HALL EFECT IN METALS :

Hall Effect enables the charge carrier concentration and mobility to be determined by experiment. Direction of the Hall Voltage in silver indicates negative charge carriers, which is in agreement with concepts of the model of the 'free electron gas'. Limitations of this model are shown by the so called 'abnormal Hall Effect' of tungsten. The experiment carried out under identical conditions for tungsten show the Hall Voltage to have about same magnitude but opposite direction as in silver.
This can be explained by the 'Energy Band diagram'. The tungsten atom has $\ldots.5s^2\ 5p^6\ 5d^4\ 6s^2\ldots$ electronic structure. When the atoms come close together to form the solid, the close lying states 5dE and 6s broaden into bands, with s band broadening considerably more than the d band. This is because of the larger size of the s orbital. The figure schematically shows the allowed energies as a function of the interatomic distance. The number of allowed states is ten per atom in the d band and two in the s band. In tungsten there are six electrons to be shared between these two bands. The result is that at the interatomic distance in tungsten there are holes in the d band and electrons in the s band, making tungsten predominantly a hole conductor.

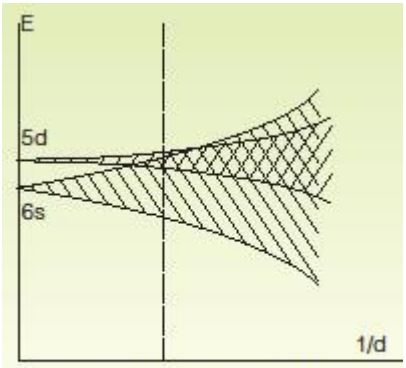

Fig.: Allowed energies as a function of interatomic distance (d)

This sort of mixed (electrons and holes) conduction is a general characteristic of transition metals. The apparatus consists of the following:

a) Hall Probe-Silver (HP-Ag)
- **Material** : Silver Strip (8 × 6 × 0.05 mm)
- **Contacts** : Press type for current
  Spring Type for Voltage
- **Hall Voltage** : ~17 µV/10A/10KG

b) Hall Probe-Tungsten (HP-W)
- **Material** : Tungsten Strip (8 × 6 × 0.05 mm)
- **Contacts** : Press type for current
  Spring Type for Voltage
- **Hall Voltage** : ~15 µV/10A/10KG

c) High Current Power Supply, Model PS-20A
- **Range** : 0-20A continuously variable
- **Accuracy** : ±0.5%
- **Regulation** : ±0.5% for ±10% variation of mains
- **Display** : 3½ digit, 7 Segment LED

d) Digital Micro voltmeter, DMV-001 (specifications as per datasheet)

e) Electromagnet, Model EMU-75T
- **Pole Pieces** : 75mm tapered to 25mm
- **Mag. Field** : 17KG ±5% at 10mm air gap
- **Energizing Coils** : Two of approx. 13Ω each
- **Power** : 0-90Vdc, 3A, for coils in series
  0-45Vdc, 6A, for coils in parallel

f) Constant Current Power Supply, Model DPS-175 (specifications as per datasheet)

g) Gauss meter, DGM-202 (specifications as per datasheet)

The experiment is complete in all respect.