B.E.

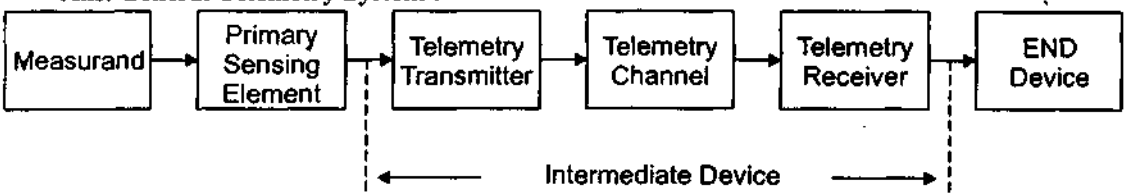
Sixth Semester Examination, December-2008

Telemetry Data Processing & Recording (IC-304-E)

Note : Attempt any five questions out of eight.

Q. 1. (a) Give description of various blocks of a generalized instrument. **10**

Ans. General Telemetry System :



Telemetry may be defined as measurement at distance. A general telemetry system as shown in fig. The primary detector and device of telemetry system have same position and functional roles as in the generalized measurement system. However, there are three system elements in the intermediate stage which are peculiar to a telemetry system they are :

(i) Telemetry Transmitter

(ii) Telemetry Channel

(iii) Telemetry Receiver

The function of the telemetry transmitter is to convert the output of a primary sensing element into electrical signal and to transmitt it over a telemetry channel. This signal is in electrical format and is received by a receiver placed at remote location. This signal is converted into a usable form by the receiver and indicated or recorded by an end device.

Q. 1. (b) Discuss modes of data transmission. **10**

Ans. (i) Land Line Telemetry

(ii) RF (radio frequency) telemetry

(i) A land line telemetry system requires a telemetry channel which is a physical link between the telemetry transmitter and receiver. This physical link may be a cable, wire, existing telephone and telegraphic cable and power line carrier. The land line telemetry is in fact a direct transmission of information through cables and transmission lines. The direct transmission via cables employs current, voltage, frequency, position or impulse to convey the information. Current voltage and position type system can be used. The information may be the form of analog or digital signal. While current, voltage, position frequency and pulse types of signal can be used for analog telemetry only pulse signal can be used for digital telemetry.

The land line telemetry systems can be classified as :

(i) Voltage telemetry system

(ii) Current telemetry system

(iii) Position telemetry system

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(ii) Radio Frequency (RF) Telemetry : There is no physical link between the transmitting and receiving station. The link between the transmission station (where the actual measurement are being carried out) and the receiving station (where the measurand is measured, recorded and information used for control purpose) can only be established through radio link.

RF telemetry is usually more suitable if the data is to be transmitted over distance greater then 1 km.

The method employed for data transmission depends upon the variable and the distance over which it has to be transmitted. The following method may be used for data transmission :

(i) Hydraulic transmission

(ii) Pneumatic transmission

(iii) Electrical + Electronic transmission.

Q.2. What is Telemetry and explain in detail its various types ? **20**

Ans. "Telemetry is a technology which enable a user to collect data from several point at inaccessable or inconvenient locations, transmit that data to a convenient location and present the several individual measurements in a usable form." Type of Telemetry system :

(i) Land line telemetry

(ii) RF telemetry system

Land Line Telemetry : Land line telemetry system requires a telemeter channel which is a physical link between the telemeter transmitter or receiver.

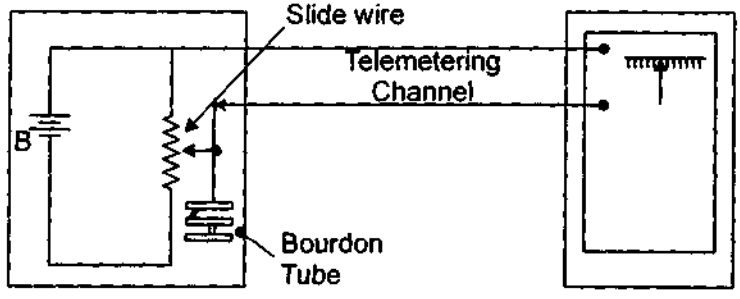
This physical link may be cable or telephon link.

(a) Voltage Telemetry System

(b) Current Telemetry System

(c) Position Telemetry System

(a) Voltage Telemetry System :



A voltage telemetry system transmit the measured variable of a function of AC or DC voltage.

A voltage telemetry system is suitable for adding several output voltage in series. This is subject to condition that the measurement is linear. However, the voltage system requires a relatively more expansive receiving equipment.

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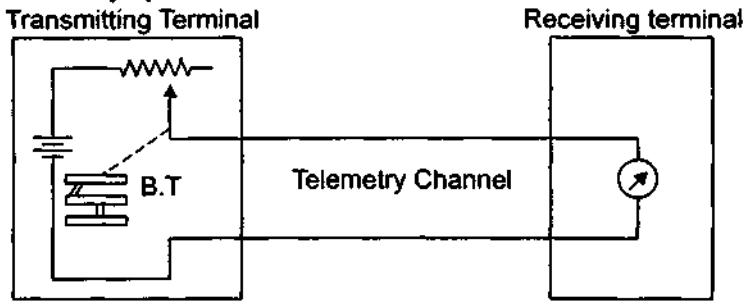
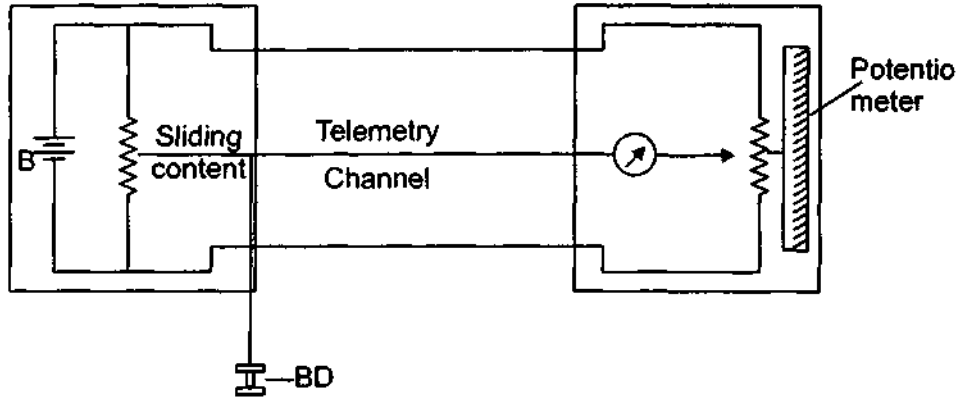
(ii) Current Telemetry System :



It has a slide wire potentiometer connected in series with a battery. The sliding contact of the potentiometer is positioned by a pressure sensitive bourdon tube. The telemetry channel consist of a pair of wire connected to a current measuring device.

(iii) Position Telemetry System :



A position telemetry system transmitt and reproduce the measured variable by positioning variable register or other components in a bridge circuit from so as to produce proportional change at both transmitter or receiver ends.

RF Telemetry System : There is no physical link between transmitting and receiving. The link between transmitting and receiving station can only established through radio link. RF telemetry is usually more suitable if the data is to be transmitted over a distance greater then 1 km. The data is transfer from one location to another using modulation. Like amplitude, frequency modulation technique.

Q. 3. (a) What is pulse frequency system ? Explain with block diagram. **10**

Ans. In pulse frequency system converts the sample voltage into a train of pulse whose instantaneous frequency or repetition rate, is directly refused to the sampled voltage magnitude. Hence, Here the amplitude of the pulse is fixed only its frequency changes.

Is the simplest form of time division multiplexing because the sample are tansmitted without being modified. As stated previously, it is vitally important in a time division system that the demodulator be synchronized exactly with the commutator. Synchronization channels must be introduced as part of the commutation scheme. On the receiving end, no data is decommutated until these channel have been properly recognized and time-tagged at which time the decommutation process can be begin.

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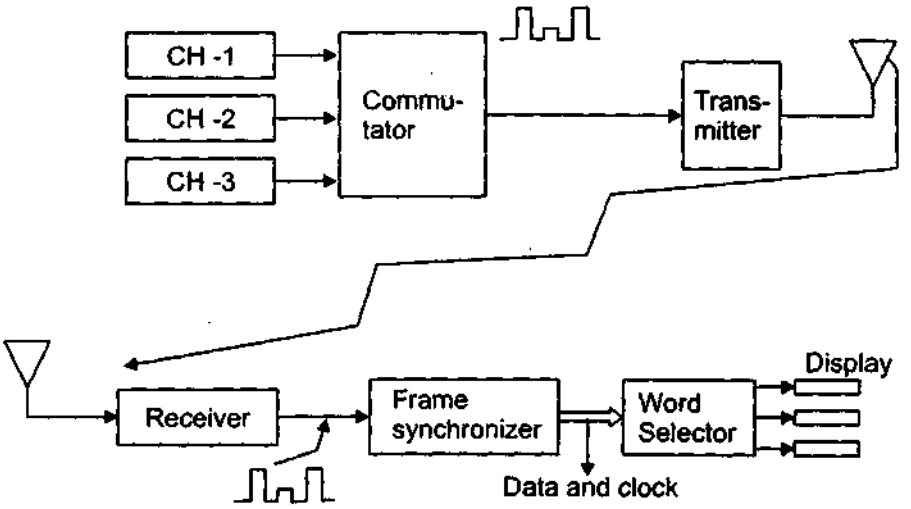

Q. 3. (b) Discuss working of wire line channels. **10**

Ans. Wire line channels for Land-line telemetry wire line channels are used. The wire line is the simplest type of channel for transmission of information. The wire line may be ;

(a) Privately owned or (b) Leased from posts and telegraphs department. In case of leased type of lines from P & T department the channels may be telegraph, teletype or telephone lines.

The lines may be aerial lines or may be cables. The line telemetering equipment is subject to the following hazards (i) direct of induced voltages due to lightning (ii) voltages due to unintentional contact with adjacent high voltage power circuits and (iii) voltage induced electromagnetically or electrostatically by high voltage power circuits that run parallel to the data transmission lines.

The lines and equipment must be protected against the above mentioned undesirable effects.

Cables have advantages over the aerial lines in that :

(i) Being unexposed to lightning are more reliable.

(ii) They have high insulation; and

(iii) Their parameters remain the same irrespective of the changes in the atmospheric conditions.

For land line telemetry an enormous variety of connectors are employed. They range from, a pair of open wires, a pair of twisted wires, wires of a telephone cable, to co-axial cables. Non co-axial cables can be used for bandwidth upto 10 MHz over a length of a few hundred metres. The coaxial cable have a much wider range.

Cable installations are expensive and also are difficult to move once installed, but they are more efficient and reliable.

Q. 4. Define multiplexing and explain its various types in detail ? **20**

Ans. Twenty one data channels with subcarrier center frequency ranging from 400 Hz to 100 kHz have been distinguished for telemetry use figure gives the of the 21 sub carries. As noted all have a ± 7.5% frequency division assuming a modulation index of 5, we can obtain a recommended intelligence bandwidth.

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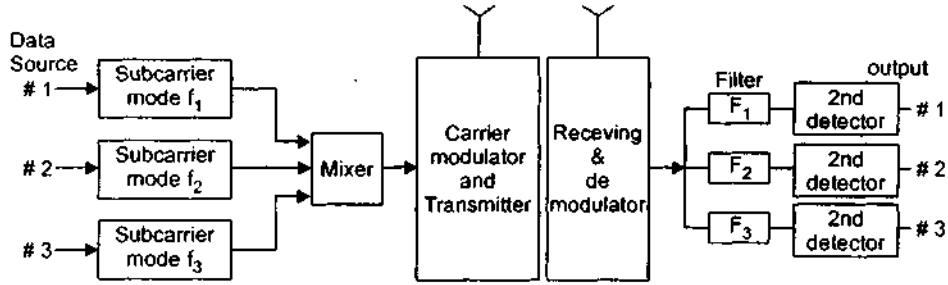
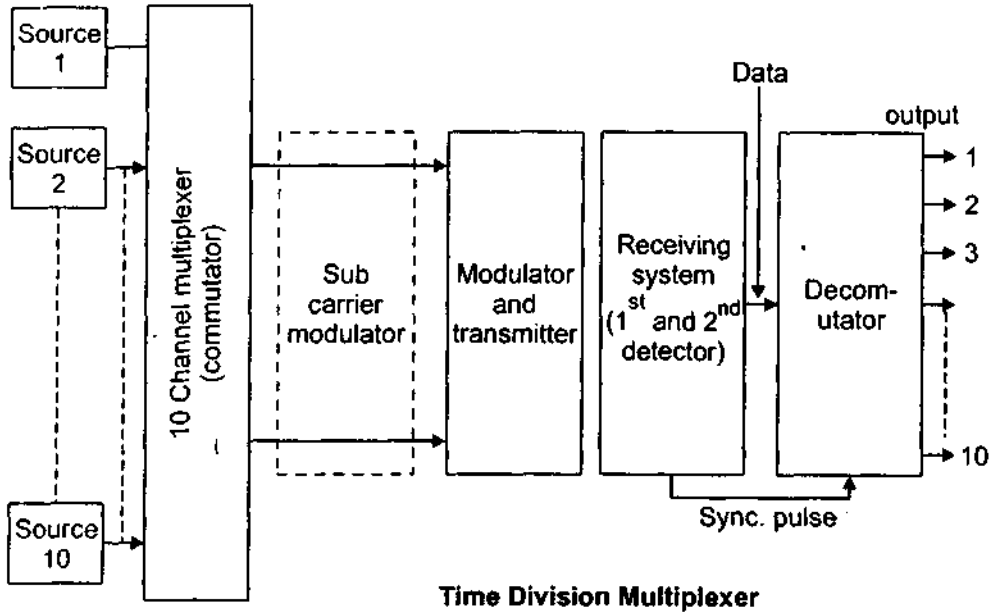
Frequency Division Multiplexing :



The subcarrier frequency division as specified in figure are proportional to the center of frequency, that if the center of frequency is higher the frequency division is proportionally higher. This frequency multiplexing scheme is referred to having a proportional bandwidth format.

Time Division Multiplexing : Time division multiplexing involves the transmission of data samples rather than continuous data transmission typical of frequency division. When the telemetry slow-changing, low bandwidth data (e.g., temperature). It would be extremely wasteful. If these temperature measurement occupy a full RF communication link. To increase efficiency, the communication link should be used for other measurement during the 'dead' interval between temperature samples.



Time Division Multiplexer

Q. 5. (a) Enumerate the difference between analog and digital data processing. **10**

Ans. (i) Accuracy : The best analog instrument are rated usually with in ±0.1% of full scale digital instrument can be made to much greater accuracy.

(ii) Reaction to Environment : Analog meter relatively simple and well operate under a wide range of environment.

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(iii) Resolution : This is some times referred to as readability below which difference can no longer. In analog instrument the limit is one part in several hundred.

(iv) Power Requirement : Digital instrument draw only negligible power whereas the analog instrument may load the circuit under measurement and thus indicate an erroneous reading.

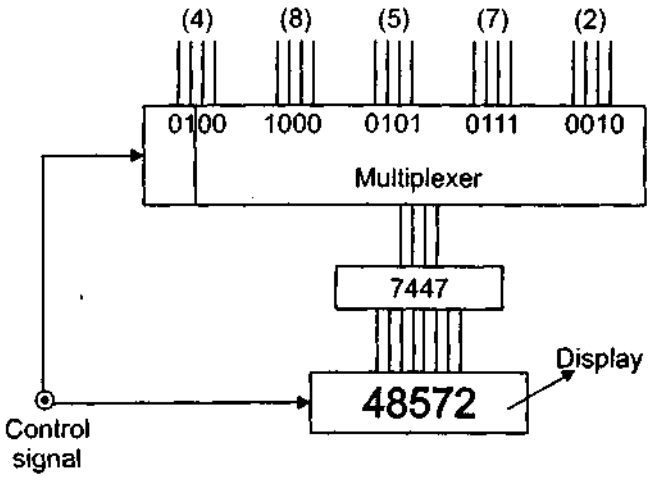
(v) Cost and Portability : Analog instrument are extremely portable and usually do not require an outside source of supply for measurements.

(vi) Range and Polarity : Most digital instrument are essentially dc instruments measure up to 100 V and up to 1000 V by means of the range attenuator.

(vii) Freedom from Observational Error : Digital instruments are free from observational error.

Q. 5. (b) Explain BCD to Dot matrix converter with the help of neat diagram. **10**

Ans.



A 3× 5 dot matrix is required for display of numeric character while the display the alphanumeric character requires a 5× 7 dot matrix. A 4 bit BCD input is required for conversion to approprate dot selection code, which will operate the dot to display the character.

A 5× 7 dot matrix is shown in fig. All the LED required for display of a character are not illuminated simultaneously. Usually they are activated a row at a time. For example, the first row of LED is first grounded and voltage applied to the appropriate column.

Q. 6. (a) Discuss and explain : **10**

(i) Quantization

(ii) Aperture

Ans. (i) Quantization : The decision level of the A/D convertor are at 0.5, 1.5, 2.5, 3.5 etc. Thus, the design level spaced 1V apart. Analog value between two decision level cannot be codeed. In fact analog value between 1 ± 0.5 are read as digital value 001. The distance between decision level is Q. The quantization size. An n bit A/D convertor has 2^n discrete level with resolution $\frac{1}{2}n$ or 1 part in 2^n and analog decision levels $= 2^n - 1$

Therefore level $= 2^n$

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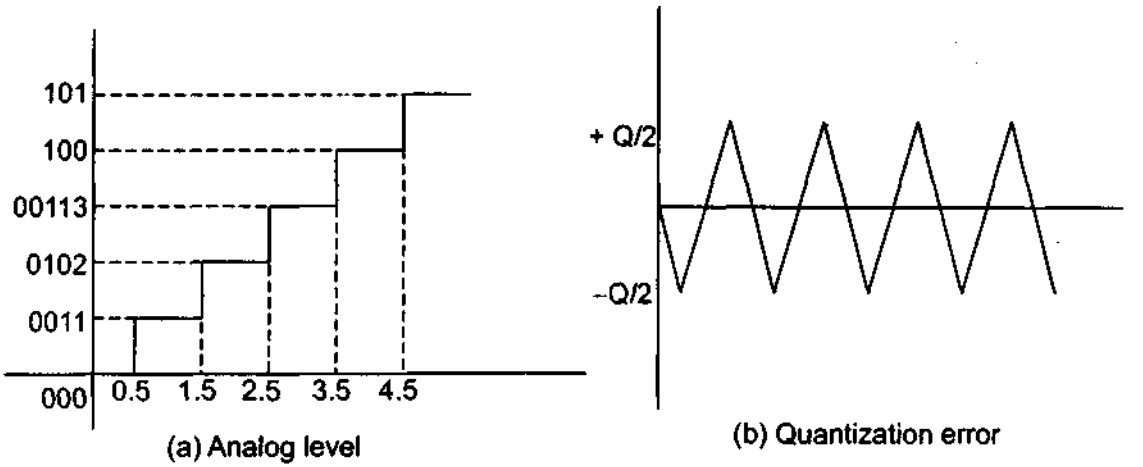
Resolution $= \frac{1}{2}n$

Decision level $= 2^n - 1$



(a) Analog level

(b) Quantization error

If the input to the quantizer is moved through its full range and substracted from the discrete output level is shown in figure is called quantization error.

(ii) Aperture Time : In order to perform the operation of quantizing and coading a signal, an A/D convertor require an aperture time

$$\Delta E = \left[d/dt \, (E_m \sin \omega t) \right]_{e=0} \times t_a = E_m \omega t_a$$

$$t_a = \frac{\Delta E}{\omega E_m} = \frac{\Delta F}{2\pi f E_M}$$

Q. 6. (b) What is the difference between latch and a flip-flop ? **10**

Ans. (i) Latches and flip-flop are bistable element with two stable state. The main difference between latch and flip-flop is in the method used for changing state.

(ii) Latches are bistable element whose state depends on asynchronous input. On the other hand, edge trigger flip-flop are bistable element with synchronous input whose state depends on input only at the triggering transmission of clock pulse. Edge trigger can be positive edge triggering or negative edge triggering.

(iii) RS latch can be built with NOR gates or NAND gates.

In this latch a high on both R and S input lead to race condition.

(iv) A clocked RS latch has a clock input in addition to R and S input. A state change can occur only when clock signal become high.

Q. 7. (a) Explain different digital display methods. **10**

Ans. Seven Segment Display : Figure shows a seven segment display. This is used for numeric display. It consist of seven segments a,b,c,d,e, f and g. A segmental display form the digit to be displayed by illuminating proper segment from the group.

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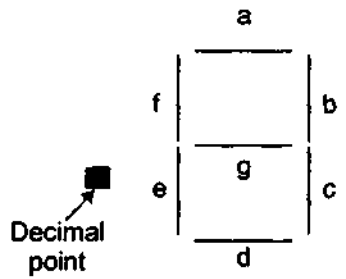
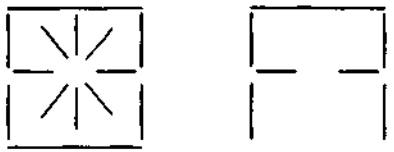
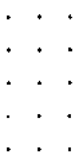


Fourteen Segment Display : For display of Alphanumeric character (both numericals as well as alpha bets) a fourteen segment display unit show in figure used.



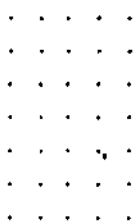
Dot matrix Display :

(i) 3× 5 Dot Matrix Display



A 3 × 5 dot matrix is shown in fig. may be used for display of numeric characters

(ii) 5× 7 Dot Matrix Display

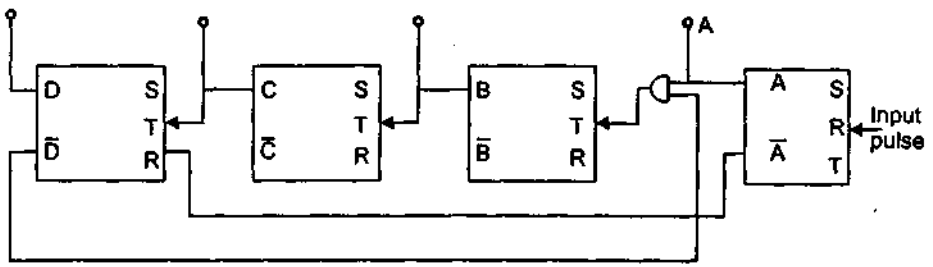


for display a Alphanumeric character a 5 × 7 dot matrix is used as shown in fig.

5 × 7 dot matrix

Q. 7. (b) Explain working of decade counter. **10**

Ans.



Decade Counter

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Four flip-flop can be in cascade to act as counters for the input pulses. A decade counter uses four RST flip-flop A,B,C,D figure shows four RST flip-flop in cascaded.

A square wave input to the counter. This square wave is called a clock. The output from flip-flop. A drive the flip-flop B the output of if B drive the flip-flop C which in turn drives flip-flip D.

To start operation all flip-flop are reset and therefore the state of the four RS flip-flop are.

$DC\ BA$ = 0000 and $\overline{DCBA}$ = 1111 when the first clock pulse is applied to T input terminal of RS flip-flop A it change its state on the negative going edge of the pulse. Thus, at the end of the first pulse the state of flip-flops

$$DCBA = 0001\ \overline{DCBA} = 1110$$

2nd pulse

$$DCBA = 0010\ \overline{DCBA} = 1101$$

Count is incremented by one for each an every pulse and than count 0-9 as so on.

Hence a decade counter act as a decade frequency divider since it divided the frequency by 10 and therefore it is called a decade dividing assembly (DDA).

Q. 8. Write short notes on : **20**

(a) Resolution and sensitivity in digital meters.

(b) Nixie tube.

Ans. (a) Resolution and Sensitivity in Digital Meters : The number of digit position (or simply the number of digits) used in a digital meter determines the resolution. Thus, a three digit display on a digital voltmeter (DVM) for 0-1 range will be able to indicate value from zero to 999 mV with smallest increment or resolution of 1mV.

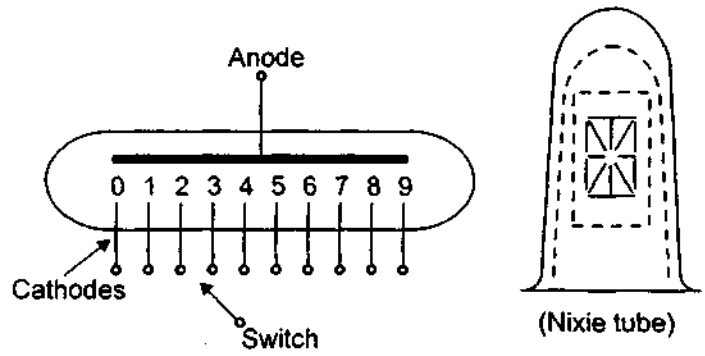
If n = number of full digit

Resolution $= 1/10^n$

Sensitivity is the smallest change in input which a digital meter is able to detect. Therefore, it is lowest voltage ranges full scale value multiplied by the meter's resolution.

Sensitivity $S = (f.S.)_{min \times R.}$

(b) Nixie tube :



Symbol of Nixie-tube

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A basic construction of a digital indicator tube shown in fig., It is a cold cathode glow discharge tube which is popularly known as **Nixie.**

The electrode are enclosed in a glass filled envelope with connecting pins at bottom, Neon gas is usually employed and it gives an orange-red-glow when activated. However, other colours are available when different gases are used.

There is an one anode and 10 cathodes. After a negative voltage is applied to the selected cathode a simple gas discharge diode formed which light are selected digit.

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