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BRANCH: BTECH - CSE AND SPEC IN AI/ML – VIT CHENNAI

BECE101P_SLOT-L5+L6_EXPERIMENT – 01

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AIM: To study basic electronic components, sources and measuring equipment. To identify, mark the terminal and find the value of a particular components from the given group of electronic components, Study of electronic measurement devices (Multi-meter, DSO and function generator etc.)

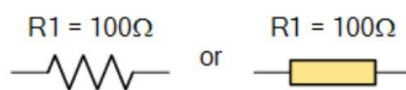
SOFTWARE REQUIRED: We don't use any software here, as all are hardware equipment that we have study, understand and label. We are just studying and understanding the apparatus and equipment in our lab, to understand what they do and how they operate (labelling also).

- But we can use all of the equipment below in LTSPICE SOFTWARE for the experiments we do further in our lab course.

APPARATUS: Resistors of different types (ranging of different values with colour coding, variable resistance, rheostat), Capacitors (ranging of different values, spherical or plates, ceramic and electrolytic), inductors of different types, signal (function) generator, multi-meter, digital storage oscilloscope (DSO), decade resistance box, decade capacitance box and decade inductance box.

THEORY:

1. Resistor:



- These are passive devices, required no additional power source.
- Regulates flow of electrons through it.
- Electrical energy is lost in the form of heat.
- Networks of series or parallel.
- This results in resistors as voltage droppers, voltage dividers or current limiters within a circuit.
- Types - Carbon Composition Resistor, Film or Cermet Resistor, Wire-wound Resistor, Semiconductor Resistor

Resistor Colour coding: bands of various colour show the user the values regarding the resistor, there is method to understand and indicate the various attributes of the resistor.

There are 4bands, 5bands, and 6bands indication.

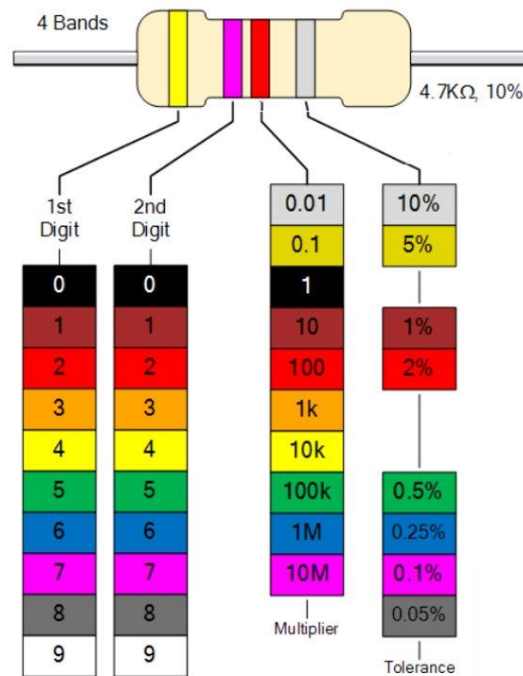
4 band basics:

Band1 -> 1st digit

Band2 -> 2nd digit

Band3 -> Multiplier

Band4 -> Tolerance



Example: 1st band -> yellow

2nd band -> violet

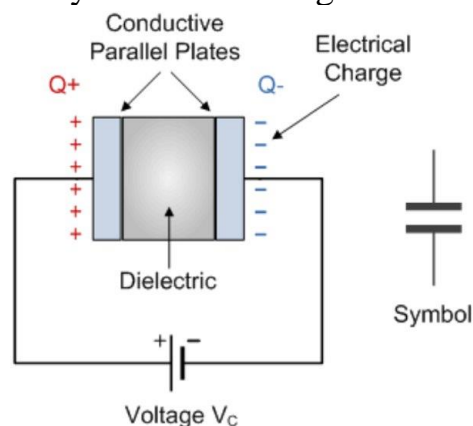
3rd band -> red

4th band -> silver (10% tolerance)

RESISTANCE: 4700 +/- 10%

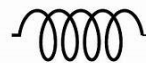
2. Capacitor:

- Component which has the ability or “capacity” to store energy in the form of an electrical charge producing a potential difference (*Static Voltage*) across its plates, much like a small rechargeable battery.
- It consists of 2 or more electrically conductive plates separated by a small length which are separated by air or insulating material called dielectric.



- The property of capacitor to store charge on its plates in the form of electrostatic field is called as capacitance. $C = EA/d$, E is permittivity
 $E = E_0 * E_r$ where $E_0 = 8.854 * 10^{-12}$ and E_r is relative permittivity
- General units in Micro, Nano or Pico Farads
- There are electrolytic (e.g. $4700\mu F, 35V$) and ceramic (e.g. $103 \rightarrow 10 * 10^3 pF$)

3. Inductor: also called coil or chock or reactor, is a passive 2 terminal electrical component that energy in a magnetic field when electrical field flows through it.
- An inductor typically consists of an insulated wire wound into a coil.



- An inductor is characterised by inductance(H-henry), given by the ratio of voltage by the rate of change of current.
- In the measurement of magnetic circuits, it is equivalent to weber/ampere.
- Inductors have values that typically range from $1 \mu H$ ($10^{-6} H$) to $20 H$.
- Many inductors have a magnetic core made of iron or ferrite inside the coil, which serves to increase the magnetic field and thus the inductance.

4. Decade Resistance box($k\Omega$), Decade Capacitance box(μF), Decade Inductance box(mH or μH OR H): apparatus looking like box to apply a large(or specific) and accurate resistance, capacitance, inductance that has large range of values that can be applied.





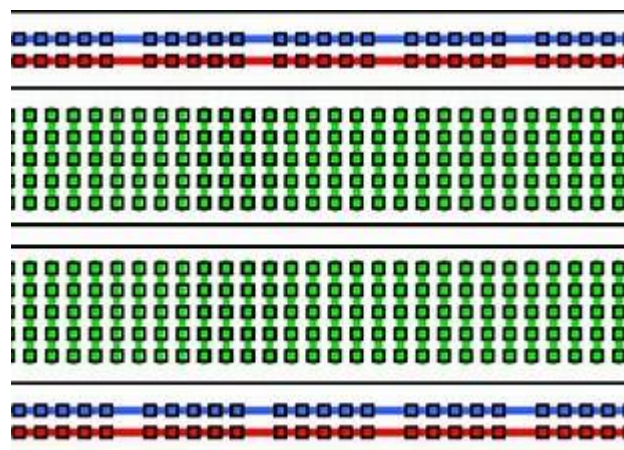
To apply some value of resistance like 1111Ω , we put the dial for $k\Omega$ at 1, dial for 100Ω at 1, dial for 10Ω at 1 and for 1Ω at 1. That is the way use all of the decade boxes for all of these passive elements in a circuit.

5. Oscilloscope:



- An oscilloscope is a device that allows you to see how voltage changes over time by displaying a waveform of electronic signals.
- On the left side, we can see the waveforms on the screen like sin, cos, square etc.
- The dials on top are used for position, level in horizontal and vertical axis.
- Below that, we have dials for adjustment of voltage->y-axis and time->x-axis.
- The trigger source and related setting on the bottom right corner.
- The intensity and focus setting dials on the right side to the screen.

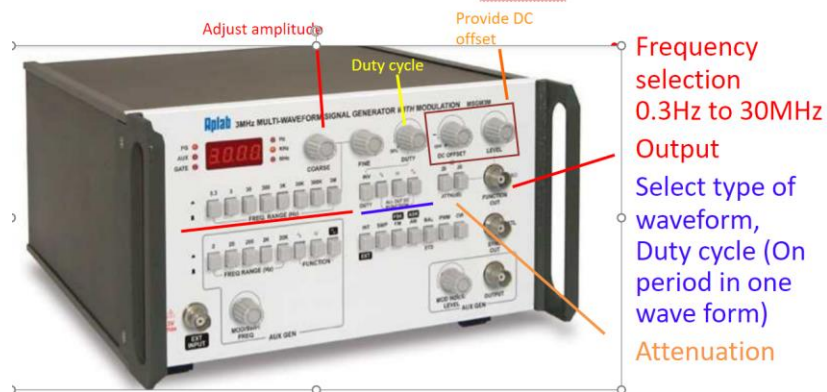
6. Breadboard: used for prototyping an electronic circuit. It has internal connections made in it. Easily can be used for connections to devices, supply or ground.



- The internal connections are shown in the figure above.

7. Signal Generator (up to 30MHz):

- An electronic device or instrument that generates continuous and discrete signals like analog and digital is known as a signal generator. These systems are mainly used for testing, signal tracing, debugging, troubleshooting, amplifier response adjustment, etc.



- In the above figure, we can also see the various dials and buttons used for adjusting various attributes of the signal generator. It applies different waveforms with different amplitudes, frequency, dc offset and duty cycle.
- The signal generator and the oscillator are almost the same except for the main difference the signal generator is capable of modulating its sinusoidal signals with other signals as well.
- Attenuators weaken or attenuate the high-level output of a signal generator, for example, to provide a lower-level signal for something like the antenna input of a sensitive radio receiver. The attenuator could be built into the signal generator, or be a stand-alone device.
- With main output, we have aux generator (up to 20KHz) type: Sine, ramp, square etc.
- With main output and aux generator we perform modulation (AM, FM etc.).
- We can observe the given figure and understand all the labelling.

8. Multi-meter: an instrument designed to measure electric current, voltage, and usually resistance, typically over several ranges of value.

It has 3 parts: display, selection knob, ports.

The display usually has four digits and the ability to display a negative sign. A few multi-meters have illuminated displays for better viewing in low light situations.

The selection knob allows the user to set the multi-meter to read different things such as milliamps (mA) of current, voltage (V) and resistance (Ω).

Two probes are plugged into two of the ports on the front of the unit. COM stands for common and is almost always connected to Ground or '-' of a circuit. The COM probe is conventionally black but there is no difference between the red probe and black probe other than colour. The V Ω Hz port is used to measure Voltage/Impedance/Frequency. The A port is used to measure current upto 20 A and the mA port is used to measure current upto 500 mA. There are also buttons such as Range, Reset, Hold value and Check Duty Cycle.

1.11 Multimeter

OFF, Voltage, Resistance, Diode(sound),
Capacitance, Frequency, Temp,
Gain(hFE), Current (μA , mA, A)

One cable in Common

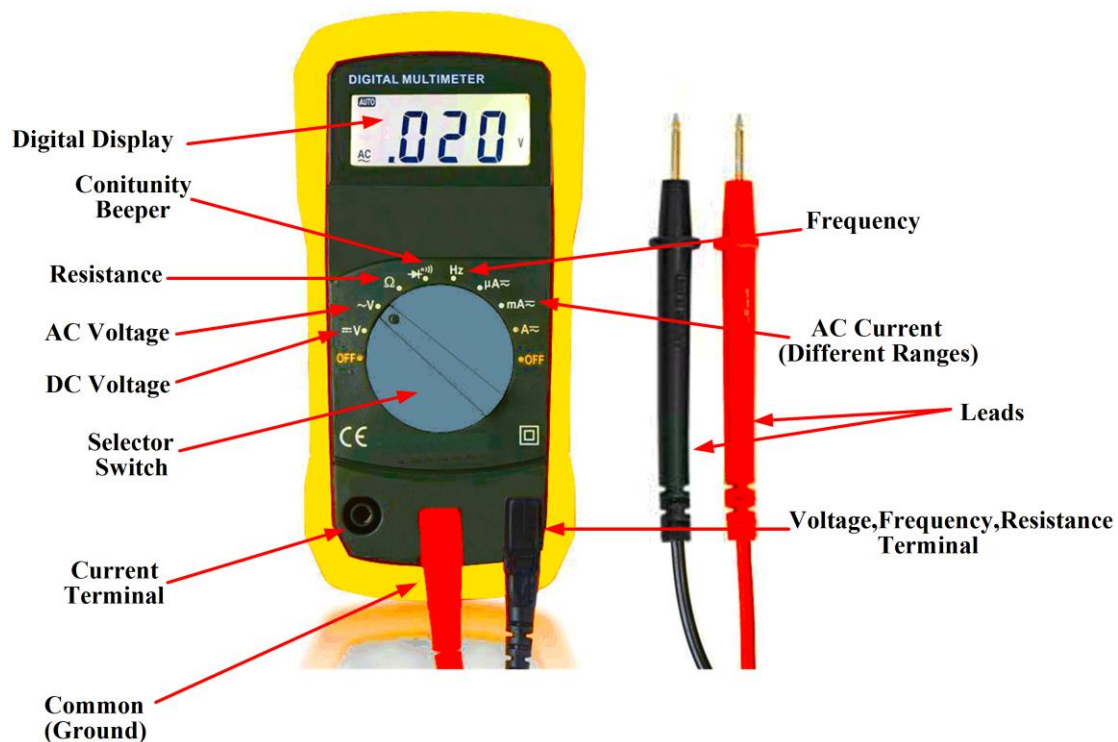
For Voltage/Impedance/Frequency
measurement,
test probe:

For current - upto 20A

For current - upto 500mA



- Above is given the labelling of all the buttons and things we can use for measuring, setting or adjusting different attributes.
- The circular dial on top right below the screen is for transistor check e.g., PNP and NPN check.
- Just below the screen, there is reset, adjust range, hold values, check duty cycle and reload.
- Another figured labelling of the digital multi-meter below,



RESULT: We were able to study basic electronic components, sources and measuring equipment like resistors, capacitors, inductors, signal generator, DSO, multi-meter, breadboard and decade boxes. We were able to see all the equipment and apparatus in the lab. We were able to deeply study and understand all the functions, types and uses of each of the equipment mentioned above. We can now utilize these for various purposes in our

experiments. We can use them in LTSPICE as well where we will perform our next experiments. Overall, we understood almost everything about the lab apparatus/equipment.

INFERENCE: We were shown all the equipment used in the lab. How the work, what they do. So, all in all we were able to study and understand to study basic electronic components, sources and measuring equipment, finding values and knowing DSO, multi-meter, signal generator and the passive elements.

-----THE END-----