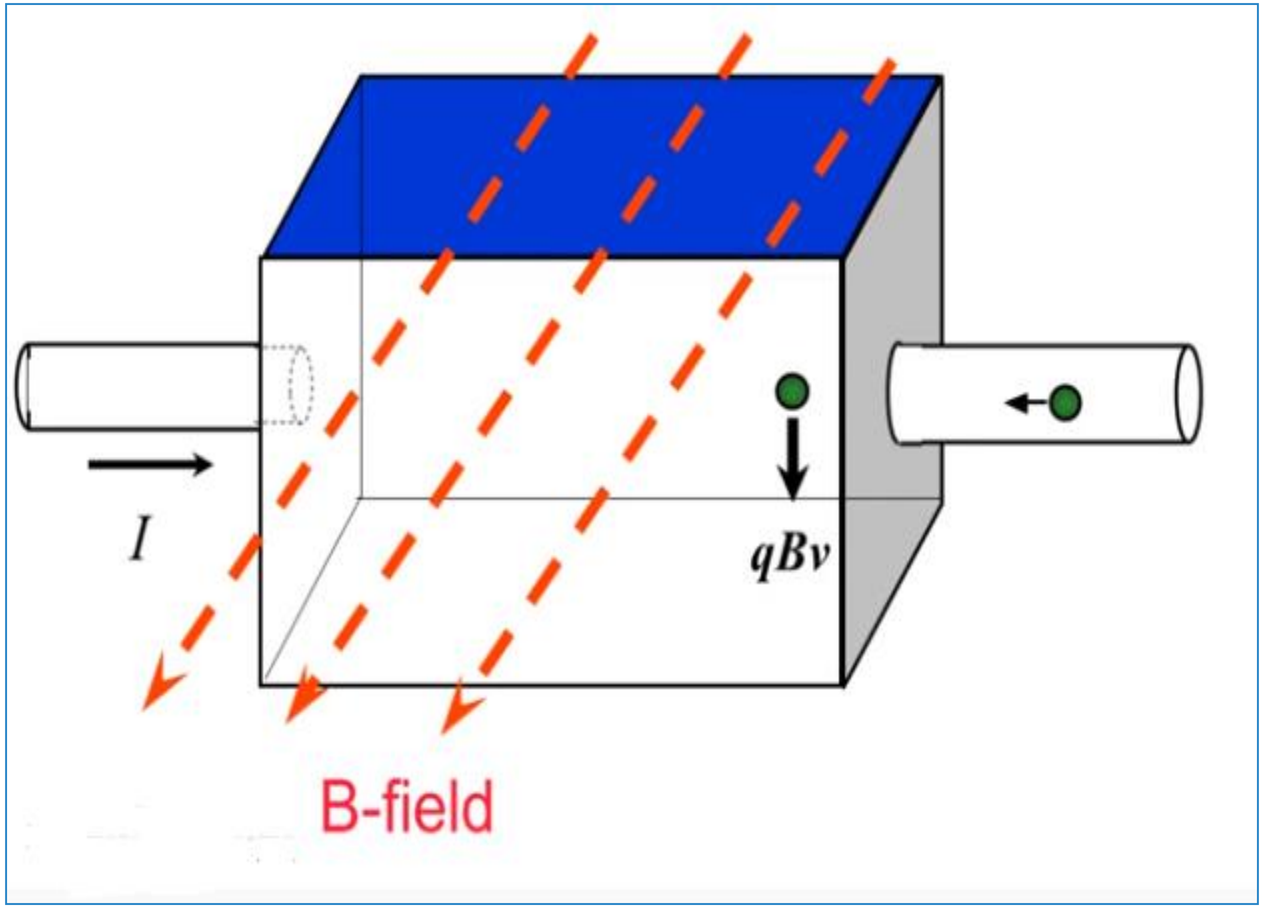
- Electrons.
- Electrons move in the opposite direction of the current

Hall Effect



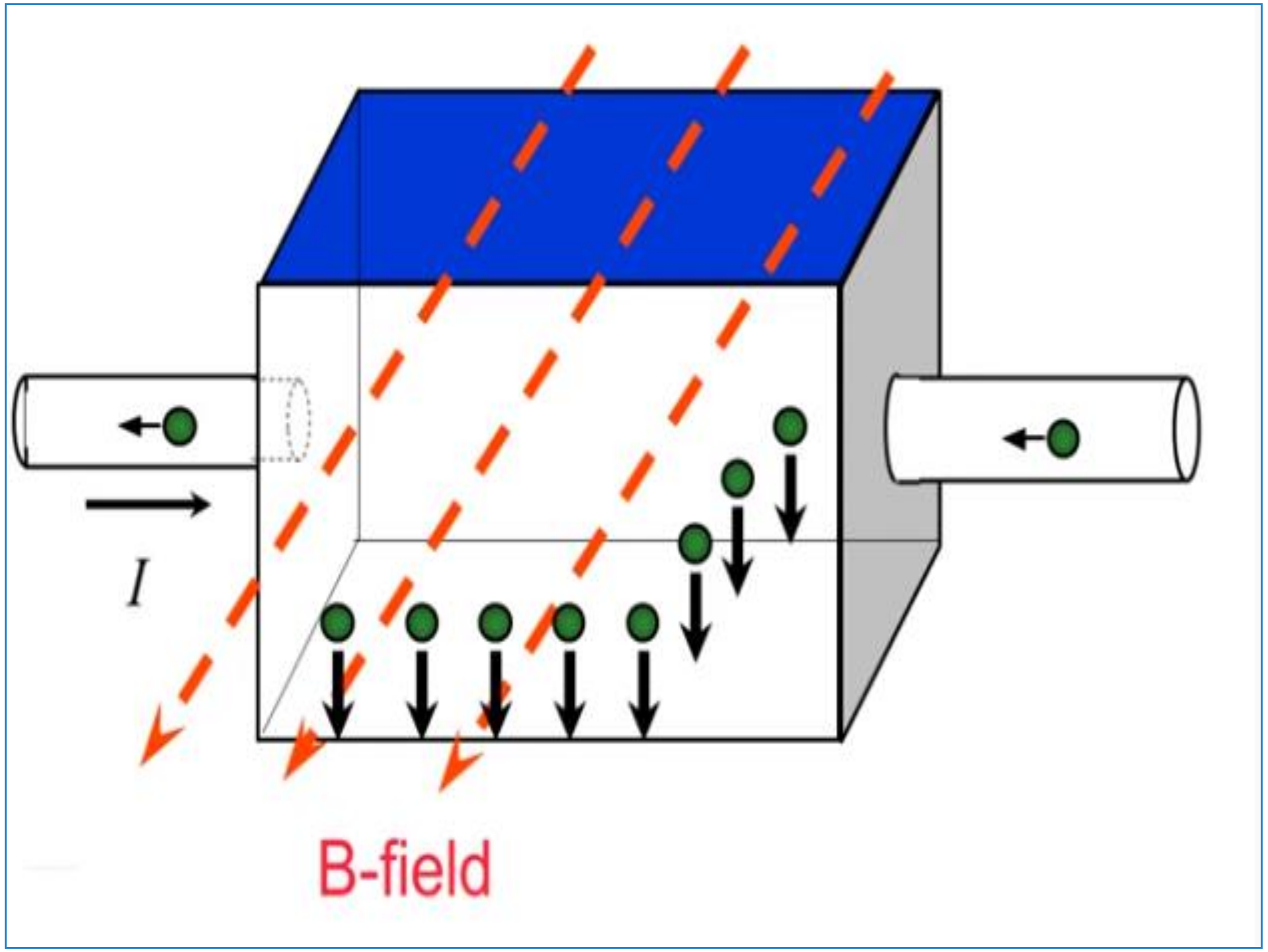
- Apply Magnetic Field (B_z) in ‘z’ direction

Hall Effect



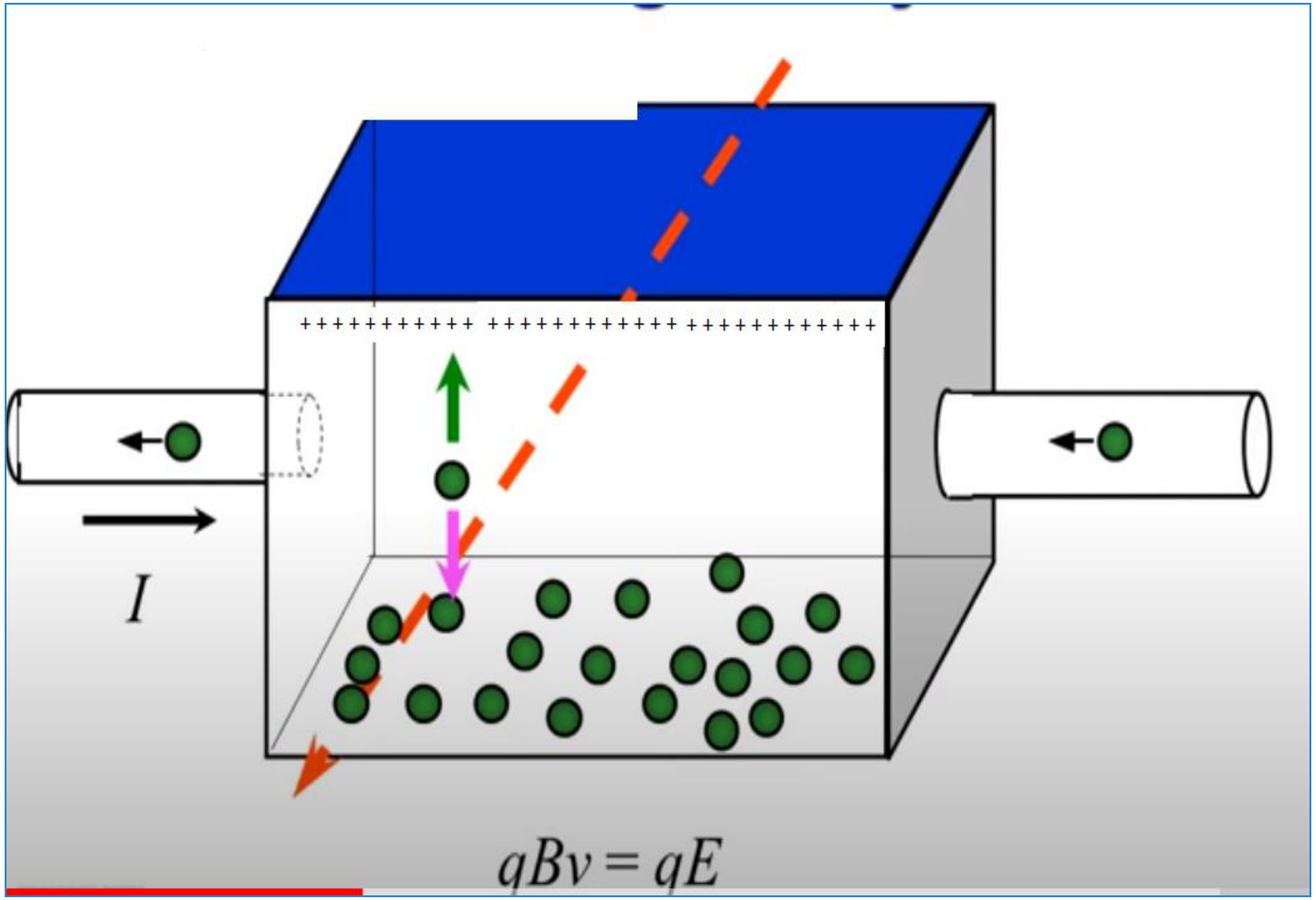
- Due to the magnetic field, the electron experience the force.
- Force = qB_zv,
- v= drift velocity
- B_z = Magnetic Field
- q = charge of electrons

Hall Effect



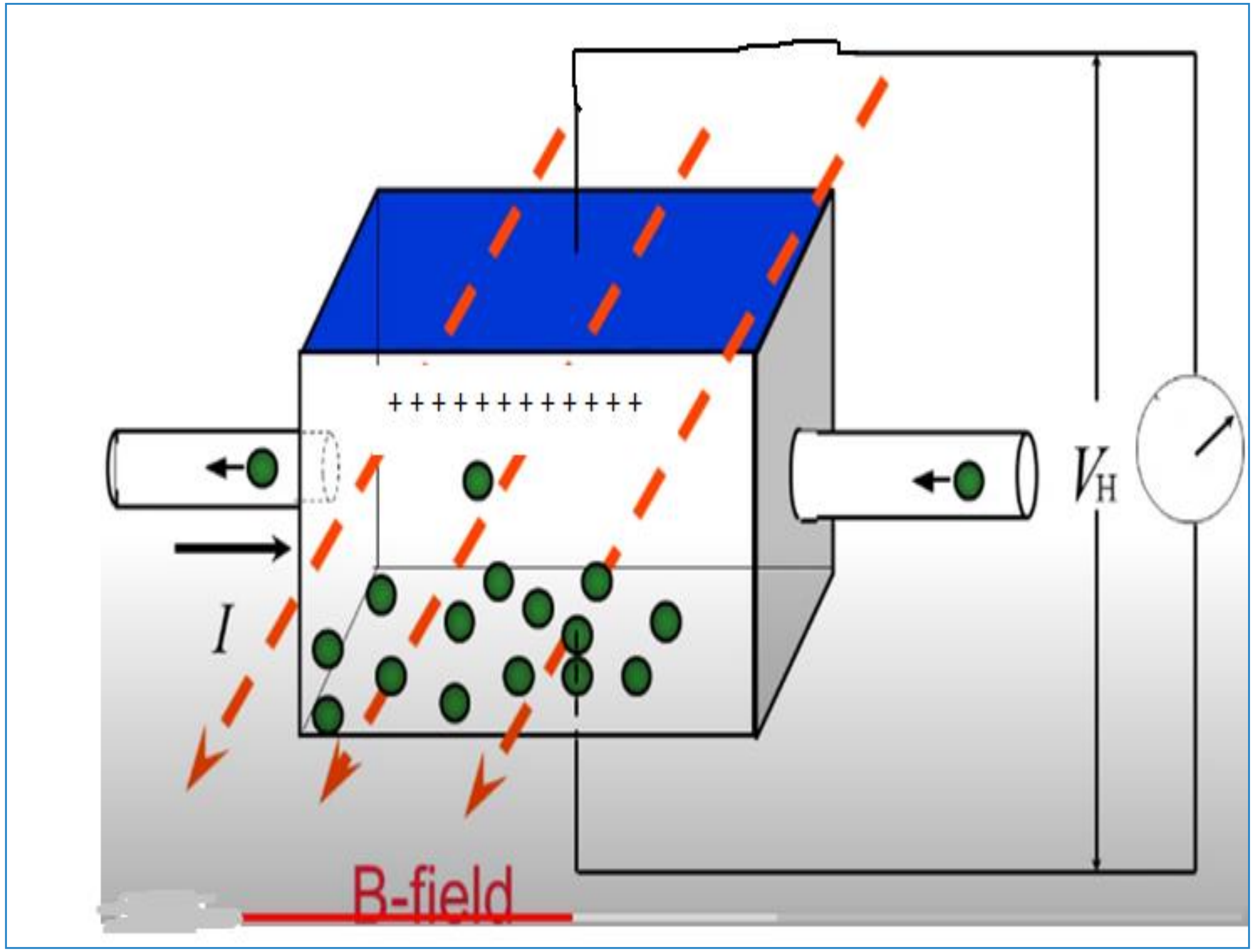
- The force is acting on the downward direction on the electrons
- Force = qB_zv.

Hall Effect



- At equilibrium the downward should be balanced by the upward force, F= qE_y
- E_y =*electric field in y direction.*
- Hence qB_zv = qE_y

Hall Effect



- The potential difference is created between the top and bottom of the semiconductor, Electric Field E_y gets induced in y direction
- If the voltmeter is connected, potential measured is called ***Hall voltage/potential V_H*** .
- If V_H = +ve voltage is created - its p type semiconductor.
- If V_H = – ve voltage is created - its n type semiconductor.

Hall Effect

- *Hall Effect –*

  If a current I_x carrying semiconductor in placed in a transverse Magnetic field B_z, then potential difference is induced in the direction perpendicular to the current and Magnetic field, that potential difference E_y is called Hall Electric Field.

Hall Effect Problem

EXAMPLE 3–8 Referring to Fig. 3-25, consider a semiconductor bar with $w = 0.1$ mm, $t = 10$ μm, and $L = 5$ mm. For $\mathscr{B} = 10$ kg in the direction shown (1 kG = 10^{-5} Wb/cm^2) and a current of 1 mA, we have $V_{AB} = -2$ mV, $V_{CD} = 100$ mV. Find the type, concentration, and mobility of the majority carrier.

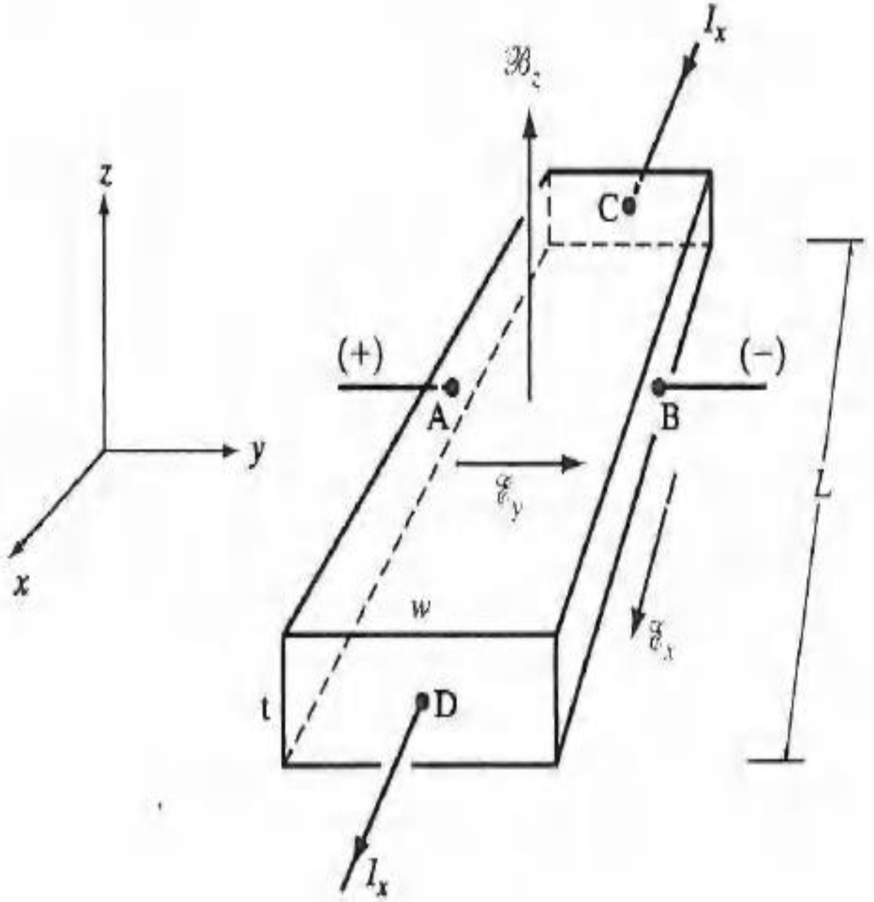
SOLUTION $\mathscr{B}_z = 10^{-4}$ Wb/cm^2

From the sign of V_{AB}, we can see that the majority carriers are electrons:

$$n_0 = \frac{I_x \mathscr{B}_z}{qt(-V_{AB})} = \frac{(10^{-3})(10^{-4})}{1.6 \times 10^{-19}(10^{-3})(2 \times 10^{-3})} = 3.125 \times 10^{17}\ \text{cm}^{-3}$$

$$\rho = \frac{R}{L/wt} = \frac{V_{CD}/I_x}{L/wt} = \frac{0.1/10^{-3}}{0.5/0.01 \times 10^{-3}} = 0.002\ \Omega \cdot \text{cm}$$

$$\mu_n = \frac{1}{\rho q n_0} = \frac{1}{(0.002)(1.6 \times 10^{-19})(3.125 \times 10^{17})} = \mathbf{10{,}000\ cm^2(V \cdot s)^{-1}}$$



Thank You

HAVE A NICE DAY