Technocrats Summer Task – 1: Instruments

- T.V.Vishnu Kumar

Multimeter and Clamp meter:

A Multimeter is an electrical measurement device used for measuring Voltage, Amps, Resistance and much more quantities (Depending upon the type of Multimeter) till the required degree of accuracy (e.g. 10^-3,10^2,10^3…. Again depending upon the type of Multimeter used). They come in Analog and Digital. The digital Multimeter are more accurate than analog ones. Analog meters not so popular because it is easier to read readings from a digital model, but it is still used to measure rapidly varying values, or to measure slight change since the digital models samples the quantity being measured and then displays the value, it most often misses these values.

Some Multimeters also measure capacitance, Conductance, Duty Cycle (in %), Frequency and decibels. Also most digital models come with a continuity tester which is very useful to check soldering and connections across the circuit

All types of Multimeter come with two probe wires. There are many types of probes available, but the pointed probes are the most popular due to their flexibility and ease of use. These probes are used to make contact across the points in the circuit where we want to take measurement. The probes are connected to the Multimeter by the use of a banana jack. Most of digital Multimeters have 3 or more holes to connect the probes, one is the ground wire, one is used for measuring amps, and the other is used to measure all other quantities.

In case of clamp meters, they either come as a separate instrument which can be connected to the Multimeter or come with a Multimeter built-in. Clamp meters are used to measure current in a cases where it is not possible to remove /break the wires in order to get the measurement. They are usually used to measure AC current, but some models also measure DC current based upon the hall effect.

Multimeters come in a wide range of prices (from 150 to 81,000 rupees). The costlier models have more features and are more accurate (error percentage ± (0.025%+5) or less), have more range and also have calibration certification. But for general use cases, the cheaper models are sufficient. For example, the Mextech MAS830L Multimeter costs which around ₹500 is used in most collage labs, including our own. But if we want a model with more features, the Mextech DT-603 is ideal and at ₹1,200 it is. If we want the most accurate measurement, the Fluke 15+/IN CATIII Digital Multimeter is a good choice, but it costs around ₹5,500. All these can be purchased in amazon or in electronic shops, although they might not have the exact model you want.

Oscilloscope:

A digital storage oscilloscope (often abbreviated DSO) is an oscilloscope which stores and analyses the signal digitally rather than using analog techniques. It is now the most common type of oscilloscope in use because of the advanced trigger, storage, display and measurement features which it typically provides and also because it is easier to read than a regular CRO (Cathode Ray Oscilloscope).

Almost all DSO’s have 2 channel to measure 2 different signal simultaneously, and f desired the outputs of the 2 channel can be displayed over on another. The DSO also have 2 probes for each channel just like the Multimeters, which is used for measuring the signal/wave form. The DSO will also display an array of information (i.e. max amp, duty cycle etc.) on the screen along with the waveform. This can be helpful in situations which require trouble shooting. The CRO also has dials which can be used to change the X-Y position and time period of the graph. Also most DSOs have the option to export the waveform to a CSV file and saved to a pen drive.

The CRO is used just like a Multimeter with the probes, but way cooler. We can use it to detect small deflection in the output signal/supply voltages. Also it is used most of the time to debug PWM signals and communication busses

Tachometer:

A Tachometer is a device used to measure the rotation speed of a shaft or a disk. There are 2 types of tachometer – Contact and Non-Contact. In the contact type, there is a rod sticking out of the meter which is made to put into a small hole in the rotating body. It can measure rotating speeds of about 0.5 to 10,000 rpm. Also by attaching a circumferential ring to the rod, we can also measure the circumferential velocity of the body. A Non-Contact one uses infrared light to measure the speed of rotation of a shaft or wheel or any other rotating object.it can measure up to 1 to 99,999 rpm for it to work, it is necessary for a laser tachometer to work is that there be some contrast in colour or luster on the surface of object. If there is no such contrast or if the surface is highly polished, then a spot is marked on the surface using a marker or sticking a piece of paper onto the surface. The infrared light from them tachometer falls on the surface and gets reflected back to the detector on the tachometer. The detector detects the changes in frequency of the reflected light as reflected alternately by the object surface and the contrast spot. The number of frequency changes per unit time gives the speed of rotation of the object. The Generic SE188 Digital Laser RPM Tachometer is a good tachometer for starters. The Mextech DT-2236C has both contact and non-contact mode of operation and is better suited for situations which require both method of measurement.