

ESE112 Engineering Lab

Introduction to Electrical Circuit Theory

Electric Charge

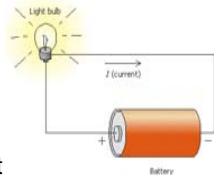
- Fundamental to all Electrical phenomena
- Is a property of atomic particles of which matter exists
 - Protons(+ve), Electrons (-ve)
- Measured in Coulombs(C)
 - $1\text{ C} = 6.2 \times 10^{18}$ charged particles

ESE112

2

Electricity

- Charges can become mobile if there is force to move them
 - Voltage (V) is the energy required to move a unit charge through an element
 - Potential difference between two points
 - Measured in Volts (V) i.e. 1 Joule/1 Coulomb
- Motion of charges creates Electric Current
 - Current is the rate of flow of charge
 - Easy to measure current than measuring charge
 - Measured in Amperes (A) i.e. 1Coulomb/1sec
 - Current flows from high-potential to low potential
 - The direction of the current is taken to be as the movement of positive charges i.e. opposite to flow of negative charges



ESE112

3

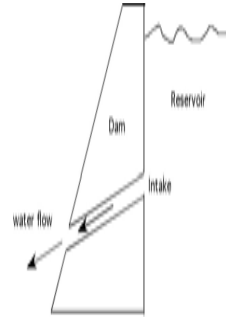
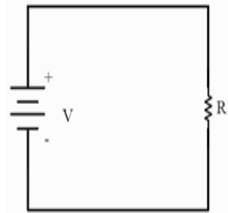
Resistance (R)

- Is the opposition to the flow of charge
- Depends on
 - Directly proportional to length of element (l)
 - Inversely proportional to cross-sectional area (A)
 - Inversely proportional to *conductivity* of the element
- Measured in Ohms (Ω)

ESE112

4

Relationship between V,I,R



Ohms Law : $V = IR$

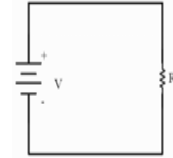
ESE112

5

Kirchoff's Electrical Laws

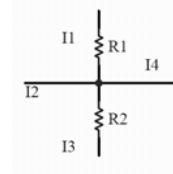
Voltage Law

- Sum of the Voltage around a closed path (or loop) is zero



Current Law

- Sum of current entering a node (or closed boundary) is zero



ESE112

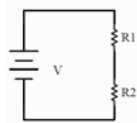
6

Resistors in Series and Parallel

Find Equivalent Resistance

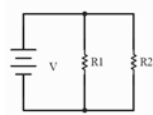
Resistors in series

- $R_{eq} = R_1 + R_2 + \dots + R_n$



Resistors in Parallel

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

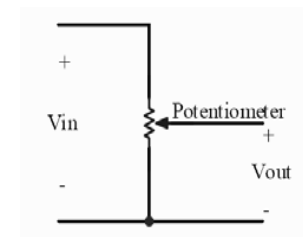
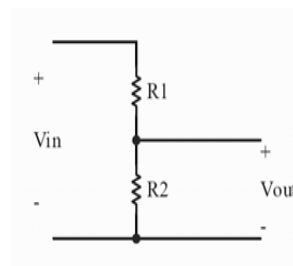


- Using KVL and KCL we can prove Series and Parallel Equivalent Resistance Equations

ESE112

7

Voltage Divider



ESE112

8

Summary of Symbols



Battery



Resistance



Variable Resistance

ESE112

9

Measuring V,I,R

- Digital Multimeter Meter (DMM) can measure V,I, R
- Voltage
 - Connect the DMM to the two points in a circuit where you want to measure voltage
- Resistance
 - Measure the across the resistor while not connected in the circuit
- Current
 - Get that current to flow through the DMM

ESE112

10

Polarity When Measuring

- Polarity is important
- Usually the terminals of the DMM will be coded to indicate polarity
 - Red terminal (positive) and a black terminal (negative)
- If you get a negative reading means that your DMM probes are reversed

ESE112

11