5.) Multiplier / Divider :- Scales the counted value up or down before displaying it.

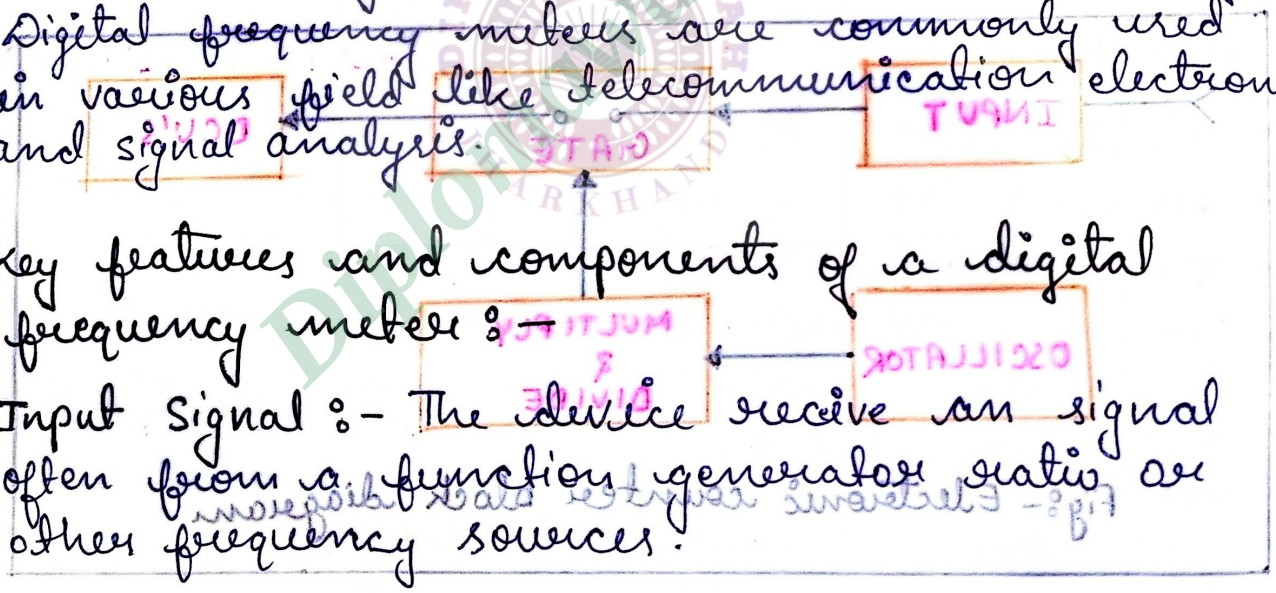
6.) Display / output :- Shows the final count in a readable format.

Unit :- 09

1.) Digital frequency meter :-

A digital frequency meter is an electric instrument used to measure the frequency of a signal. It typically displays the frequency in hertz (Hz) on a digital display, providing an accurate and direct reading of the input signal frequency.

Digital frequency meters are commonly used in various field like telecommunication electronics and signal analysis.



Key features and components of a digital frequency meter :-

i.) Input Signal :- The device receive an signal often from a function generator radio or other frequency sources.

ii.) frequency counting :- The meters counts the number of cycles of the input signal over a specific time interval.

iii.) Digital Display :- The frequency is displayed in numerical form making it easier to read and interpret compared to analog meter.

iv) Accuracy :- Digital frequency meter offers accuracy than analog frequency counters with a resolution that can be fined- tuned.

v) Measurement range :- There meters can measure a wide range of frequencies, from low-frequency signals in the H_2 range to high frequency signals in the GH_2 range.

vi) Additional features :- Some models may include additional features such as the ability to measure period duty cycle and total time, or include interfaces for external control or data logging.

» Time Interval Measurement :-

Time interval measurement is the process of determining the time difference between two events or signal. It is commonly used in scientific/engineering and industrial applications such as in digital oscilloscope frequency counters and time of flight measurements.

The measurement is typically expressed in units of time, such as millisecond (ms) microsecond (ms) and nano second (ns).

Key concept in Time interval measurement :

1) Start and stop events :- The "start" event is when the measurement begins and the "stop" event is when the measurement ends. The time interval is the difference between these two events.

II) Measurement resolution :-
Time interval measurement often require resolution things to detect very short difference between events.

III) Devices for time interval measurement :-
Digital times / stop watches : simple devices used for baric time interval measurement.

Applications :-
- Signal timing :- Measuring the delay between different signal events or transitions.
- Synchronizations :- In system that require precise timing, like in communication networks or GPS system.

2) Digital LCR meter :-
A digital LCR meter is an electronic instrument used to measure the inductance (L), capacitance (C) and resistance (R) of components in an accurate and precise manner.
These meters are widely used in electronics and electrical engineering for testing and characterizing passive components such as capacitors, inductors and resistors.

* Inductance (L) :- Measure the ability of a component to store energy in a magnetic field (measured in henries, H).
* Capacitance (C) :- Measure the ability of a component to store energy in an electric field (measured in Farads, F).

* Resistance (R):- Measures the opposition to current flow in a component (measured in ohms).

* Frequency range:- Many digital LCR meters allows you to measure the L, C and R values at different test frequencies often ranging from 1KHz to several MHz.

* Measurement Modes:-
  - Series mode: Used to measure the L, C or R of a component in a series configuration.
  - Parallel mode: Used to measure the L, C or R of a component in a parallel configuration.

Application:-
- Component testing
- Circuit design and debugging
- Quality control.

Digital Multimeter....

A digital multimeter (DMM) is an essential electronic measuring instrument that can measure multiple electrical parameters such as voltage, current and resistance.

It is widely used in electronic, electrical engineering and general troubleshooting for testing and diagnosing circuits components and electrical system.

Key features of a digital multimeter:-

1) Measuring Function:-
   - Voltage (DC/AC):- Measure the potential difference

between two points in a circuit. It can measure both direct current (DC) and alternating current (AC).

- Current (DC/AC):- Measure the flow of electric charge in a circuit like voltage. It can measure both DC and AC currents.
- Resistance:- Measure the opposition to current flow in a component or circuit. It is expressed in ohm (Ω).

ii) Additional function:-

- Continuity Testing:- The meter emits an audible sound if the resistance is very low indicating a short or continous path in the circuit.
- Diode Testing:- It can test diodes by measuring their forward voltage drop, helping verify if they are functioning properly.

iii) Display:- Digital multimeters features an LCD (Liquid Crystal display) that shows numerical reading clearly.

iv) Battery / Power:- DMMs are typically powered by batteries usually 9V or AA, some higher end models may also come with rechargeable batteries or power saving modes to extend battery life.

Applications:-

- Troubleshing circuit.
- Electrical and electronic works.
- Automotive diagnostics

3) Microprocessor Based Instrument :-

A microprocessor based instrument is an electronic device or system that uses a microprocessor as its central processing unit (CPU) to control and manage its functions.

These instrument are widely used in various applications such as measurement control data acquistion and communication system examples include digital multimeter, digital oscillascopes medical instruments and industrial process controller.

= Key features :-

1) Microprocessor control :- The microprocessor acts as the brain of the instrument, processing data and controlling functions.

2) Programmability :- Can be programmed to perform various tasks and measurement.

3) High accuracy and speed :- Offers precise data processing real-time of operation.

4) Display Interference :- often has digital displays (LCD/LED) to show data.

5) Data Storage and communication :- Supports data logging and communication with external devices like computer or networks.

Examples of Microprocessor based Instrument :

1) Digital Multimeter :- Measures voltage, current and resistance.

2) Digital Thermometer :- For temperature measurement

iii) Digital Oscilloscope :- Visualize electrical sig

iv) Programmable logic controller (PLC) :- For industrial automation.

v) Medical devices :- ECG machines, blood pressure monitor etc.

≫ IEEE 488 GPIB instrument :-

IEEE 488 (GPIB) instrument refers to devices that use the General purpose Interference Bus (GPIB) based on the IEEE 488 standard, For communication and control in test and measurement system.

This standard was orginally developed by Hewlettpackard (now Keysight Technologies) and is widely used in laboratories and industrial for interfounding measurement instrument.

Key features of IEEE 488 (GPIB) :-

i) Multi device Interference :- Supports communication with up to 15 devices on a single test.

ii) High Speed :- Fast data transfer compared to several communication protocals of its time.

iii) Synchronous and Parallel communication :- Ensures reliable and simultaneous data transfer.

iv) Plug and Play Interference :- Simple cabling and standardized connection.

v) Device Roles :- Instruments can acts as a controllers talkers or listeners.

vi) Controller :- Manages communication on the bus.
- Talker :- Sends data to other devices.
- Listner :- Receives data from the talkers.

Common GPIB instrument :-
1) Oscilloscope.
2) Multimeter.
3) Spectrum analyzers.
4) Power Supplies.
5) Signal generator.

Application :-
Test and measurement, automation scientific research, manufacturing, and Quality control.