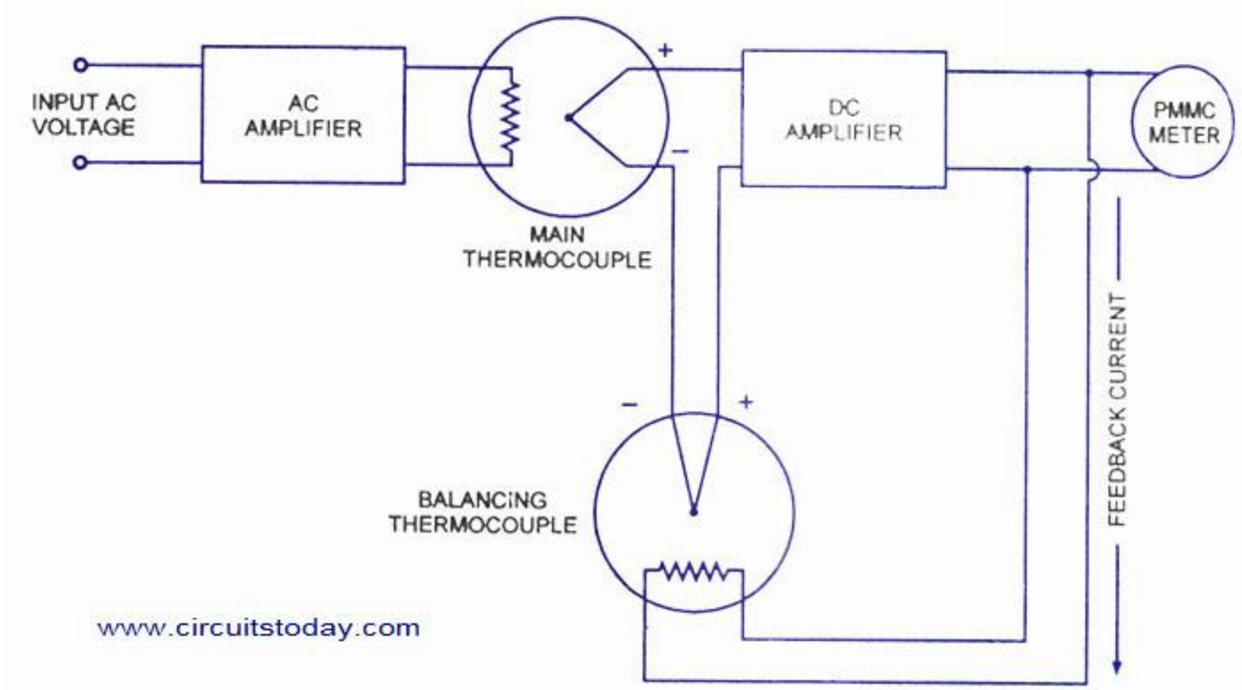
Module -4

1.Explain the working of true rms reading meter.

Ans:



Block Diagram of True RMS Reading Voltmeter

RMS value of the sinusoidal waveform is measured by the average reading voltmeter of which scale is calibrated in terms of rms value. This method is quite simple and less expensive. But sometimes rms value of the non-sinusoidal waveform is required to be measured. For such a measurement a true rms reading voltmeter is required. True rms reading voltmeter gives a meter indication by sensing heating power of waveform which is proportional to the square of the rms value of the voltage.

Thermo-couple is used to measure the heating power of the input waveform of which heater is supplied by the amplified version of the input waveform. Output voltage of the thermocouple is proportional to the square of the rms value of the input waveform. One more thermo-couple, called the balancing thermo-couple, is used in the same thermal environment in order to overcome the difficulty arising out of non-linear behavior of the thermo-couple. Non-linearity of the input circuit thermo-couple is cancelled by the similar non-linear effects of the balancing thermo-couple. These thermo-couples form part of a bridge in the input circuit of a dc amplifier, as shown in block diagram.

AC waveform to be measured is applied to the heating element of the main thermocouple through an ac amplifier. Under absence of any input waveform, output of both thermo-couples are equal so error signal, which is input to dc amplifier, is zero and therefore indicating meter connected to the output of dc amplifier reads zero. But on the application of input waveform, output of main thermo-couple upsets the balance and an error signal is produced, which gets amplified by the dc amplifier and feedback to the heating element of the balancing thermo-couple. This feedback current reduces the value of error signal and ultimately makes it zero to obtain the balanced bridge condition. In this balanced condition, feedback current supplied by the dc amplifier to the heating element of the balance thermo-couple is equal to the ac current flowing in the heating element of main thermo-couple. Hence this direct current is directly proportional to the rms value of the input ac voltage and is indicated by the meter connected in the output of the dc amplifier. The PMMC meter may be calibrated to read the rms voltage directly.

By this method, rms value of any voltage waveform can be measured provided that the peak excursions of the waveform do not exceed the dynamic range of the ac amplifier.

2.Write a short note on Q-meter.

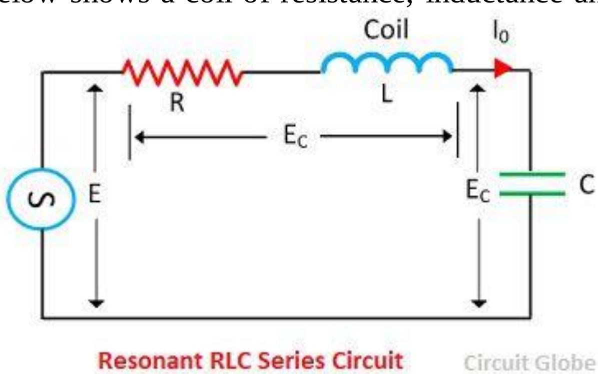
Ans.

Definition: The instrument which measures the storage factor or quality factor of the electrical circuit at radio frequencies, such type of device is known as the Q-meter. The quality factor is one of the parameters of the oscillatory system, which shows the relation between the storage and dissipated energy. The Q meter measures the quality factor of the circuit which shows the total energy dissipated by it. It also explains the properties of the coil and capacitor. The Q meter uses in a laboratory for testing the radio frequency of the coils.

Working Principle of Q meter

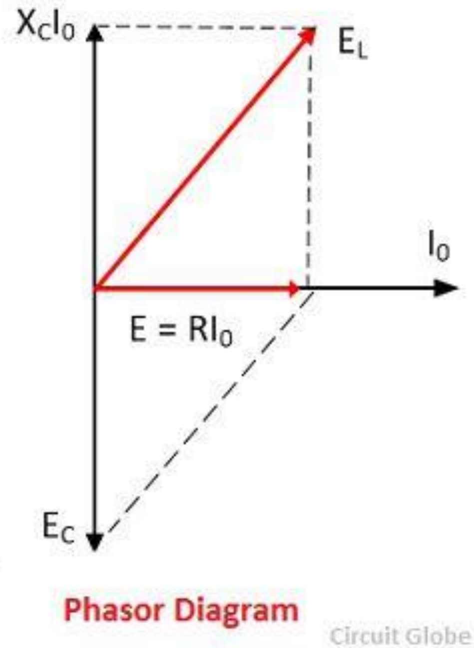
The Q meter works on series resonant. The resonance is the condition exists in the circuit when their inductance and capacitance reactance are of equal magnitude. They induce energy which is oscillating between the electric and magnetic field of the capacitor and inductor respectively.

The Q-meter is based on the characteristic of the resistance, inductance and capacitance of the resonant series circuit. The figure below shows a coil of resistance, inductance and capacitance connected in series with the circuit.



At resonant frequency f_0, $X_C = X_L$ The value of capacitance reactance is $X_C = \frac{1}{2}\pi f_0 C = \frac{1}{\omega_0 C}$ At inductive reactance, $X_L = \frac{1}{2}\pi f_0 L = \frac{1}{\omega_0 L}$

At the resonant frequency, $f_0 = \frac{1}{2\pi\sqrt{LC}}$ and current at resonance becomes $I_0 = \frac{E}{R}$ The

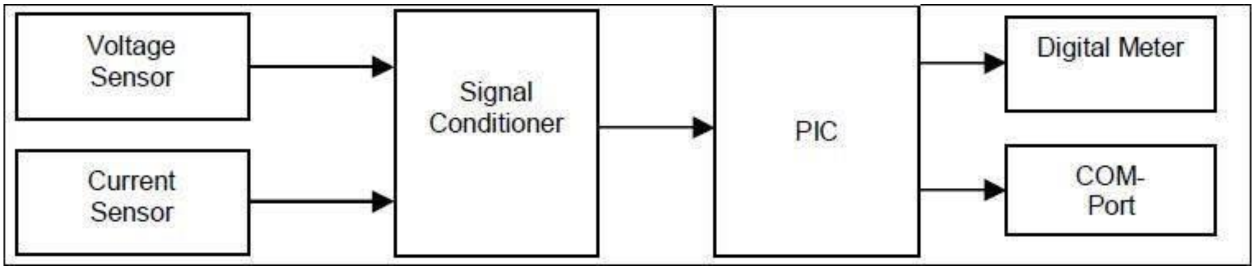


phasor diagram of the resonance is shown in the figure

The voltage across the capacitor is expressed as $E_C = I_0 X_C = I_0 X_L = I_0 \omega_0 L$ Input voltage $E = I_0 r$ $\frac{E_C}{E} = \frac{I_0 \omega_0 L}{I_0 R} = \frac{\omega_0 L}{R} = Q$ $E_0 = QE$ The above equation shows that the input voltage E is Q times the voltage appears across the capacitor. The voltmeter is calibrated for finding the value of Q factor.

3. With a neat block diagram explain the electronic energy meter.

Ans:



An **Electronic Energy Meter** (**EEM**) functionally outperforms the traditional Ferrari's wheel meter. One important advantage of EEM is that in non linear loads, its metering is highly accurate and electronic measurement is more robust than that of the conventional mechanical meters. The Power companies benefits from EEM in three significant ways.

1. It reduces the cost of theft and corruption on electricity distribution network with electronic designs and prepayment interfaces.

2. Electronic energy meter measures current in both Phase and Neutral lines and calculate power consumption based on the larger of the two currents.

3. EEM improves the cost and quality of electricity distribution.

How EEM Works?

The conventional mechanical energy meter is based on the phenomenon of "Magnetic Induction". It has a rotating aluminium Wheel called Ferriwheel and many toothed wheels. Based on the flow of current, the Ferriwheel rotates which makes rotation of other wheels. This will be converted into corresponding measurements in the display section. Since many mechanical parts are involved, mechanical defects and breakdown are common. More over chances of manipulation and current theft will be higher.

Electronic Energy Meter is based on Digital Micro Technology (DMT) and uses no moving parts. So the EEM is known as "Static Energy Meter" In EEM the accurate functioning is controlled by a specially designed IC called ASIC (Application Specified Integrated Circuit). ASIC is constructed only for specific applications using Embedded System Technology. Similar ASIC are now used in Washing Machines, Air Conditioners, Automobiles, Digital Camera etc.

In addition to ASIC, analogue circuits, Voltage transformer, Current transformer etc are also present in EEM to "Sample" current and voltage. The 'Input Data' (Voltage) is compared with a programmed "Reference Data' (Voltage) and finally a 'Voltage Rate' will be given to the output. This output is then converted into 'Digital Data' by the AD Converters (Analogue- Digital converter) present in the ASIC.

4. **With a neat block diagram explain the digital voltmeter Integrating type**.-

Ans: As we have already discussed what is working of digital voltmeter and its types, now we will discuss the second type DVM i.e, integrating type digital voltmeter. This digital voltmeter measures the true average value of the input voltage over a fixed measuring period. In contrast, the ramp type DVM samples the voltage at the end of the measuring period.

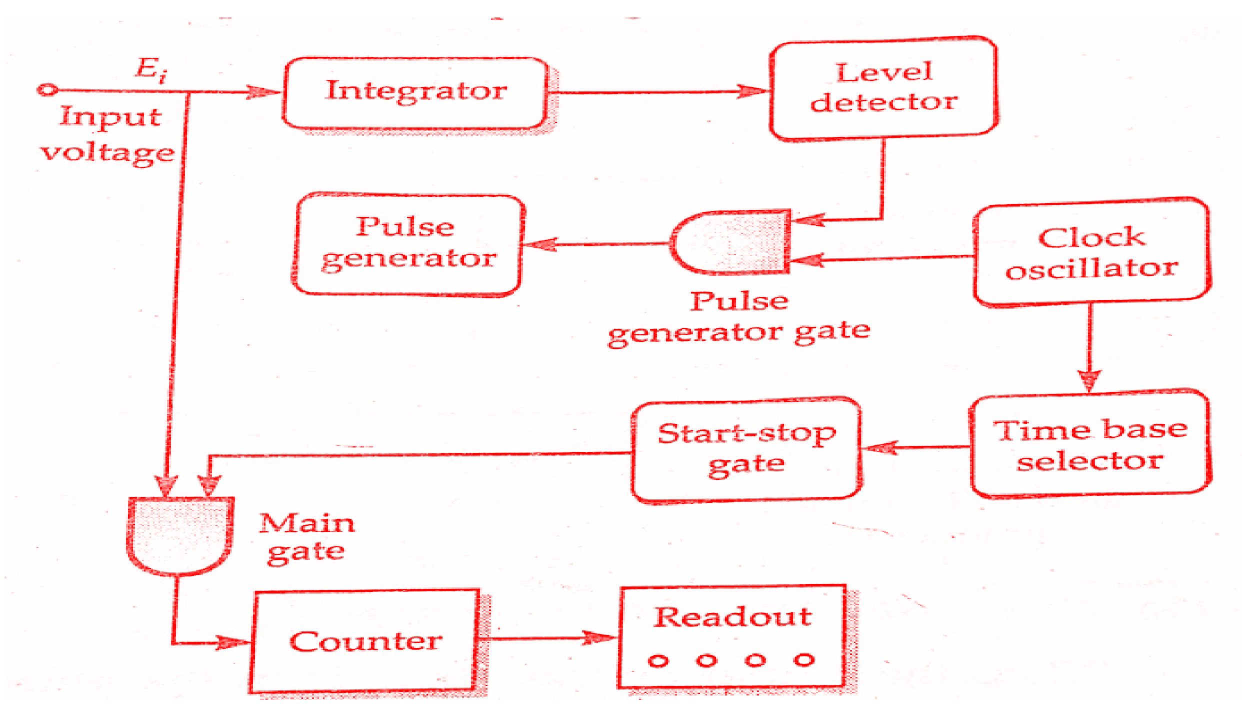
This voltmeter employs an integration technique whirls uses a voltage to frequency conversion. The voltage to frequency (V/F) converter functions as a feedback control systemwhich governs the rate of pulse generation in proportion to the magnitude of input voltage.

Actually, when we employ the voltage to frequency conversion techniques, a train of pulses, whose frequency depends upon the voltage being measured, is generated. Then the number of pulses appearing in a definite interval of time is counted. Since the frequency of these pulses is a function of unknown voltage, the number of pulses counted in that period of time is an indication of the input (unknown) voltage.

The heart of this technique is the operational amplifier acting as an Integrator.

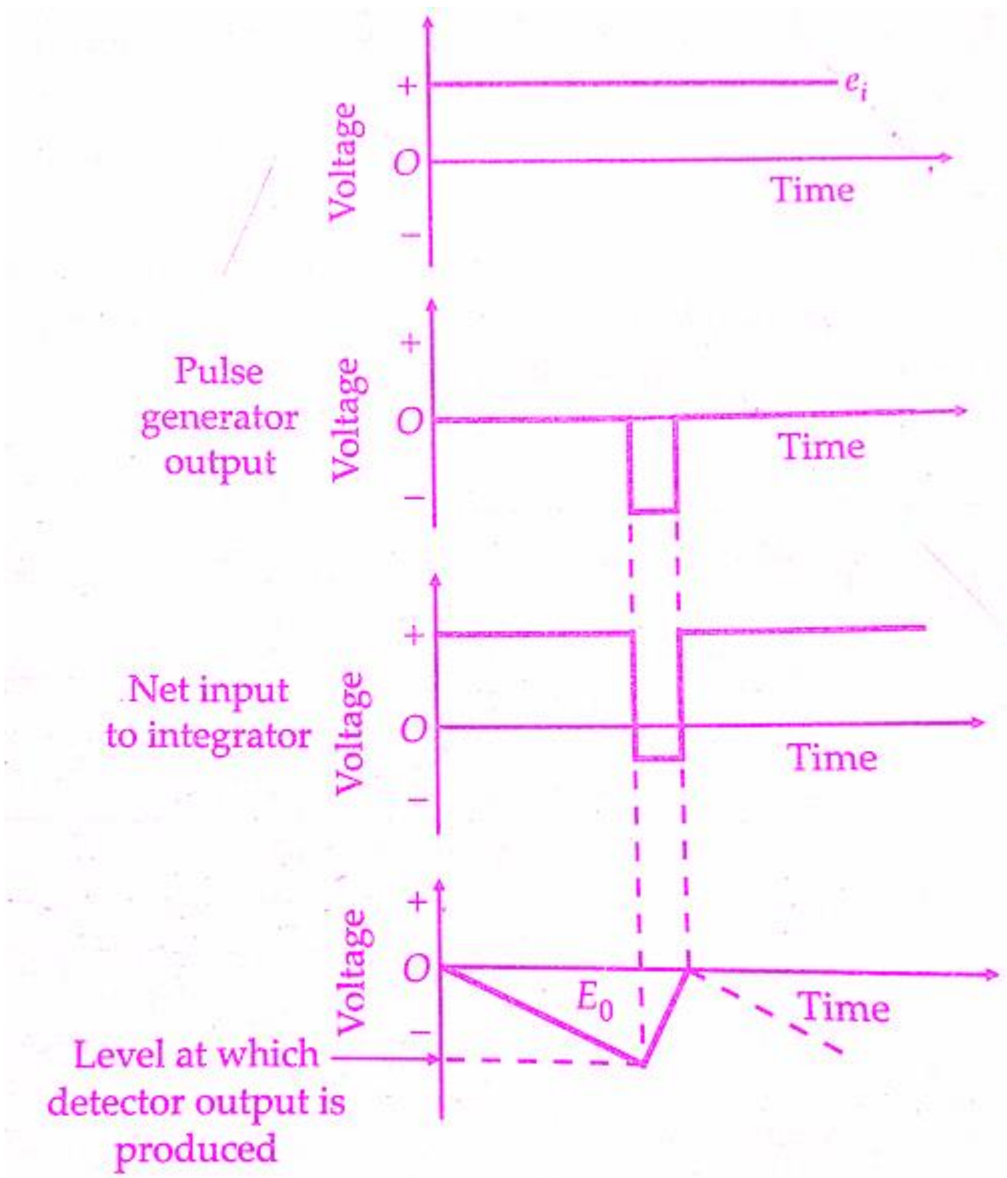
Output voltage of integrator Eo = - Ei (1/RC) t

Thus if a constant input voltage Ei is applied, an output voltage Eo is produced which rises at a uniform rate and has a polarity opposite to that input voltage. In other words, it is clear from the above relationship, that for a constant input voltage the integrator produces a ramp output voltage of opposite polarity.



The level detector is a device similar to a voltage comparator. The output voltage from integrator (Eo) is compared with the fixed voltage of an internal reference source, and, when Eo reaches that level, the detector produces an output pulse. It is evident that greater the value of input voltage Ei the sharper will be the slope of output voltage Eo, and quicker the outputvoltage Eo willreachitsreferencelevel.

The output pulse of the level detector opens the pulse generation gate, permitting pulses from a fixed frequency clock oscillator to pass through the pulse generator. This generator is a device such as a Schmitt trigger, that produces an output pulse of fixed amplitude and width for everypulseitreceives.

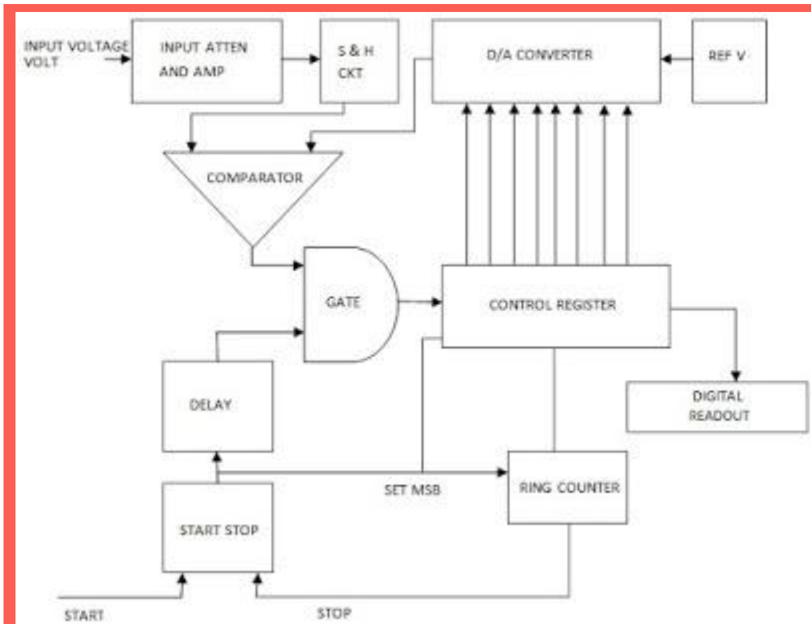


5. **With a neat block diagram explain the digital voltmeter successive approximation type.**

The block diagram showing a digital voltmeter of successive approximation type is shown in Figure.

(a) Description of the Block Diagram:

It consists of input attenuator and amplifier. The output of the input amplifier is given to the sample and hold circuit. There is a reference supply source whose output is given to the D/A converter. The output from the sample and hold circuit and D/A converter is given to a comparator. The output from the start stop multi is given to the delay circuit. The delay circuit's output goes to the gate. The gate is connected to the control register. The ring counter gives its output to the control register, and also to the start stop multi. The control register's output goes to the digital readout circuitry.



Block Diagram of Successive Approximation Type DVM

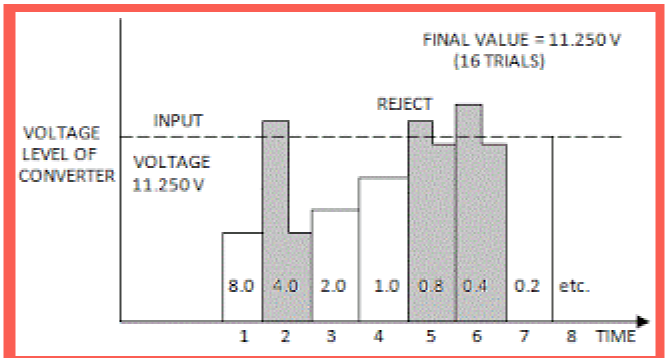
(b) Working:

We start from the start stop multi. To commence measurement cycle a start pulse will be applied to the start stop multi. This results in setting up of ‘1' in the most significant hit of the control register. A '0' is set at all bits of less significance. Let us assume that the control register is an 8 bit register.

With this setting its reading will be 1000 0000. For this initial setting of the control register the D/A converter produces an output of one half (1/2 E) of the reference supply voltage. As can be seen from the block diagram the D/A converters output is given to the comparator. The comparator also has its input from the input side of the sample and hold circuit. If the input voltage is more than the reference voltage produced by the D/A converter, the comparator gives an output, retaining the contra` register to stay in the initial setting of 1 in the most significant bit. The D/A converter goes on supplying the half reference voltage.

Now the ring counter advances the count by 1 in the second MSB of the control register. Its reading therefore becomes 1100 0000. This makes the D/A converter to enhance its output by another half i.e. half plus one fourth i.e. 3/4 E. Again the comparator compares the reference voltage with the input voltage. If in this comparison the reference voltage is more than the input voltage the comparators output changes. This change causes control register to reset the second most significant bit to '0’. This makes the D/A converter to return to the previous level of 1/2 E Volts. The DA converter now awaits another input from the control register for the next approximation. The ring counter in its turn advances by another count. Now the third most significant bit of control register will be set to 1. The D/A converter produces an output of half plus one eighth of the reference voltage.

This way the measurement cycle continues over a series of successive approximations. During this course the converters output is either retained or rejected as explained above. The series of successive approximations are shown in Figure. Ultimately the ring counter reaches the last count. The measurement cycle stops. The digital output of the control register now gives the Final approximation of unknown voltage.



Successive Approximation Type DVM

The sample and hold circuit in the input of the DVM is to prevent the conversion error. This is because of the fact that when voltages other than D.C. are measured, conversion results are inconsistent. The simplest form of sample and hold circuit consists of a switch and a capacitor.

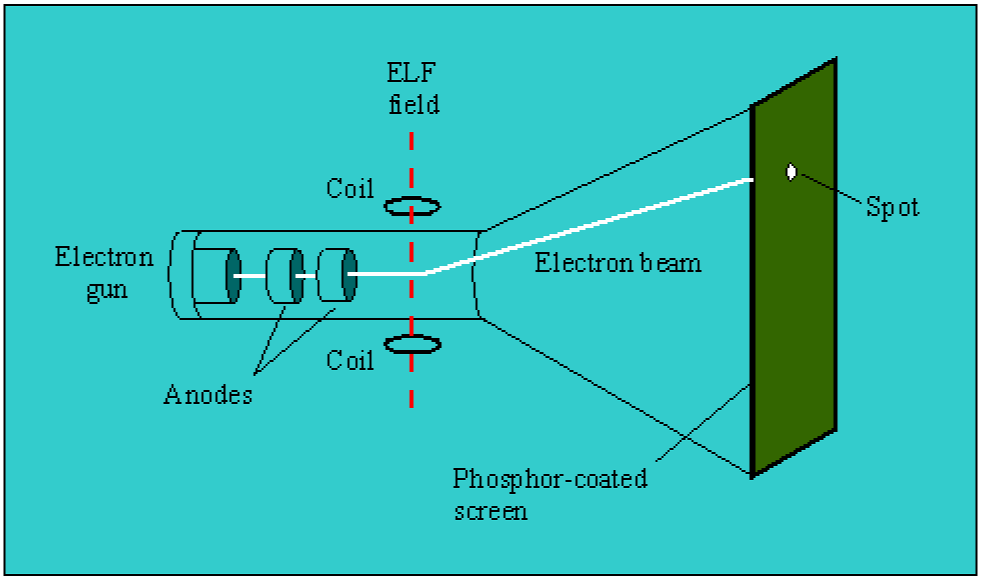
When the switch is closed the capacitor gets charged to the instantaneous value of the applied voltage. This is termed the sample mode. If the switch is open the capacitor retains the charge it acquired during the instant of charging.

The switching is made synchronous with the ring counter pulse. The measurement and conversion occurs when the switch is open, which is called the hold mode. Practically electronic switching is used.

Module-5

1.With a suitable diagram, working of cathode ray tube(CRT).

Ans: A cathode ray tube (CRT) is a specialized vacuum tube in which images are produced when an electron beam strikes a phosphorescent surface. Most desktop computer displays make use of CRTs. The CRT in a computer display is similar to the "picture tube" in a television receiver. A cathode ray tube consists of several basic components, as illustrated below. The electron gun generates an arrow beam of electrons. The anodes accelerate the electrons. Deflecting coils produce an extremely low frequency electromagnetic field that allows for constant adjustment of the direction of the electron beam. There are two sets of deflecting coils: horizontal and vertical.(In the illustration, only one set of coils is shown for simplicity.) The intensity of the beam can be varied. The electron beam produces a tiny, bright visible spot when it strikes the phosphor-coated screen.



To produce an image on the screen, complex signals are applied to the deflecting coils, and also to the apparatus that controls the intensity of the electron beam. This causes the spot to race across the screen from right to left, and from top to bottom, in a sequence of horizontal lines called theraster. As viewed from the front of the CRT, the spot moves in a pattern similar to the way your eyes move when you read a single-column page of text. But the scanning takes place at such a rapid rate that your eye sees a constant image over the entire screen.

The illustration shows only one electron gun. This is typical of a monochrome, or single-color, CRT. However, virtually all CRTs today render color images. These devices have three electron guns, one for the primary color red, one for the primary color green, and one for the primary color blue. The CRT thus produces three overlapping images: one in red (R), one in green (G), and one in blue (B). This is the so-called RGB color model.

In computer systems, there are several display modes, or sets of specifications according to which the CRT operates. The most common specification for CRT displays is known as SVGA (Super Video Graphics Array). Notebook computers typically use liquid crystal display. The technology for these displays is much different than that for CRTs.

2.Write a short note on ECG.

Ans: The electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the heart. While it is a relatively simple test to perform, the interpretation of the ECG tracing requires significant amounts of training. Numerous textbooks are devoted to the subject.

The heart is a two stage electrical pump and the heart's electrical activity can be measured by electrodes placed on the skin. The electrocardiogram can measure the rate and rhythm of the heartbeat, as well as provide indirect evidence of blood flow to the heart muscle.

A standardized system has been developed for the electrode placement for a routine ECG. Ten electrodes are needed to produce 12 electrical views of the heart. An electrode lead, or patch, is placed on each arm and leg and six are placed across the chest wall. The signals received from each electrode are recorded. The printed view of these recordings is the electrocardiogram.

By comparison, a heart monitor requires only three electrode leads – one each on the right arm, left arm, and left chest. It only measures the rate and rhythm of the heartbeat. This kind of monitoring does not constitute a complete ECG.

Electrode leads on the chest wall are able to detect electrical impulses that are generated by the heart. Multiple leads provide many electrical views of the heart. By interpreting the tracing, the physician can learn about the heart rate and rhythm as well as blood flow to the ventricles (indirectly).

Rate refers to how fast the heart beats. Normally, the SA node generates an electrical impulse 50-100 times per minute. Bradycardia (brady=slow+cardia=heart) describes a heart rate less than 50 beats per minute. Tachycardia (tachy=fast+cardia=heart) describes a heart rate faster than 100 beats per minute.

Rhythm refers to the type of heartbeat. Normally, the heart beats in a sinus rhythm with each electrical impulse generated by the SA node resulting in a ventricular contraction, or heartbeat. There are a variety of abnormal electrical rhythms, some are normal variants and some are potentially dangerous. Some electrical rhythms do not generate a heartbeat and are the cause of sudden death.

3. **Write a short note on LCD and LED.**

Ans: LCD :

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. An LCD is made with either a passive matrix or an active matrix display display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time (your mouse will appear to move more smoothly across the screen, for example).

LED:

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an *infrared-emitting diode* (IRED).

An LED or IRED consists of two elements of processed material called *P-type semiconductor*s and *N-type semiconductor*s. These two elements are placed in direct contact, forming a region called the *P-N junction*. In this respect, the LED or IRED resembles most other diode types, but there are important differences. The LED or IRED has a transparent package, allowing visible or IR energy to pass through. Also, the LED or IRED has a large PN-junction area whose shape is tailored to the application.

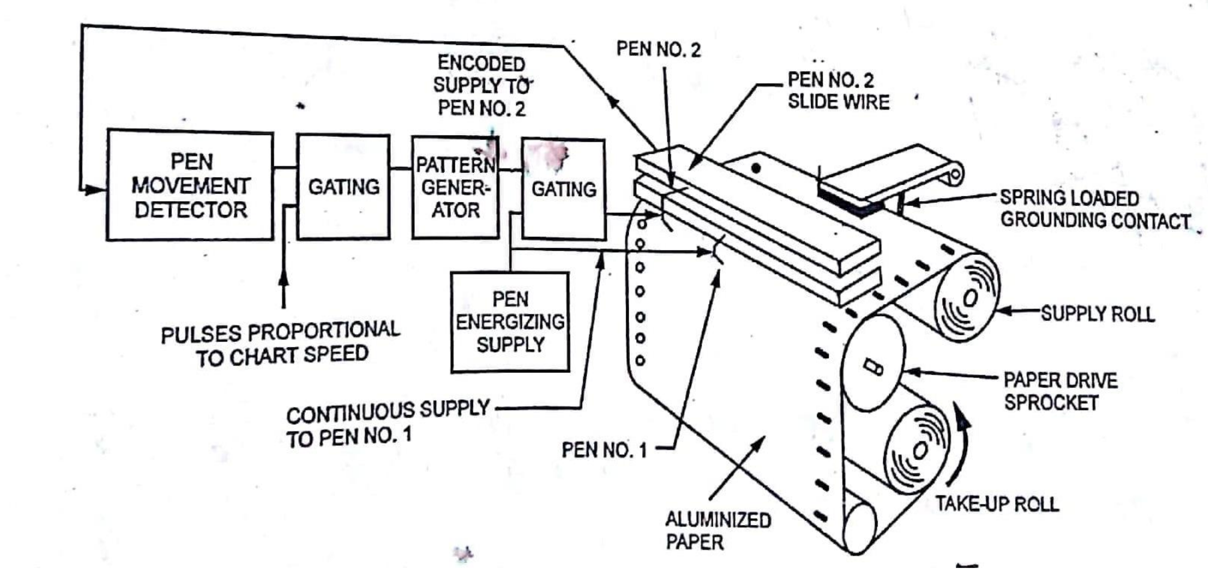
Benefits of LEDs and IREDs, compared with incandescent and fluorescent illuminating devices, include:

- Low power requirement: Most types can be operated with battery power supplies.
- High efficiency: Most of the power supplied to an LED or IRED is converted into radiation in the desired form, with minimal heat production.
- Long life: When properly installed, an LED or IRED can function for decades.

Typical applications include:

- Indicator lights: These can be two-state (i.e., on/off), bar-graph, or alphabetic-numeric readouts.
- LCD panel backlighting: Specialized white LEDs are used in flat-panel computer displays.
- Fiber optic data transmission: Ease of modulation allows wide communications bandwidth with minimal noise, resulting in high speed and accuracy.
- Remote control: Most home-entertainment "remotes" use IREDs to transmit data to the main unit.
- Optoisolator: Stages in an electronic system can be connected together without unwanted interaction.

4. With a suitable diagram, working of strip chart recorder.



- This device measures a quantity wrt time [X-t recorder]

1) Paper drive system:-

Consists of a long roll of paper called as chart, moving vertically and driven by a synchronous motor with a constant speed selectors.

2) Marking mechanism :-

(a) pen & Ink :⇒

There are several types of pens, including the bucket pen, the V-pen, the fibre-tipped pen & ball point pens.

- In ordinary (normal speed) type, V-pen, foundain pen, large reservoir capillary feed recording tips are common.
- For higher speed ballpoint pen is ~~not~~ suitable.
- Usually Red colour pen is used for writting.
- Advantage is simplicity, low operating cost, operation over a wide range of recording speeds is possible.
- Disadvantage is that ink can spillage, can breake and ink pot can dried of so difficult to analysis for the higher range of frequency.

(b) Impact printing :⇒

- The moving pointer is clamped in position for a slightly prolonged instant & a press bar above the pointer mechanism pressed down in a carbon ribbon located between the paper charts & the pointer.
- A print wheel like a pointer travels from one end of the scale to other.
- print wheel provides adequate ink to the pointer.
- This mechanism used for measurement of pressure, temperature etc.

(c) Thermal writing :⇒

- This is an Inkless technique.
- This include thermal writting on a heat sensitive paper
- In this system electric current is passed through the tip of the movable stylus. The current heat the stylus and the heat cause a thin, clean line to appear on the special heat sensitive paper.
- This is a costlier method and canot be used where recording process generates heats and recording will affect indirectly.

(d) Electric Writing :-

Electric writing paper is used, which is a form of a dense black substrate coated with aluminium.

- A tungsten wire stylus is used, which is kept in very light ~~cont~~ contact with the aluminium surface
- A voltage of 35 V dc minimum is required.
- supply current is continuously interrupted at approximately 8 KHz.
- Advantage can be used for wide range of application
- Disadvantage is the cost.

(e) Light beam method :-

- In this system, mirror is fitted on the galvanometer and a beam of light is reflected through it which strikes the photosensitive paper.
- The advantage of this method is that it allows higher frequency to be recorded & allows a relatively large chart speed with a good resolution.
- The disadvantage is high quality paper is used. This method is not suitable for processes requiring instantaneous monitoring.

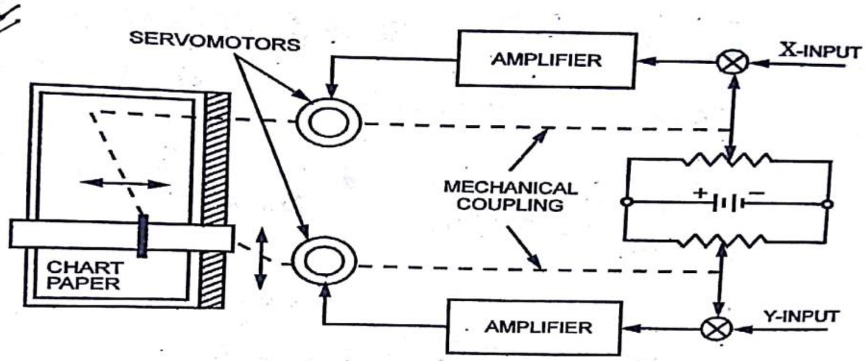
(f) Electrostatic Writing :-

This system employs a stylus producing a high voltage discharge thereby producing a permanent trace on an electrosensitive paper. This systems consists of three elements namely an imaging head, a toaning head & a vaccum knife.

A vaccum knife then removes all excess toner & particles leaving the charged particle images.

XY recorder:

IMP



→ These instruments are employed where X-Y is the variables. $y = f(x)$ instead of plotting each variable separately as a function of time.

→ In such a recorder one of variables is applied to the X-input & the other to the Y-input & the recorder plots their variations against one another.

→ An X-Y recorder closely resembles & functions like a single pen recorder except that the chart (Y-axis) is moved in response to changes in a variable instead of a uniform time rate.

→ In recorders chart remains fixed in its position & the pen moves simultaneously in both the X & Y dirn in response to electrical signals applied to its two i/p terminals.

→ Same type as stripchart → X-Y recorder.