Network Theory (EE-203-F)

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SYLLABUS

- **SECTION-A** : Signal analysis, complex frequency, and network analysis. General characteristics and descriptions of signals, step function and associated wave forms, The unit impulse Introduction to network analysis, network elements, initial and final conditions, step and impulse response, solution of network equations,
- **SECTION-B:** Review of Laplace transforms, poles and zeroes, initial and final value theorems, The transform circuit, Thevenin's and Norton's theorems, the system function, step and impulse responses, the convolution integral. Amplitude and phase responses. Network functions, relation between port parameters, transfer functions using two port parameters, interconnection of two ports.

- **SECTION-C** : Hurwitz polynomials, positive real functions. Properties of real immittance functions, Synthesis of LC driving point immittances, Synthesis of RC driving point impedances, Synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances.
- **SECTION-D** : Properties of transfer functions, zeroes of transmission, synthesis of Y21 and Z21 with 1ὠ terminations Introduction to active network synthesis, Network Topology and Graph Theory.
- **Text Books:**
- 1. Bird - Electric Circuit theory & technology,Elsevier
- 2. Franklin F. Kuo, “Network Analysis and synthesis”, 2ndEdition, Wiley India Pvt Ltd.
- 3. D Roy Choudary, “Network and Systems” New Age International,
- **Reference Books:**
- 1. M. E. Van Valkenberg, “Network Analysis”, 2ndEdition, Prentice Hall of India Ltd.

- CLASS WORK MARKS= 50
- THEORY MARKS= 100
- DURATION OF EXAM= 3 hr

BOOKS

- K.M. Soni- Network Theory
- Nitin Sharma- Fundamental of network analysis and synthsis
- Franklin F. Kao- Network Analysis and Synthesis

Section -A

- Signal Analysis
- Complex Frequency and Network Analysis
- General Characteristics and Descriptions of signal
- Step Function and Associated Wave Forms
- The Unit Impulse
- Introduction to network analysis
- Network elements
- Initial and final conditions
- Step and Impulse response
- Solution of network equation

An electrical network

- An electrical network is a combination of network elements like resistance, capacitor and inductor.
- The input to a network is normally referred as excitation while its output is known as response.
- Network analysis deals with determining the response of the network when its excitation and network is given.

Definition

- A **conductor** is a material that current can pass through easily, like metals.
- An **insulator** is a material that current cannot pass through easily, like plastic.
- A **resistor** is a material that resists, but doesn't stop the flow of current.

Electrical Current

- Electric current is the rate of flow of charge through a conductor:

$$\bar{I} = \frac{\Delta Q}{\Delta t}.$$

The instantaneous current is given by:

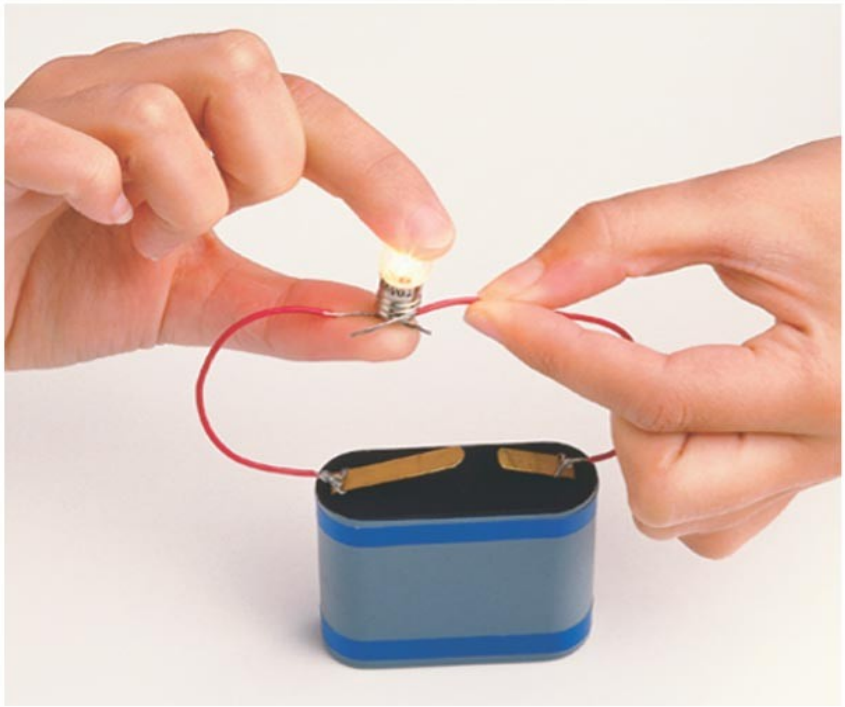
$$I = \frac{dQ}{dt}.$$

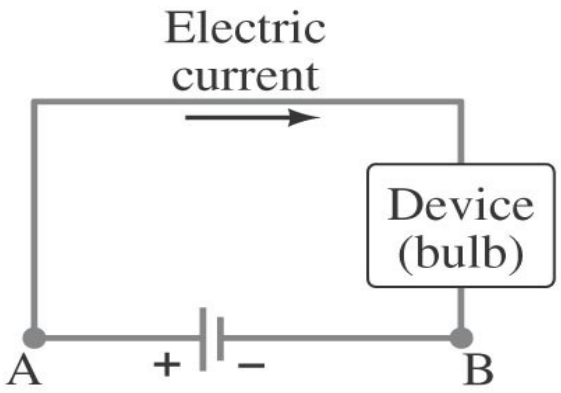
Unit of electric current: the ampere, A:

1 A = 1 C/s.

Electric Current

- A complete circuit is one where current can flow all the way around.



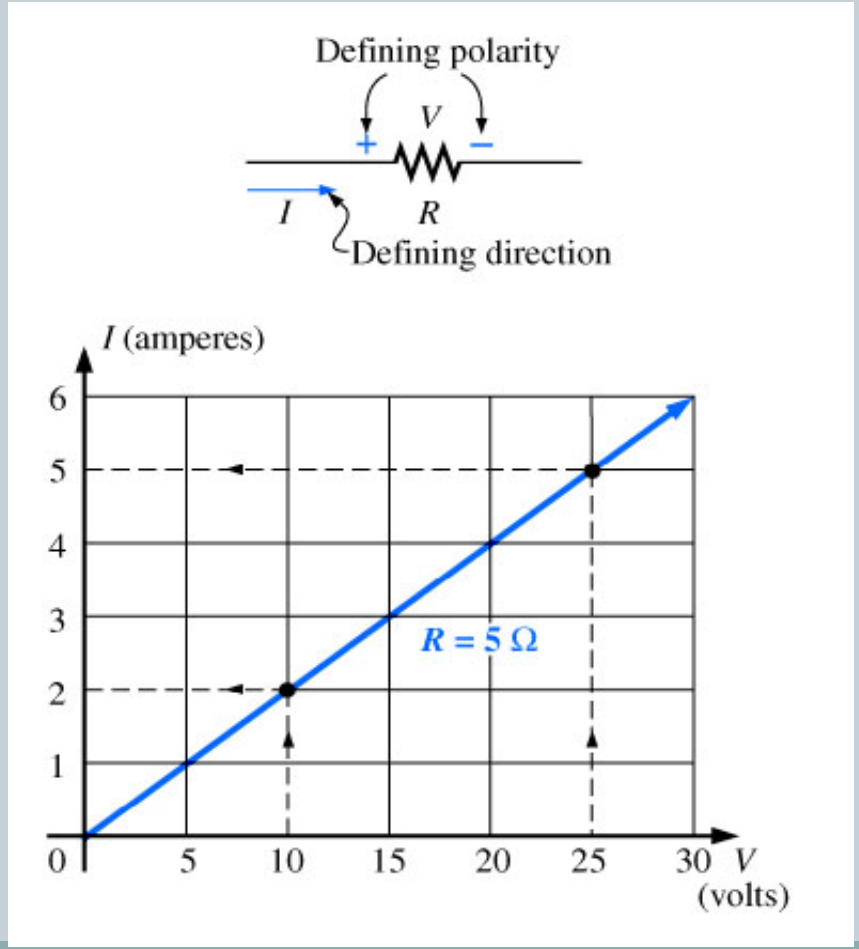


Ohm Law

- It state that the voltage across many types of conducting materials is directly proportional to the current flowing through the material

$$v = iR$$

- Where R is a constant



Resistance

- Opposition to the flow of electrons.
- It changes electrical energy into thermal energy and/or light.
- Measured in ohms.
- Conductors have less resistance than insulators.

Resistivity

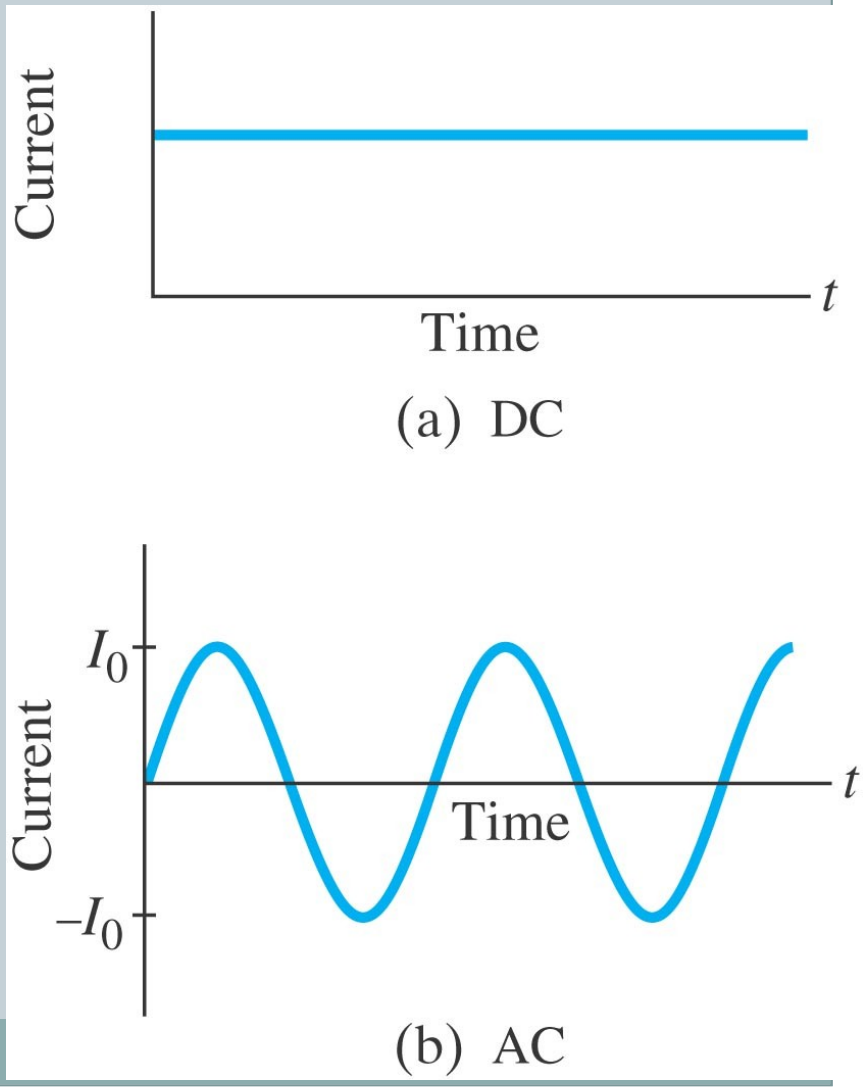
- The resistance of a wire is directly proportional to its length and inversely proportional to its cross-sectional area:

$$R = \rho \frac{\ell}{A}.$$

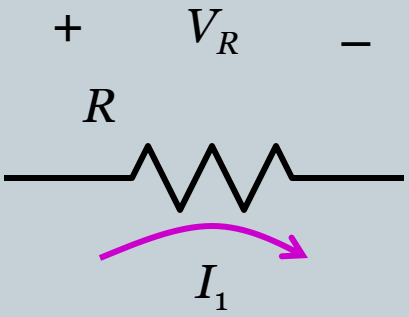
- The constant ρ, the resistivity, is characteristic of the material.

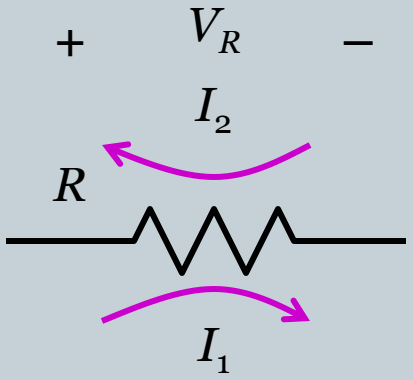
Type of supply

- Current from a battery flows steadily in one direction (direct current, DC).
- Current from a power plant varies sinusoidally (alternating current, AC).



Voltages from Mesh Currents





$$V_R = I_1 R$$

$$V_R = (I_1 - I_2) R$$

Resistance in Series

- Current will be same through all Resistors
- In series circuit, voltage drop across each is different due to its different resistance.
- Sum of Three voltage drop is equal to voltage applied
- Using KVL

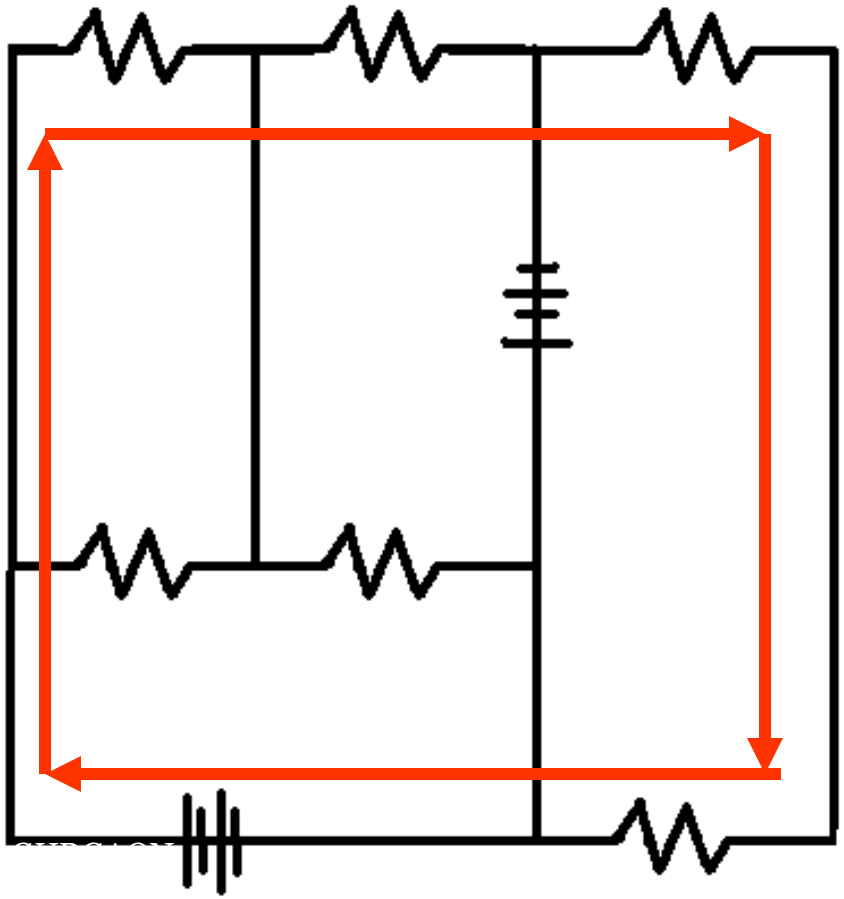
Resistance in parallel

- Potential difference across all resistance must be same.
- Current in each resistor must be different.
- Total current is the sum of all separate current

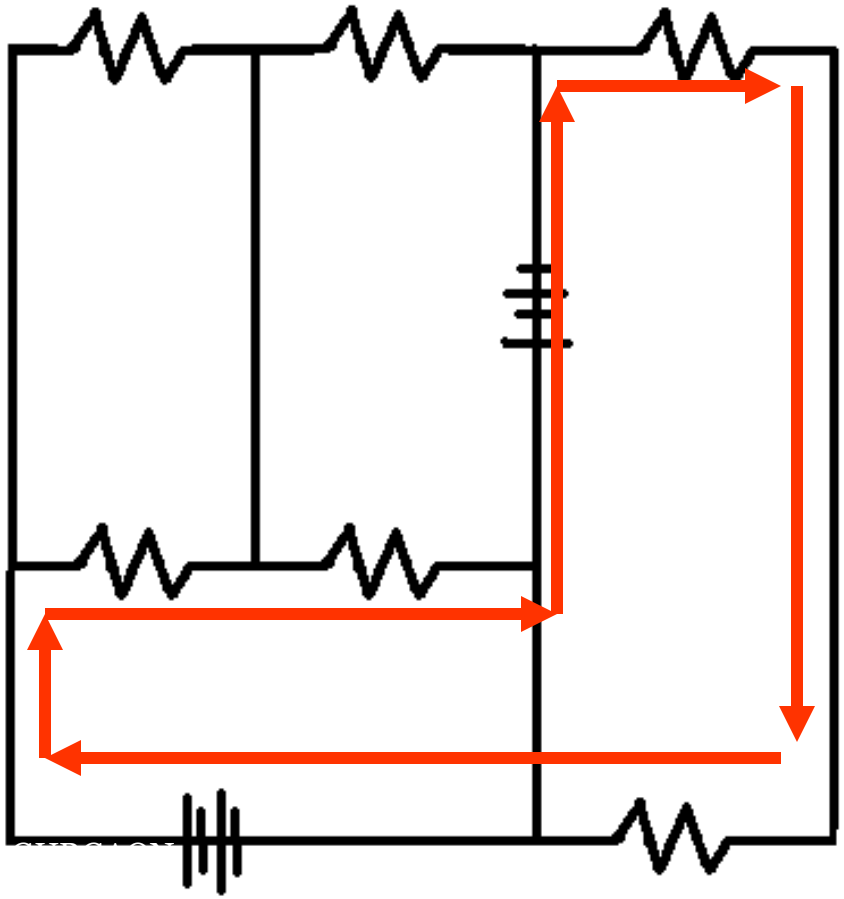
KVL (Kirchhoff's Voltage Law)

- The sum of the potential differences around a closed loop equals zero.
- Sum of the Voltage drops across resistors equals the Supply Voltage in a Loop.

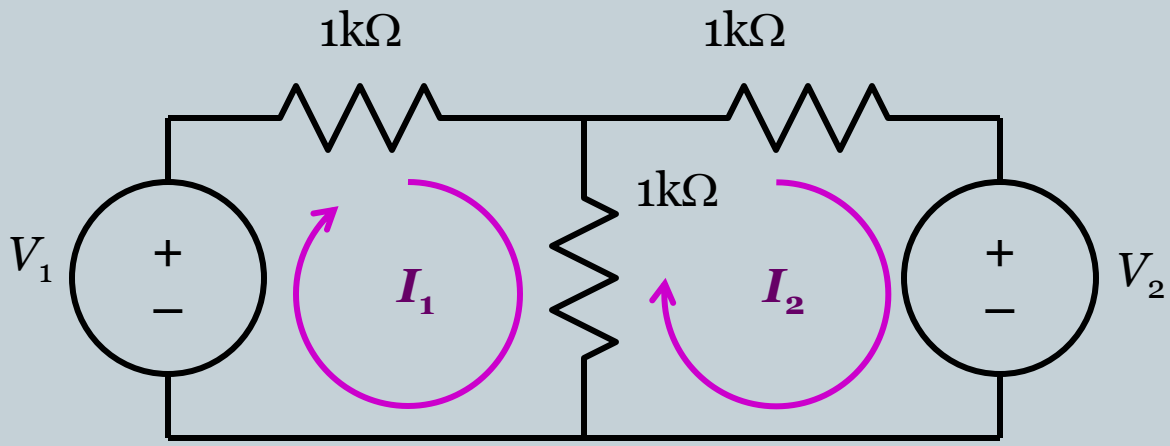
Closed Loop #3



Closed Loop #4



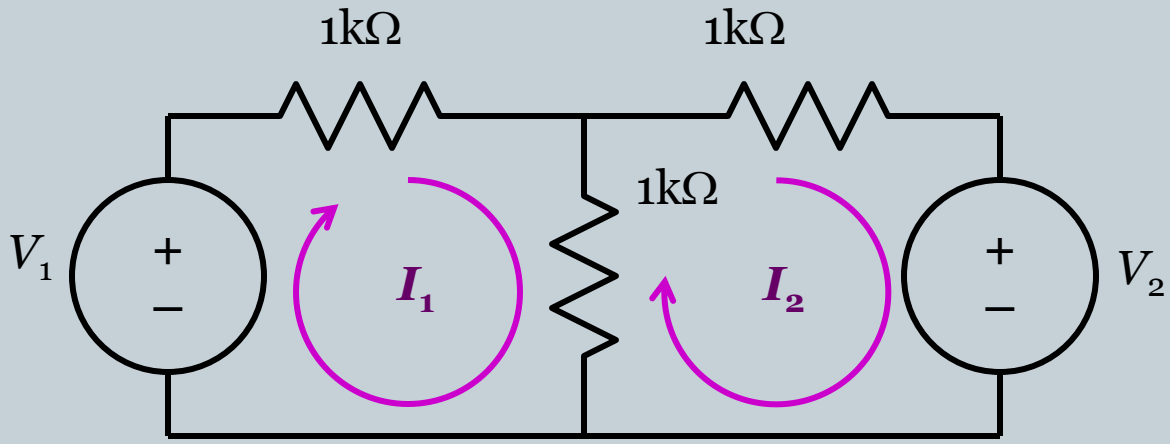
3. KVL Around Mesh 1



$$-V_1 + I_1\,1\text{k}\Omega + (I_1 - I_2)\,1\text{k}\Omega = 0$$

$$I_1\,1\text{k}\Omega + (I_1 - I_2)\,1\text{k}\Omega = V_1$$

3. KVL Around Mesh 2



$$(I_2 - I_1)\,1\text{k}\Omega + I_2\,1\text{k}\Omega + V_2 = 0$$

$$(I_2 - I_1)\,1\text{k}\Omega + I_2\,1\text{k}\Omega = -V_2$$

Assignment Question

- Solve the given circuit by Cramer's rule