Experiment 1: Study of Electronic Components and Electronic Measurement Devices

Basic Points:

Electronics: Mechanics of electron

There are 4 main type of analyses:
- DC analysis
- DC Operating Point analysis
- Transient analysis
- AC analysis

Ohm's Law: Current is directly proportional to the voltage and constant of proportionality is 1/R under constant temperature and pressure conditions. $\boxed{I = \dfrac{V}{R}}$

Limitation of KCL:
- Only applied when electric charge in the circuit is constant
- Not applicable for high frequency AC circuits
- Not applicable for non-conservative circuits

Limitation of KVL:
- Only applied when magnetic fields do not change
- Not applicable for high frequency AC circuits
- Not applicable for non-conservative circuits

Passive Devices: (Require no additional power source)

1) Resistor:

- Regulate or set the flow of electrons (current) through them.
- Electrical energy is lost in the form of heat in resistor.
- Resistors can be connected together in series or parallel combinations.
- Resistors are used as voltage droppers, voltage dividers and current limiters in the circuit.

$$I = \frac{V}{R}$$, Resistance(R) is measured in ohms(Ω).

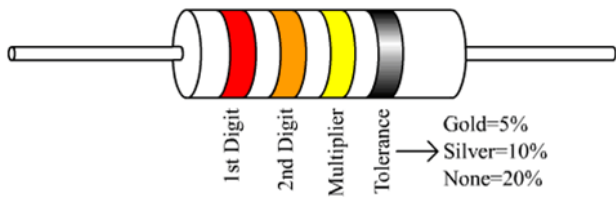Symbol in circuit: —\/\/\/— —☐—

Types of resistors:
- Carbon Composition Resistor
- Film or Cermet Resistor
- Wire – wound Resistor
- Semiconductor Resistor

Colour coding:
- 4 bands
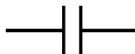- 5 bands
- 6 bands

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

Gold=5%
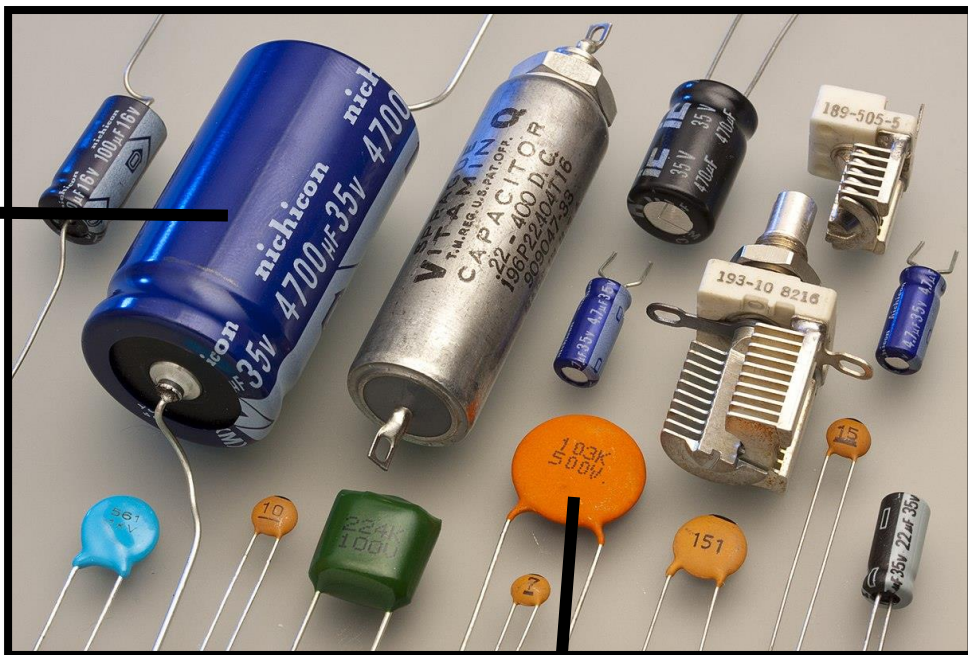Silver=10%
None=20%

2) Capacitor:

- Stores energy in the form of an electrical charge producing a potential difference across its plates.
- It consists of 2 or more parallel plates which are electrically separated by air or a good insulating material. This insulating layer is called the Dielectric.
- $C = \dfrac{\varepsilon A}{d}$, Capacitance(C) is measured in Farads(F).

Symbol in circuit: ——| |——

Type of capacitors:
- Electrolyte Capacitors
- Ceramic Capacitors

Electrolyte
Capacitor

391	102	472	103	333	104	474	105
$39 \cdot 10^1$	$10 \cdot 10^2$	$47 \cdot 10^2$	$10 \cdot 10^3$	$33 \cdot 10^3$	$10 \cdot 10^4$	$47 \cdot 10^4$	$10 \cdot 10^5$
$= 390p$	$= 1n$	$= 4n7$	$= 10n$	$= 33n$	$= 100n$	$= 470n$	$= 1\,\mu F$

3) Inductor:

- Inductor stores energy in a magnetic field when electric current flows through it.
- It consists of an insulated wire wound into a coil.
- Inductance is ratio of the voltage to the rate of change of current.
- $L = \dfrac{V}{\frac{I}{t}}$, Inductance (L) is measured in Henry(H) or weber/ampere\

Symbol in circuit:
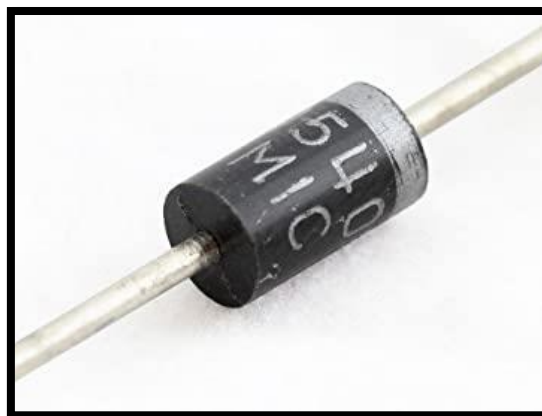
Active Devices:

1) Diode:

- Diode allows the flow of current in only one direction.
- Most common type is the *p-n* junction diode. It has two poles: P - black (+ve) and N - white (-ve)

Symbol in circuit:

Anode (+) ▶︎ Cathode (-)

Zener Diode: (Breakdown diode)

- It is a semiconductor device that is designed to operate in the reverse direction.
- Zener Effect: When the voltage across the terminals of a Zener diode is reversed and the potential reaches the Zener Voltage, the junction breaks down and the current flows in the reverse direction.
- There are two types of breakdowns for a Zener Diode:
   - Avalanche Breakdown
    - Zener Breakdown

2) Transistor:

- It is a semiconductor device.
- Can be used as an amplifier, switch or an oscillator
- It is 3 terminals 2 port system

Breadboard:

- Breadboard used to connect electrical components.
- They are generally used for testing new circuits.
- The Horizontal holes at the top and bottom are internally horizontally shorted. The holes in the middle are shorted vertically internally.
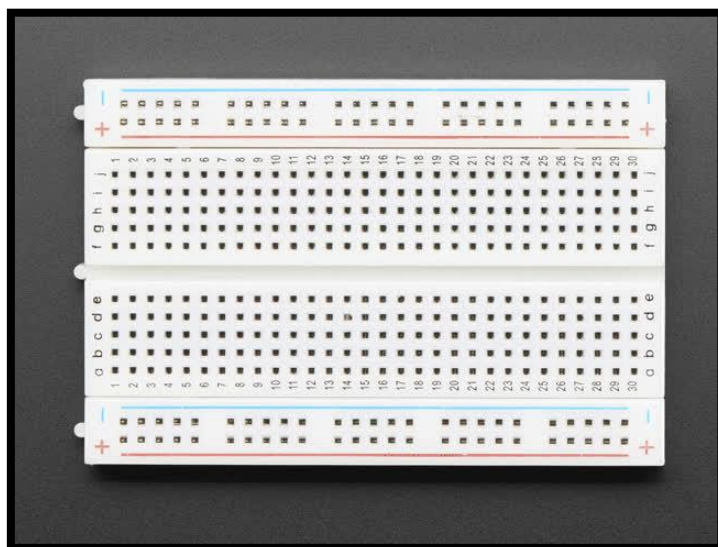
Decade Boxes:

They utilise a series of internal resistors, capacitors, or inductors to replicate specific electrical values in an application.

Decade Resistance Box

Decade Capacitance Box (µF)


Decade Inductance Box (mH)

Multimeter:

A multimeter is a measuring instrument that can measure multiple electrical properties like Voltage, Resistance, Diode (sound), Capacitance, Frequency, Temp, Gain (hFE), Current (µA, mA, A)

Cathode Ray Oscilloscope (CRO):

- It is an electronic test instrument
- It is used to obtain waveforms when the different input signals are given.
- By seeing the waveform, we can analyse some properties like amplitude, frequency, rise time, distortion, time interval.
- On adding capacitor to it will show ellipse graph. it is connected to function generator.
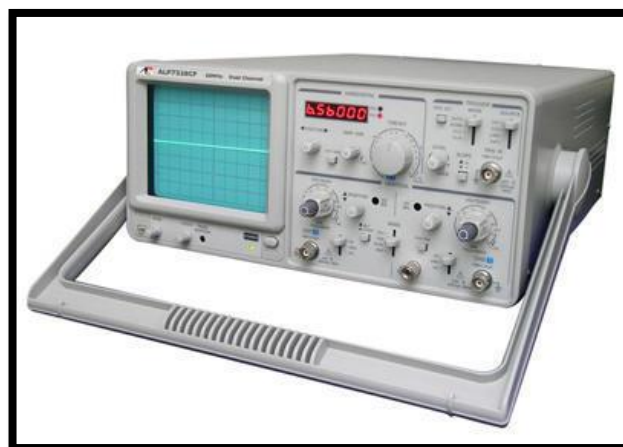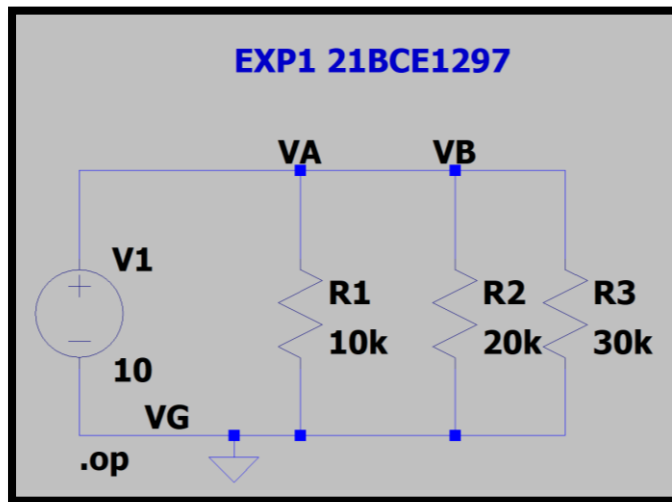
Power supply:

- It supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to voltage, current, and frequency needed to power the load.
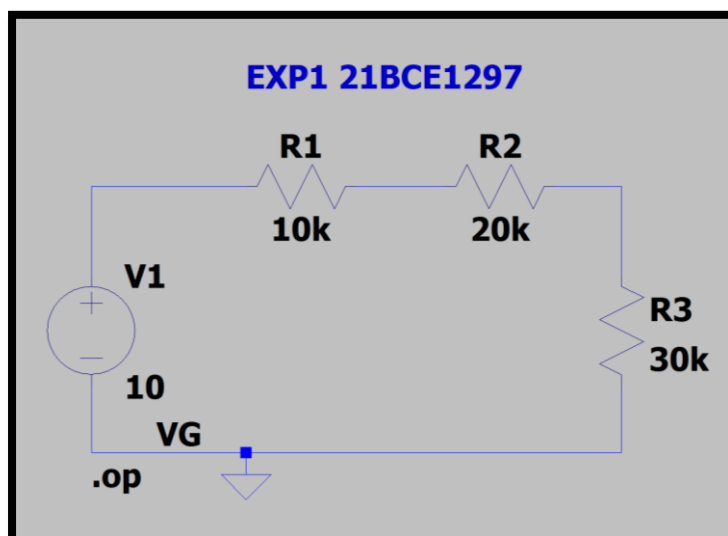
LTSpice:

EXP1 21BCE1297


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* C:\Users\Vidhi Shah\Desktop\VITC Sem 1\Assignments\EEE Lab\FAT\Draft1.asc
         --- Operating Point ---

V(vb):          10              voltage
I(R3):          0.000333333     device_current
I(R2):          0.0005          device_current
I(R1):          0.001           device_current
I(V1):          -0.00183333     device_current
```


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* C:\Users\Vidhi Shah\Desktop\VITC Sem 1\Assignments\EEE Lab\FAT\Draft1.asc
         --- Operating Point ---

V(n001):        10              voltage
V(n002):        8.33333         voltage
V(n003):        5               voltage
I(R3):          0.000166667     device_current
I(R2):          -0.000166667    device_current
I(R1):          -0.000166667    device_current
I(V1):          -0.000166667    device_current
```