UNIT-IV: Display Instruments

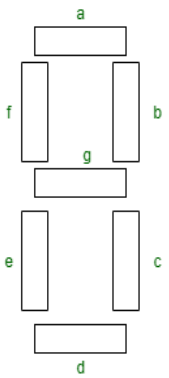
1. Compare LED, LCD, and SSD displays based on construction, working principle, and applications.

Comparison of LED, LCD, and SSD Displays

Feature	LED (Light Emitting Diode Display)	LCD (Liquid Crystal Display)	SSD (Seven Segment Display)
Construction	Consists of a matrix of LEDs arranged in a panel. Each LED acts as a pixel.	Made of liquid crystal material sandwiched between two glass plates with electrodes and polarizers.	Consists of 7 LED segments arranged in the shape of the digit "8" with an optional decimal point.
Working Principle	Emits light directly when current passes through the semiconductor diode.	Works on the principle of controlling light passage through liquid crystals using electric fields and polarizers. Requires a backlight.	Each segment glows when current flows through its LED. By combining segments, numbers (0–9) and some letters are displayed.
Applications	Used in TV screens, billboards, digital watches, mobile displays, traffic signs, etc.	Used in calculators, laptops, digital watches, instrumentation displays.	Used for simple numeric displays like digital clocks, counters, meters, calculators, and measuring instruments.

2. Explain the working of a 7-segment display. Distinguish between common anode and common cathode types with diagrams.

Seven Segment Displays



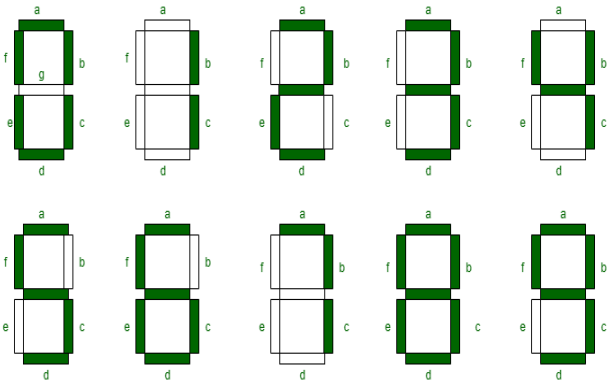
- Seven segment displays are the output display device that provides a way to display information in the form of images or text or decimal numbers which is an alternative to the more complex dot matrix displays.
- It is widely used in digital clocks, basic calculators, electronic meters, and other electronic devices that display numerical information.
- It consists of seven segments of light-emitting diodes (LEDs) which are assembled like numerical 8 as shown in fig.

Working of Seven Segment Displays

- The number 8 is displayed when the power is given to all the segments and if you disconnect the power for ‘g’, then it displays the number 0.

- In a seven-segment display, power (or voltage) at different pins can be applied at the same time, so we can form combinations of display numerical from 0 to 9.
- seven-segment displays can not form alphabets like X and Z, so it can not be used for the alphabet and they can be used only for displaying decimal numerical magnitudes.
- seven-segment displays can form alphabets A, B, C, D, E, and F, so they can also be used for representing each display unit is usually has a dot point (DP).
- The display point could be located either towards the left or towards the right of the display pattern.
- This type of pattern can be used to display numerals from 0 to 9 and letters from A to F hexadecimal digits.

Decimal Digit	Individual Segments Illuminated						
	a	b	c	d	e	f	g
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	1	1	0	0	1	1
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1



Therefore, Boolean expressions for each decimal digit that requires respective light-emitting diodes (LEDs) are ON or OFF.

The number of segments used by digit: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 are 6, 2, 5, 5, 4, 5, 6, 3, 7, and 6 respectively.

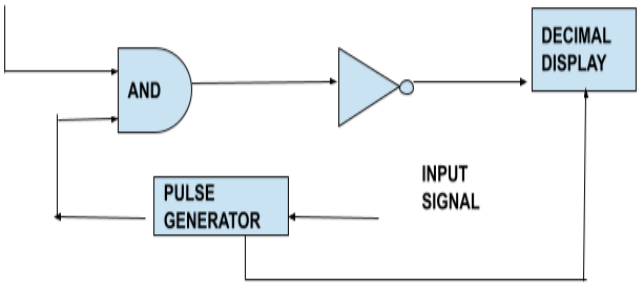
Seven segment displays must be controlled by other external devices where different types of microcontrollers are useful to communicate with these external devices, like switches, keypads, and memory.

Modes of Connection

1. **Common Cathode (CC):** All cathodes are tied to ground, segments glow when given logic HIGH.
2. **Common Anode (CA):** All anodes are tied to +Vcc, segments glow when given logic LOW.

Feature	Common Cathode (CC)	Common Anode (CA)
Connection	Cathodes tied to GND	Anodes tied to +Vcc
Segment ON condition	Apply **logic 1** (HIGH)	Apply **logic 0** (LOW)
Interface with logic	Works easily with TTL	Needs inversion for TTL
Usage	General purpose	Multiplexed displays

3. Discuss the application of display technologies in digital voltmeters and counters.



- **Input Signal** – The signal or voltage to be monitored is known as the input signal.
- **Pulse Generator** – A pulse generator is a voltage source that generates a rectangular impulse using analog, digital, or both methods. The frequency and width of the rectangular pulse are controlled by the controller's digital circuitry.
- **AND** – It produces a high output when both inputs are high. When a train pulse and a rectangle pulse are fed to it, the AND gate produces a train pulse output. They have the same duration as the pulse generator's rectangular pulses.
- **Decimal Display** – The decimal display keeps track of the number of impulses and their duration. The voltage value is then displayed on a display screen, which can be LCD or LED, after it has been calibrated.

The steps are as follows –

1. The pulse generator receives an unknown voltage signal and generates a pulse with a width proportionate to the input signal.
2. One leg of the AND gate receives the pulse generator's output.
3. A train of pulses is used as the input signal to the AND gate's opposite leg.
4. The AND gate produces a positive triggered train with the same duration as the pulse generator's pulse width.
5. The inverter receives this positive triggered train and changes it to a negative triggered train.
6. The inverter's output is sent into a counter, which counts the number of triggers in a time period proportional to the input signal, i.e. the voltage under measurement.
7. As a result, the counter can be calibrated to directly indicate voltage in volts.

Input Signal → Attenuator → ADC → Counter → Read out System

Based on the above A/D Conversion, there are many types of digital voltmeters such as – Ramp type digital voltmeter, Integrating type voltmeter, Potentiometric type digital voltmeters.

Digital counters

- A digital counter circuit, such as a decade counter IC like the 74LS90 or CD4026, counts incoming pulses. The IC's BCD output drives a decoder/driver to illuminate the correct segments on the display for each counted number.
- **Applications:** They are used in digital clocks, production line counters, and other basic electronic devices where only a numerical count is required.
- **Advantages:** Simple design, high reliability, and low cost.
- **Disadvantages:** Like with voltmeters, they are limited to displaying simple numerical digits.

Short Answer Questions (3 marks)

4. What are the advantages of LED over LCD displays?

S.NO	LED	LCD
1.	LED has a better response time than LCD.	LCD is slower than LED in terms of response time.
2.	LED consumes more power in comparison to LCD.	Whereas it consumes less power in comparison to LED.
3.	LED delivers good picture quality in comparison to the LCD display.	LCD also delivers good picture quality but less than LED.
4.	LED is costlier than LCD.	While it is less costly than LED.

5. Write a short note on the structure and use of a 7-segment display.

Structure:

- It consists of **seven LED segments** (labeled **a to g**) arranged in a rectangular fashion to form the number "8".
- Each segment is an **LED** that can be turned **ON or OFF** to form different digits.
- An **additional dot (DP)** may be present for displaying decimal points.

Use:

- The display is used for **numeric output** in various digital devices.
- It receives **binary-coded decimal (BCD)** input from a **decoder/driver IC** (like **IC 7447** for common anode type).
- By lighting specific segments, digits 0–9 are displayed.

6. Name three devices where SSDs are commonly used.

- **Digital clocks and watches** – to display time in numeric form.
- **Calculators** – to show numbers and simple symbols.
- **Digital meters** (like voltmeters or ammeters) – to indicate measured values.
- **Electronic weighing machines** – to display weight readings.
- **Scoreboards** – to show scores or timings in sports events.