Basic Electrical Science

Course Instructor: Dr. C. Vyjayanthi
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NIT Goa

Subject Code: EE151	**Basic Electrical Science**	Credits: 3 (3-0-0) Total hours: 45

Module 1	**DC circuit Analysis**

Review of circuit elements, Voltage sources, Current sources, Ohm’s Law, Kirchoff’s Laws, Mesh and Node analysis of DC circuits, Source transformation, Star-Delta Transformation, Network theorems, Time domain analysis of RC, RL, RLC with DC excitation.

Module 2	**Magnetic circuit Analysis and AC circuit Analysis**

Electromagnetic Induction, Self and mutual inductances, Magnetic circuits. Fundamentals of A.C, Average and RMS values, Form and Peak factor, Concept of Phasors, Complex operator, Network theorems, Basic concepts of three phase circuits.

Module 3	**Semiconductor Devices and Circuits**

P-N junction diode, Characteristics, Diode approximations, DC load line, AC equivalent circuits, Zener diodes Half-wave diode rectifier and Full-wave diode rectifier, Shunt capacitor filter, Ripple factor - Approximate analysis of capacitor filters, Power supply performance, Voltage regulators; Bipolar Junction transistor, Characteristics, DC Load line and Bias Point, Biasing circuit design, Amplifiers.

Module 4	**Elements of Digital Electronics**

Analog and Digital Signals, Introduction to Digital Electronics, Digital Logic Gates. Introduction to memory elements, SRAM, DRAM, ROM, PROM, EPROM, EEPROM.

Text/Reference Books

Chapter 1 and 2

1. ***Engineering Circuit Analysis,*** William Hayt and Jack Kemmerly, 8th Edition
2. ***Network Analysis***, Van Valkenburg, 3rd Edition
3. ***Electric Circuits***, Schaum's Outline Series

Chapter 3

4. ***Electronic Devices and Circuit***, Boylestad and Nashelsky

Chapter 4

5. Digital Design, Morris Mano , 6th Edition

Assessment Process

- ✓ 50 Marks – Minor (VIVA exams) + Assignments + A presentation on an Electrical Appliance (25% weightage)
- ✓ 50 Marks – Mid Exam (25% weightage)
- ✓ 100 Marks – End Exam (50% weightage)

Evolution of Electrical Systems

- 1870s – Commercial use of electricity
- 1882 – First electrical DC power system by Edison
  (New York, 59 customers, 1.5 km radius)
- 1884 – Motors were developed
- 1886 – Limitations of DC became prominent
- 1888 – Nicolas Tesla developed Polyphase systems
- 1889 – First AC transmission System (1ϕ)
- WAR OF CURRENTS
- AC Won Over DC
- 1893- 3ϕ, 2.3 kV, 12 km Distribution network (California)

- 165 kV-> 220 kV-> 330kV-> 500 kV->765kV->1100 kV
- 25 Hz, 50 Hz, 60 Hz, 125 Hz,133 Hz
- Standardized Voltages and frequency
- V-> 3.3,6.6, 11,33,66,110,132,220,400,765,800,1200 kV
- Freq -> 50 Hz (Europe, Asia, others)\ 60Hz (USA, others)
- Electronics Started Emerging
- Mercury Valves - > Transistors -> Thyristors -> IGBTs…..
- 1954 – First HVDC Transmission
- WAR OF CURRENTS – Once Again from 2010 onwards
- **Should we go for AC or DC In Transmission and Distribution Level ??**

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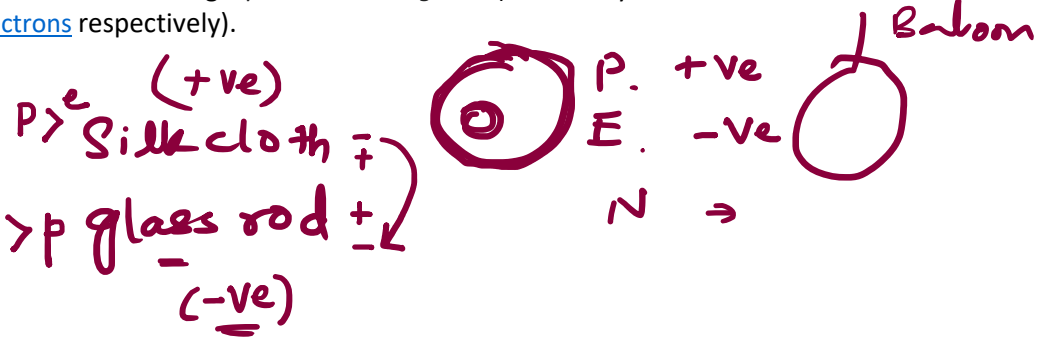
1. **Electric Charge :**
   - **Electric charge** is the physical property of matter that causes it to experience a force when placed in an electromagnetic field.
   - There are two types of electric charge: *positive* and *negative* (commonly carried by protons and electrons respectively).
2. **Current:**
3. **Voltage**
4. **Magnetic Field**
5. **Electric Field**



Type of Electricity

Static :- Friction ⇒ it cannot be transferred in bulk.

Dynamic : $\frac{dq}{dt}$ ⇒ current → Transferred ↓ in bulk & long distance

Unit of charge : Coloumb [C] charles coloumb

Charge of an e^- = -1.602×10^{-19} C

Charge of an proton = $+1.602 \times 10^{-19}$ C

1 coloumb of charge flow = $\frac{1}{1.602 \times 10^{-19}} = 6.24 \times 10^{18}$ e^-

1 coloumb of charge flow = $\frac{1}{1.602 \times 10^{-19}} = 6.24 \times 10^{18}$ e

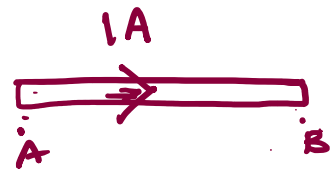
A. Very large capacitor => 0.5 coloumb of charge

Scalar	Vector
Magnitude	Magnitude
	Direction
V,	$\hat{v}$, $\tilde{V}$

Current : charge in motion

current → rate at which charge is moving past a given reference point.

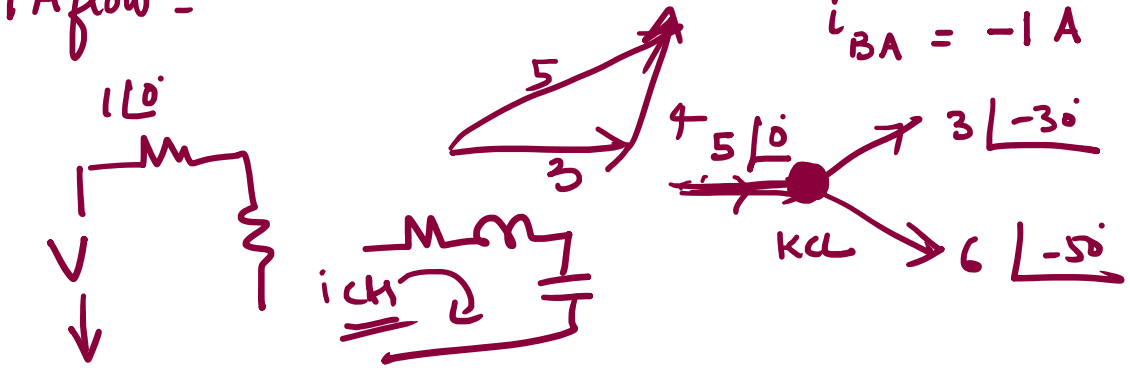
$i = \frac{dq}{dt} = 1A = \frac{1 \text{ Colomb}}{1 \text{ sec}}$



$i_{AB} = 1A$

$i_{BA} = -1A$

1A flow =



1 A flow = 6.24×10^{18} electrons flow

1 A flow = $\frac{6.24 \times 10}{1 \text{ Sec}}$ electrons flow

Conductors: Free movement of e^-

Conductor →

Insulator → Plastic, Rubber, Wood, Mica, Glass, Asbestoes

Semi-Conductor → Germanium & Silicon
Arsenic

Super Conductivity :- -273° C or 0°k