SUMMER– 15 EXAMINATION

Subject Code: **17317** **Model Answer**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

1. A) Attempt any six of the following: 12 marks

a. Define the terms:

i. Resolution ii. Dead Zone

Ans a. **Each Definition: 1M**

i. Resolution: the smallest change in input to which instrument can respond is known as resolution.

ii. Dead zone: the largest range of value of measured variable to which instrument does not respond is known as dead zone.

b. Draw a circuit diagram of universal shunt voltmeter.

Ans b. **Circuit diagram: 2M**

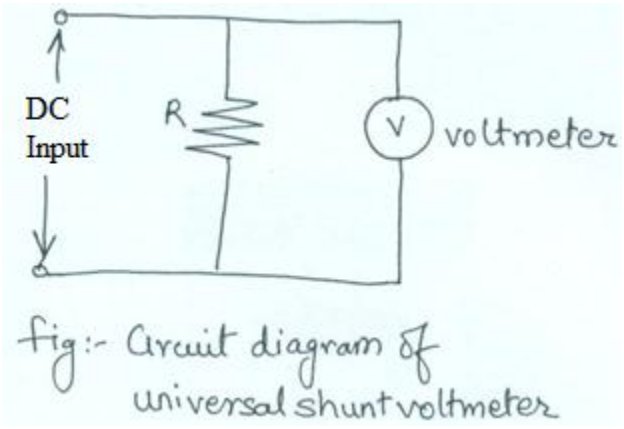


fig:- Circuit diagram of universal shunt voltmeter

c. State any two disadvantages of digital instruments.

Ans c. **Any two disadvantages: 2M**

i. They are costly.

ii. They are complex in nature.

iii. Speed of operation is limited due to digitizing circuits.

d. State principle of digital frequency meter.

Ans d. **Principle: 2M**

The single waveform is converted to trigger pulse and applied continuously to AND gate. A pulse of 1sec is applied to the other terminal and the number of pulses counted during this period indicates the frequency. The signal whose frequency is to be measured is converted into train of pulses, one pulse for each cycle of the signal. the number of pulses occurring in a definite interval of time is then counted by an electronic counter since each pulse represents the cycle of the unknown signal, the number of counts is the direct indication of the frequency of the signal since electronic counters have a high speed of operation, high frequency signal can be measured.

e. Explain in brief function of focusing and accelerating anodes in CRT.

Ans e. **correct function – 2 marks**

The assembly of focusing and accelerating anodes is used to control the scattering of electrons and increase in speed of electrons.

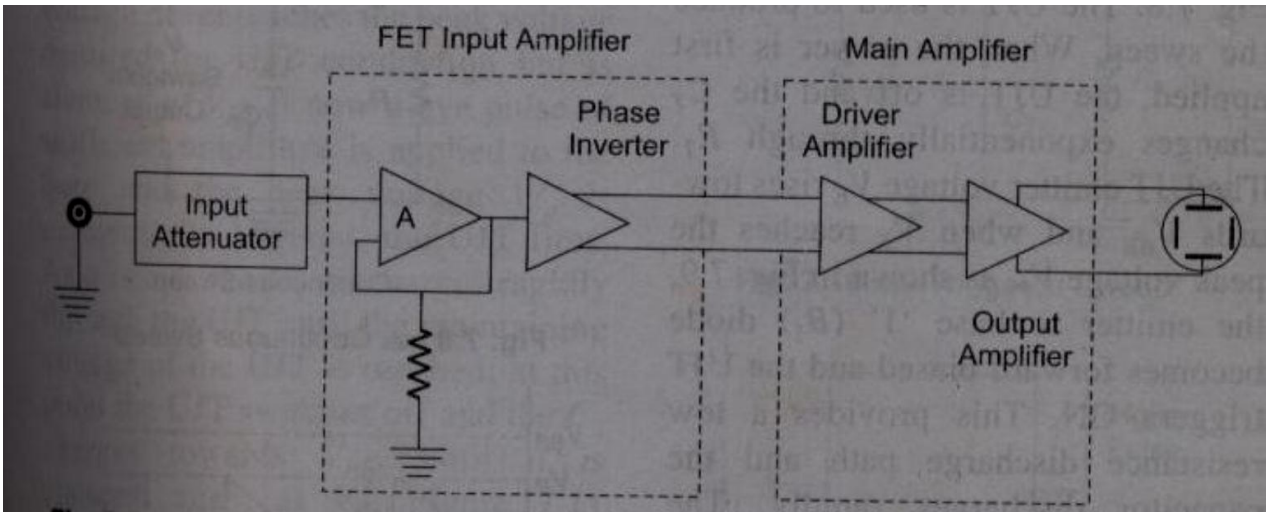
It consists of pre-accelerating anode and accelerating anode.

The focusing anode is placed between the pre-accelerating anode and accelerating anode.

When the electron beam is accelerated by the accelerating anodes it passes through the deflection plate assembly.

f. Draw a block diagram of vertical deflection system in CRO.

Ans f. **Block diagram: 2M**



g. State need of signal generators.

Ans g. **Any two points: 2M**

1. To produced controlled output waveform for testing.
2. To provide small signal with desired frequency and amplitude.

h. List one example of time domain and frequency domain instruments.

Ans h. **Example of time domain: 1M and Example of frequency domain: 1M**

Time domain instruments: CRO

Frequency domain instruments: Spectrum analyser

B) Attempt any two of the following: 8 marks

a. List dynamic characteristics of instruments. Define any two.

Ans a. **(list any four – 2 marks, definition any two – 1 mark each)**

Dynamic characteristics of instruments are:

1. Speed of response
2. Fidelity
3. Lag
4. Dynamic error.

Definition:

1. Speed of response:

The rapidity with which instrument responds to make changes in the measured quantity is called as speed of response.

2. Fidelity:

The degree to which instrument indicates the change in measured variable without dynamic error is called as fidelity.

3. Lag:

The retardation on delay in the response of an instrument to make the change in measure quantity is known as lag.

4. Dynamic error:

The difference between the true value of a quantity changing with time and the value indicated by the instrument if no static error is assumed is called as dynamic error.

b. Describe the different standards.

Ans b. **4Marks**

1) International standards:

- International standards are fixed and develop by international agreement.
- These standards are maintained at International Bureau of Weights and Measures in France. This standard gives different unit having best accuracy.
- To preserve best accuracy these standards are periodically check by absolute measurement.
- These standards are used to calibrate primary standard only.
- These are not available to ordinary user for measurement.

2) Primary standards

- These standards are preserved and maintained by National Standard Laboratories which are located at different part of the world. E.g.-NBS (National Bureau of Standards) located at Washington. These standards are periodically calibrated by International standards.

3) Secondary standards

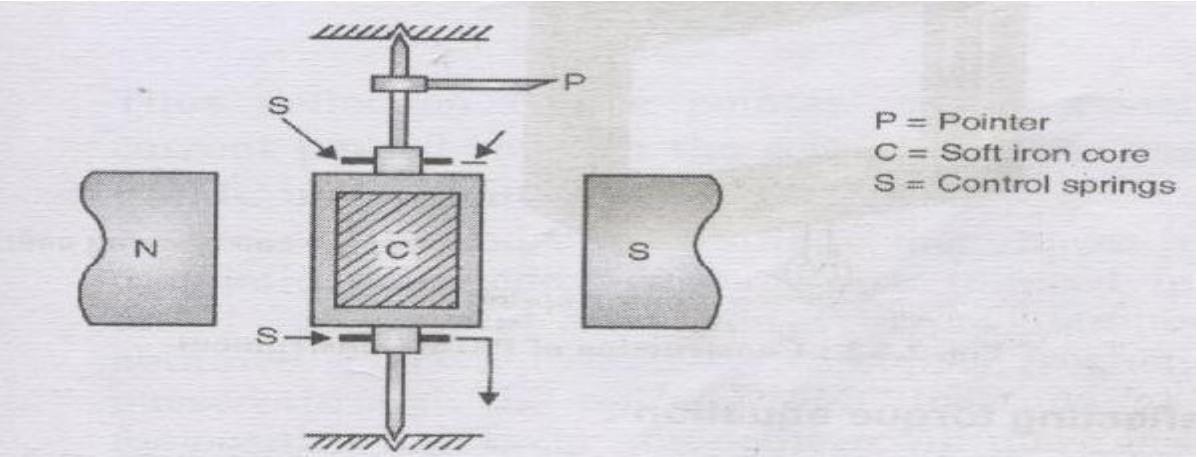
- These standards are also called as basic standards.
- These standards are used by industries and calibration laboratories.
- Each industry has its own laboratory.

4) Working standards

- These standards are used in general laboratories.
- These standards are used to check components and calibrating laboratory instruments to achieve good accuracy and better performance.

c. Draw a diagram of D' Arsonval movement and state its principle.

Ans c. **Diagram:2M, Principle:2M**



Working Principle:-

A current carrying conductor placed in magnetic field experiences a force.

It is given by the expression,

F = BIL

Where,

F= Force in Newton

B= Flux density in Tesla

I= Current in ampere

L= Length of conductor in meter.

2. Attempt any four of the following: 16 marks

a. Explain the need of calibration and calibration process.

Ans a.

Calibration: 2M

The process of deriving the value of a quantity by comparing that quantity with a standard quantity is called as calibration.

Calibration of instrument is done to obtain correct unknown value of each scale reading on measuring instrument.

Need of calibration 2M

There are 3 main reasons for having instrument calibration:

1. To ensure reading from an instrument are consistent with other measurements.
2. To determine the accuracy of the instrument reading.
3. To establish the reliability of the instrument i.e. it can be trusted.

b. Draw a block diagram of dual beam CRO.

Ans b. **Correct block diagram:4M**

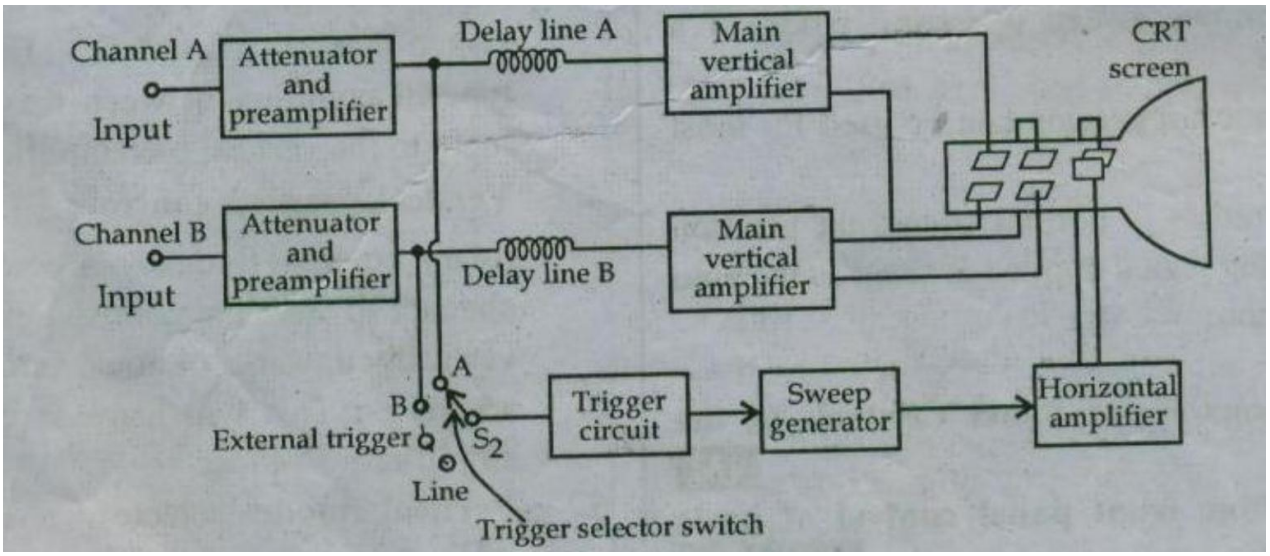


Fig: Dual beam CRO

c. Describe the waveform generation in CRO.

Ans c. **4Marks**

- To obtain a graph of amplitude versus time the signal voltage is applied to the vertical plates directly or through the vertical amplifier and it moves the spot vertically plates positions corresponding to the instantaneous values of the signal. Simultaneously the spot is moved horizontally by a sweep voltage applied to the horizontal plates. The combined action of these two voltages causes the spot to produce a trace on the screen. the horizontal sweep voltage produces the time base by moving the spot horizontally with time, while the signal moves the spot vertically in proportional to the voltage at a particular instant of time.
- There are two important sweep generator requirements.
  1. The sweep must be linear (the sweep voltage must rise linearly to the maximum value required for full screen horizontal deflection of the spot.)
  2. The spot must move in one direction only i.e. from left to right only, else the signal will be traced backwards during the return sweep. This means that the sweep voltage must drop suddenly after reaching its maximum value.

d. Draw a circuit of time base generator and explain it.

Ans d. **Diagram:2M; Explaination:2M**

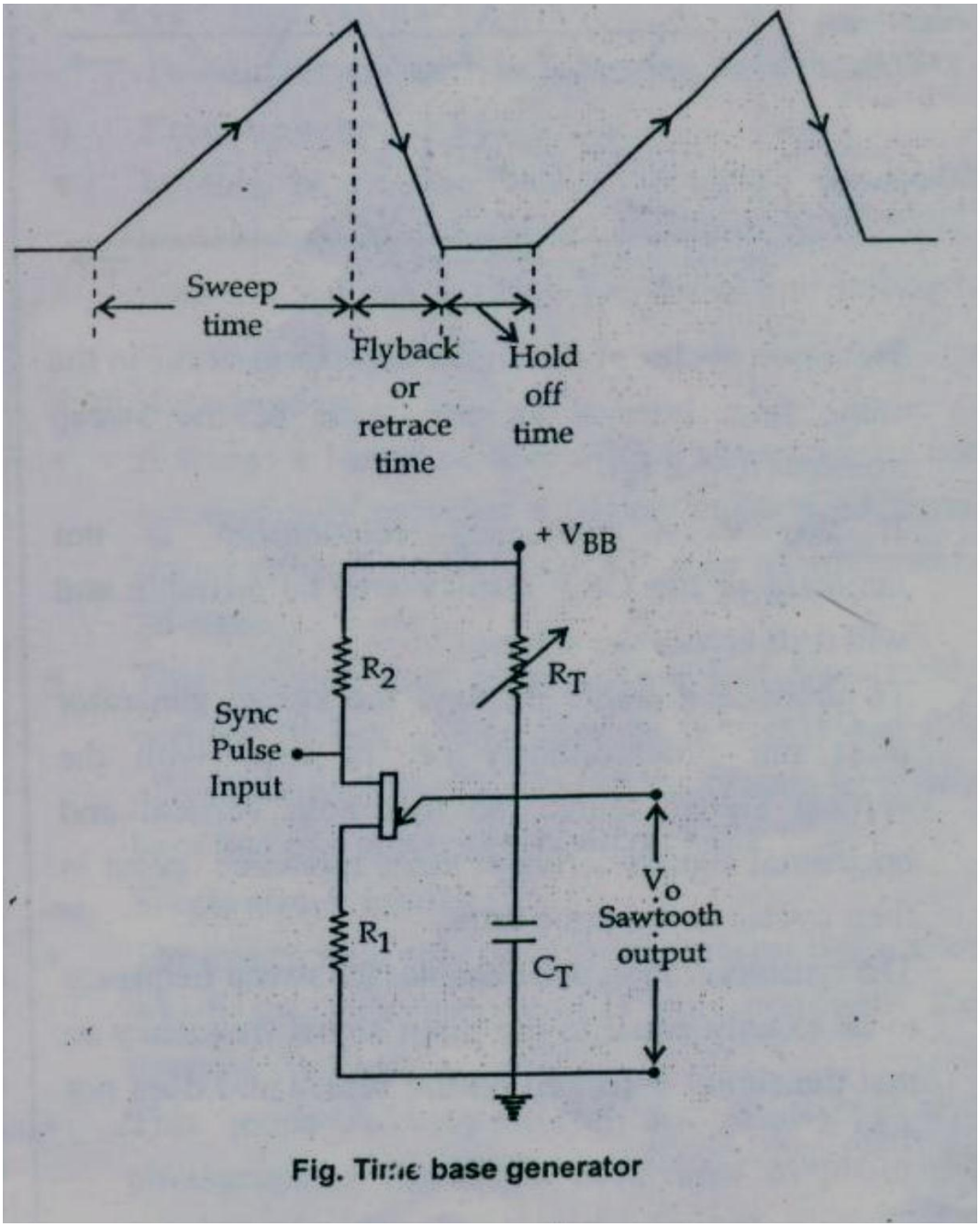


Fig. Time base generator

Time base generator:

- The main purpose of time base generator is to convert given input signal into sawtooth waveform, which will deflect the beam in the horizontal direction.
- It has two modes i.e. sweep mode and fly back mode.
- During sweep time TS the beam moves left to tight across the CRT.
- The beam is deflected towards right by increasing amplitude of ramp voltage and the fact that positive voltage attracts the negative electrons.

- During retrace time or fly back time Tr the beam returns quickly to the left side of screen.
- The control grid is generally gated OFF which black out the beam during retrace time and prevent an undesirable retrace pattern from appearing on the screen.

e. Explain operation of dual trace CRO, with neat block diagram.

Ans e. **Operation:2M; Block diagram:2M**

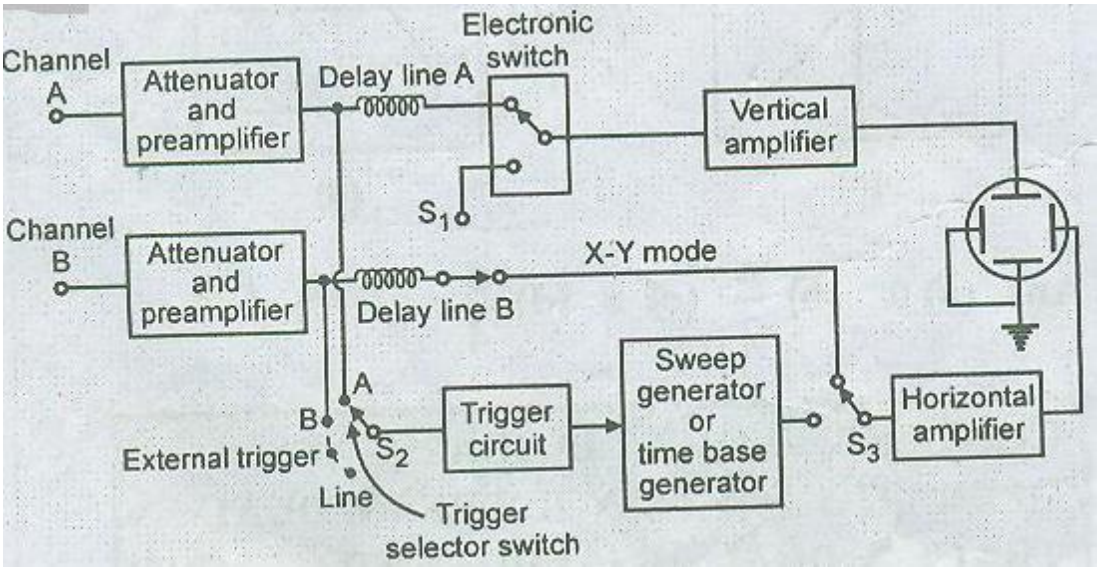


Fig: Dual trace CRO

- The block diagram of dual trace CRO is shown above.
- In this type of CRO a single beam is split into two to produce two changes.
- It consists of single electronic gun CRT, electronic switch, vertical amplifier, delay line, trigger circuit, sweep generator, horizontal amplifier, two attenuator and preamplifier.

- The dual trace CRO has two separate vertical input, channel A and channel B.
- These two channels are used to separate attenuator and pre amplifier stage which is controlled individually.
- An electronic switch is used to pass one channel at a time into vertical amplifier through delay line.
- Trigger selector switch: Trigger signals are picked up from channel A or channel B or line or external signal.
- In circuit there are three switches used. The switch S1 is used to select the channel A or channel B to connect with vertical amplifier. Switch S2 allows trigger circuit to select channel A, channel B, line or external signal. While switch S3 is used to connect horizontal amplifier to channel B in X- Y mode.

f. Explain phase measurement using Lissajous patterns.

Ans f.

Phase measurement of Lissajous figures: (4M)

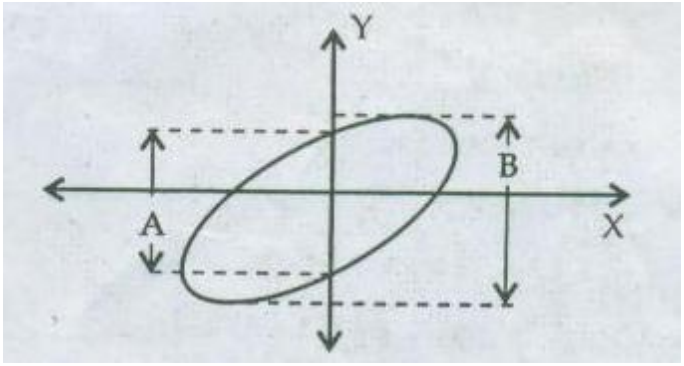
The phase measurement can be done by using Lissajous figures.

The CRO is set to operate in the X- Y mode, then the display obtained on the screen of a CRO is called Lissajous pattern, when two sine waves of the same frequency are applied to the CRO. (One vertical and one horizontal deflection plates).

Depending on the phase shift between the two signals, the shape of the Lissajous pattern will go on changing.

The phase shift is given by,

$\Theta = \sin^{-1}(A/B)$



A. The Lissajous pattern will be an ellipse if the sine waves of equal frequency but phase shift between 00 and 900 are applied to the two channels of CRO. The Lissajous pattern will be as shown below-

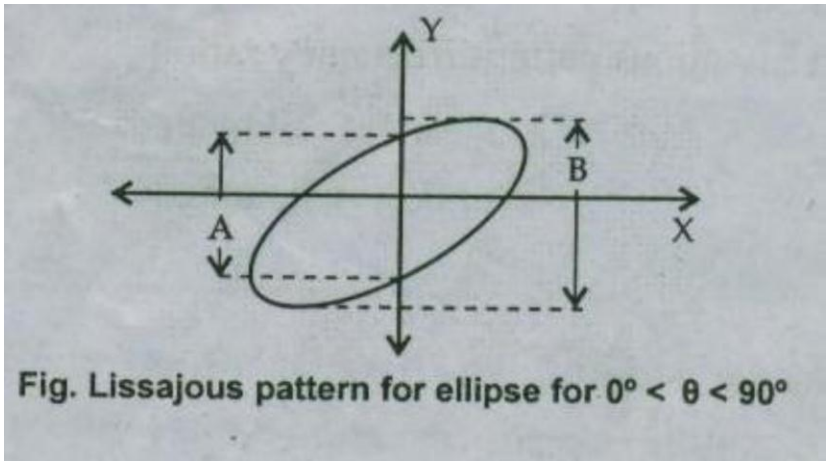
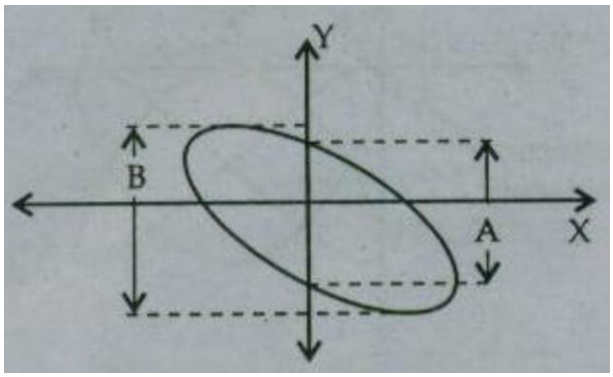
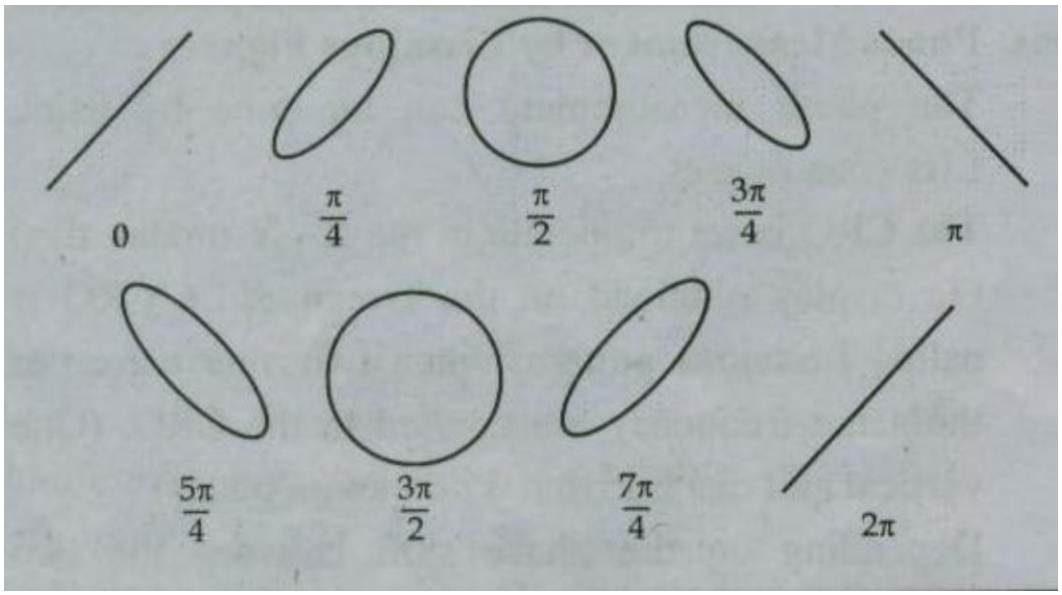


Fig. Lissajous pattern for ellipse for $0° < \theta < 90°$

B. For the phase difference above 900 and less than 1800, the ellipse appears as shown



C. Different Lissajous figure for phase difference 00, 450, 900, 1350, 1800, 2250, 2700, 3150, 3600 are shown below respectively



3. Attempt any four of the following: 16 marks

a. State detailed classification of errors.

Ans a.

4Marks

1. **Static error** :

The error which occurs in stationary condition is called as static error. These are classified as:

i. **Gross errors**: the errors which occur due to human mistakes while taking reading, handling instrument incorrect setting or adjustment and improper use of instrument are known as gross errors. The complete elimination of gross errors is not possible but we can minimize it. These errors are also called as personal errors. These errors may be avoided by taking reading and recording it carefully, by taking more than two reading, by proper handing of instrument.

ii. **Systematic errors**: these errors occur due to shortcoming of the instrument such as defective or worn part or aging or effect of environment on the instrument.
   a. **Instrumental error:** the errors which arise due to inherent shortcoming of instrument, misuse of instrument, loading effect of instrument are called as instrumental error. These errors can be removed by, selecting suitable instrument for particular application, selection of correct setting on the instrument, calibrating the instrument against standard, applying correction factor after the determination of instrumental error.
   b. **Environmental error**: these errors occur due to external condition to the measuring instrument, such as temperature, pressure, humidity, dust and external magnetic field. This error can be avoided by, keeping surrounding condition constant with the help of air conditioning, temperature control, enclosure, etc. and using proper magnetic shielding.
   c. **Observation error**: these are introduced by the observer. the most common error is the parallex error introduced in reading a meter scale. these error can be removed by taking reading carefully, using mirror scale and having the pointer and scale in same plane, and using digital instrument.

iii. **Random error**: these errors are due to unknown causes, these error remain since the systematic and gross error are removed, generally these error are very small in nature.
   2. **Dynamic error**: the difference between true value of a quantity changing with time and value indicated by instrument if no static error is assumed is called as dynamic error.

b. A basic D'Arsonval movement with an internal resistance of 50Ω and a full scale deflection current of 2mA is to be used as multirange voltmeter. Design a series of string of multipliers to obtain the voltage ranges of 0-10V, 0-50V.

Ans b. **Correct solution:4Marks**

Given: R_m= 50Ω

I_{fsd}= I_m= 2mA

To find: a) R_{s1} b) R_{s2}

Solution:

For range (0-10V), V_1=10V

Therefore,

$R_{s1}= V_1/ I_{fsd} – R_m = 10/ 2x10^{-3} -50$

= 5000-50

= 4950Ω

R_{s1}= 4.95kΩ

For range (0-50V), V_2=50V

Therefore,

$R_{s2}= V_2/ I_{fsd} – R_m = 50/ 2x10^{-3} -50$

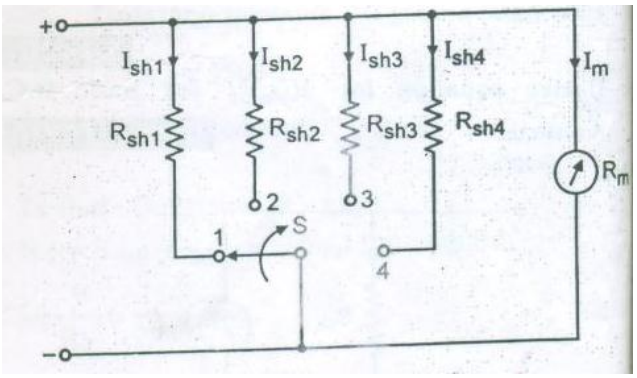
= 25000-50

= 24950Ω

R_{s2}=24.95kΩ

c. Derive the expression for shunt resistors required in multirange ammeters.

Ans c. **Correct derivation:4Marks**



(i) D.C ammeter with single range is set by shunt resistor Rsh

(ii) Now it is possible to design dc ammeter for different range

(iii) Multirange ammeters are used to obtain different current ranges.

(iv) To make multirange ammeter and to increasing the range of dc ammeter different shunt resistors are used as shown

(v) Here four shunt are used i.e R_{sh_1}, R_{sh_2}, R_{sh_3} & R_{sh_4} All these four resistors are connected in parallel with meter resistance R_m.

(vi) By using suitable rotary switch the required shunt resistance can be selected.

(vii) Let m_1, m_2, m_3 & m_4 are different multiplying powers then eqn for shunt resistors are given below -

(1) $R_{sh_1} = \frac{R_m}{m_1 - 1}$ (2) $R_{sh_2} = \frac{R_m}{m_2 - 1}$ (3) $R_{sh_3} = \frac{R_m}{m_3 - 1}$ (4) $R_{sh_4} = \frac{R_m}{m_4 - 1}$

(viii) This type of multirange are used for range upto 50A

for R_{sh_1}.

Let I_{sh_1} is current flowing through R_{sh_1}

$\therefore I_1 = I_{sh_1} + I_m$ $\therefore R_{sh_1} = \frac{1}{\frac{I_1}{I_m} - 1}$ $R_m = \frac{R_m}{m_1 - 1}$

where $m_1 = \frac{I_1}{I_m}$

for R_{sh_2}

Let I_{sh_2} is current flowing through R_{sh_2}

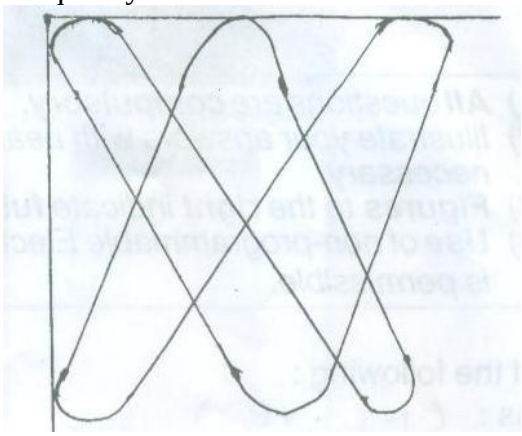
$\therefore I_2 = I_{sh_2} + I_m$ $\therefore R_{sh_2} = \frac{1}{\frac{I_2}{I_m} - 1}$ $R_m = \frac{R_m}{m_2 - 1}$

where $m_2 = \frac{I_2}{I_m}$

Similarly

$R_{sh_3} = \frac{R_m}{m_3 - 1}$ & $R_{sh_4} = \frac{R_m}{m_4 - 1}$

d. The Lissajous pattern observed on CRO is as shown in figure. Calculate the vertical input frequency if horizontal input frequency is 1500Hz.



Ans d. **correct solution: 4marks**

X=3, Y=2

Therefore, $f_y = X/Y \times f_x = 3/2 \times 1500Hz$

$f_y = 2.25kHz$

e. Draw a block diagram of function generator. State function of each block.

Ans e. **Block diagram: 2M; Function: 2M**

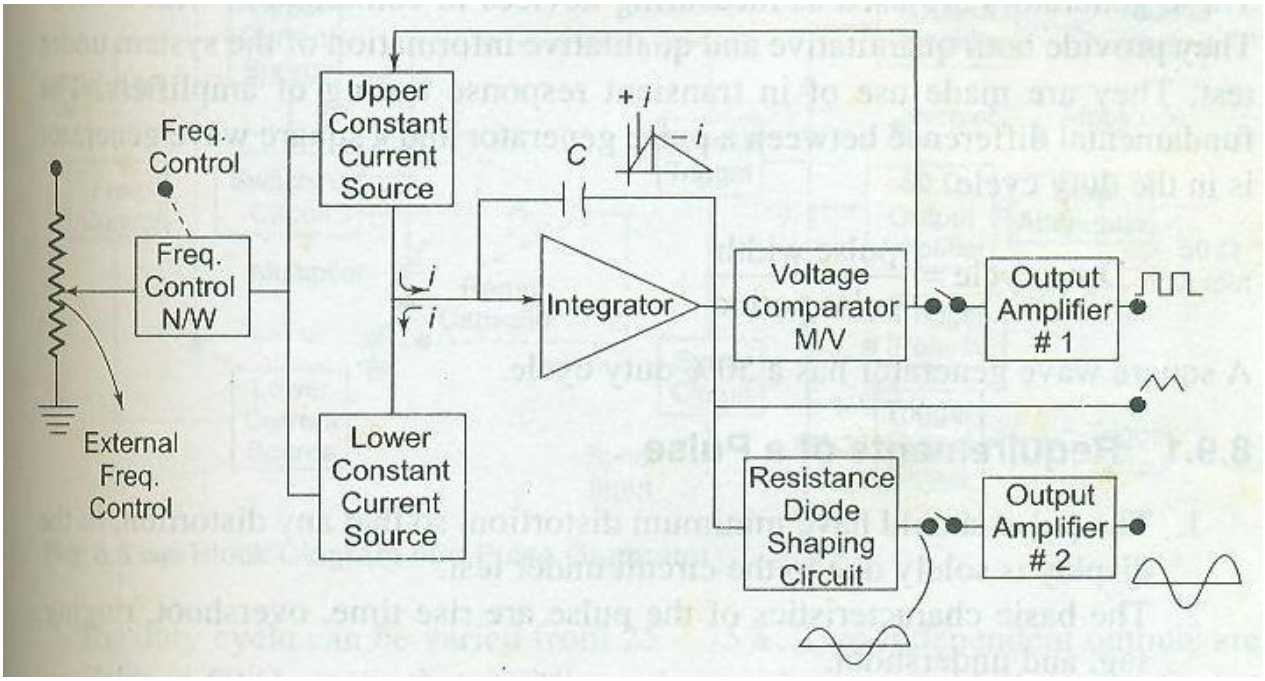


Fig: Function Generator.

The frequency is controlled by varying the capacitor in LC or RC circuit. In this instrument the frequency is controlled by varying the magnitude of current which drives the integrator. The instrument produces sine, triangular and square waves with a frequency range of 0.01 Hz to 100 kHz.

The frequency controlled voltage regulates two current sources. The upper current source supplies constant current to the integrator whose output voltage increases linearly with time, according to the equation of the output signal voltage.

$$e_{out} = \frac{-1}{C}\int_{0}^{t} i\,dt$$

An increase or decrease in the current increases or decreases the slope of the output voltage and hence controls the frequency.

The voltage comparator multivibrator changes states at a pre- determined maximum level of the integrator output voltage. This change cuts off the upper current supply and switches on the lower current supply.

The lower current source supplies a reverse current to the integrator, so that its output decreases linearly with time. When the output reaches a pre-determined minimum level, the voltage comparator again changes state and switches on the upper current source.

The output of the integrator is a triangular waveform whose frequency is determined by the magnitude of the current supplied by the constant current sources.

The comparator output delivers a square wave voltage of the same frequency. The resistance diode network alters the slope of the triangular wave as its amplitude changes and produces a sine wave with less than 1% distortion.

f. Write two uses of
   1. Video pattern generator 2. Function generator.

Ans f.

Video pattern generator: 2M

- The horizontal pattern is used to check vertical linearity.
- The vertical pattern is used to check horizontal linearity
- The cross hatch pattern is used to check vertical and horizontal linearity simultaneously and more precisely. FM signal is used for aligning sound IF as well as discriminator circuit.

Function generator: 2M

- As trouble shooting tool to different analog and digital circuits.
- As a source for alignment of different receivers.
- If rise time of square wave is significantly low, such square wave is used to test the amplifier frequency response (square wave testing)
- Well synthesized arbitrary waveforms like burst, sweep, cardiac, sawtooth, AM, FM, FSK, noise etc. are available on the function generators by reputed manufacturers. These function generators are becoming versatile source in testing tools.

4. Attempt any four of the following: 16 marks

a. State classification of analog meters.

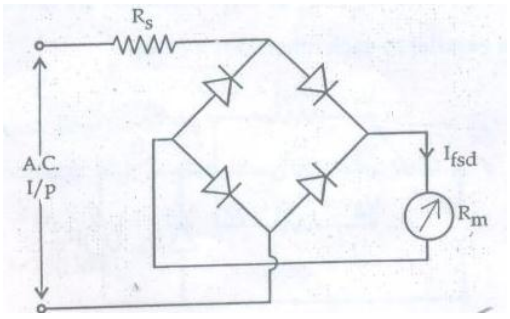
Ans a. **classification of analog meters:4M**

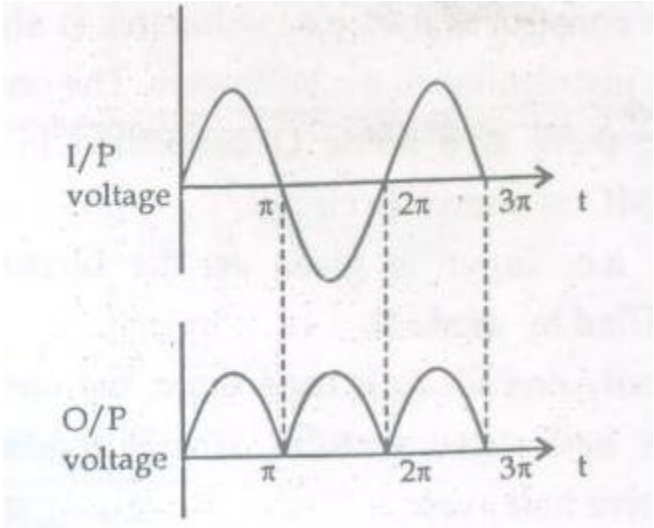
The main types of instrument used as ammeters and voltmeters are as follows:

- Permanent magnet moving coil instrument (PMMC)
- Electro dynamometer type instruments.
- Moving Iron type instruments
  Attraction type moving iron instruments.
  Repulsion type moving iron instruments
- Thermocouple instruments.
- Electrostatic instruments.
- Induction instruments.
- Hot wire Instruments.

b. Draw a diagram of full wave rectifier type AC voltmeter. Explain its working.

Ans b. **Diagram:2M; Working:2M**





The circuit of Bridge rectifier type a.c. voltmeter is shown

- In full wave bridge rectifier the output voltage double that of half wave rectifier.
- If we assume that diode has zero forward ~~bias~~ resistance & infinite reverse resistance,

$$R_s = \frac{V_{dc}}{I_{fsd}} - R_m$$

R_s = series resistance , V_{dc} – dc output voltage
I_{fsd} = full scale deflection current.
R_m = Internal resistance is applied at input,
then the output voltage is given by

$$V_{dc} = \frac{2}{2\pi} \int_0^{\pi} V_m \sin \omega t \cdot d\omega t$$

$$= \frac{1}{\pi} (-V_m) [\cos \omega t]_0^{\pi} = -\frac{V_m}{\pi} [-1-1]$$

$$V_{dc} = \frac{2V_m}{\pi}$$

we know,

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$\therefore V_m = \sqrt{2}\, V_{rms}$$

Put this value in equation (1)

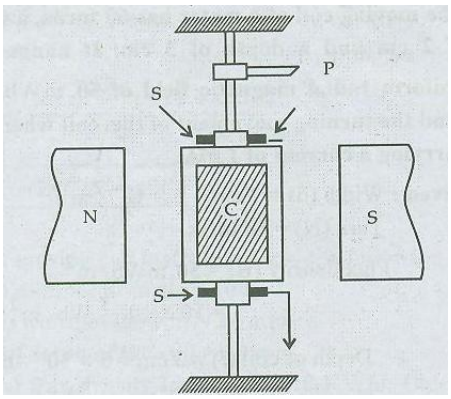
$$\therefore V_{dc} = \frac{2\sqrt{2}\, V_{rms}}{\pi}$$

$$\therefore V_{dc} = 0.903\, V_{rms}$$

- The above equation shows that such type of voltmeter shows 90.3% efficiency that of dc ~~ammeter~~ voltmeter.
- The scale marking are made by using multiplication factor.

c. Derive the relation between deflection torque in PMMC instruments.

Ans c.



Deflecting Torque Equation:

Torques which deflect the pointer from its zero position is known as deflecting torque.

The deflecting of pointer is directly proportional to quantity to be measured.

The deflection torque produced due to current flowing through coil.

Let length of coil be L meter and width of coil be d meter. Assume, I is the current flowing through coil having N turn. B is consider as flux density produce in air gap.

Therefore the force exerted by coil is

F= BiL

The deflecting torque is given by

Td = Force x distance

Td = F x S

= B x l x I x N x d ---------- (1)

Td = B x A x I x N ---------- (2)

Where, A = l x d = Area of coil former.

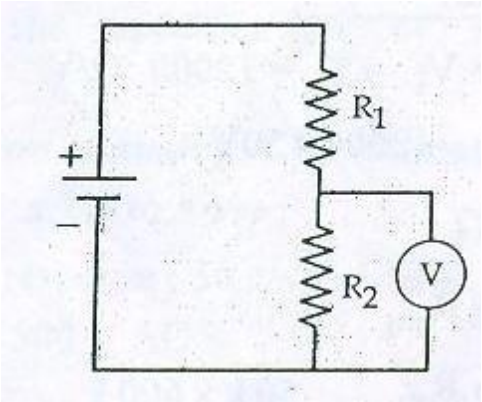
d. Explain the loading effect in voltmeters. How to avoid it?

Ans d. **Loading effect in voltmeters:2M. How to avoid it:2M**

Sensitivity of meter plays an important role while selecting a voltmeter.

- A low sensitivity meter gives accurate reading when it is used for the measurement of voltage in low resistance circuit, but it may give inaccurate reading during the measurement of voltage in high resistance circuit.
- If voltmeter is connected across low resistance, then most of the current will pass through low resistance and very less current flow through voltmeter because of its high resistance. The voltage drop is a measure of true value.

- If the voltmeter is connected across high resistance then the current may be divided into two paths and voltage drop recorded by meter is lower than true value. This effect is known as loading effect.
- Sensitivity of meter plays an important role while selecting a voltmeter.
- A low sensitivity meter gives accurate reading when it is used for the measurement of voltage in low resistance circuit, the measurement of voltage in high resistance circuit.
- If voltmeter is connected across low resistance, then most of the current will pass through low resistance and very less current flow through voltmeter because of its high resistance. The voltage drop is a measure of true value.



- If the voltmeter is connected across high resistance then the current may be divided into two path and voltage recorded by meter is lower than true value. This effect is known as loading effect.
- By giving capable load to voltmeter & keep sensitivity high loading affect can be avoided.

e. A 2mA meter with an internal resistance of 100Ω is to be converted to 0-150mA ammeter. Calculate the value of shunt resistance required.

Ans e. **Correct solution: 4M**

Given: I_m=2mA, R_m= 100 Ω, I= 150mA

To find: R_{sh}=?

Solution: m= I/I_m= 150mA/ 2mA= 150/2 =75

R_{sh}= 1/ m-1 x R_m

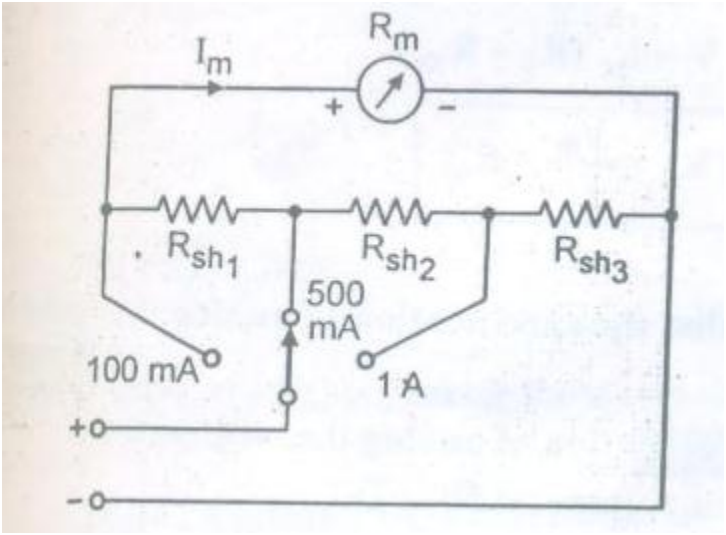
= 1/ 75-1 x 100

= 100/74

R_{sh}= 1.35Ω

f. Draw a circuit diagram of Aytron shunt type ammeter. What is the advantage of it over normal shunt type ammeter?

Ans f. **Circuit diagram:2M; Advantage:2M**



- Sensitivity is high as compared to normal shunt type ammeter

5. Attempt any FOUR of the following: 16 marks

a. State any four applications of CRO.

Ans a. **Any four applications:4M**

1. It is used in laboratory for measurement of AC/DC voltage, current, frequency, phase and study nature of waveform.
2. It is used in TV receiver for creation of images.
3. It is used in radar receiver for giving visual indication of target such as aeroplane, ship etc.
4. It is used to test AF circuit for different distortion.
5. It is used to check faulty component.
6. It is used to check signals at radio and TV receiver.
7. It is used to check B-H curve of different ferromagnetic material.
8. It is used in medical equipment such as ECG, patient monitor.
9. It is used to check modulation percentage of modulated wave.
10. It is also used to check radiation pattern generated by antenna.

b. Draw a basic block diagram of digital storage CRO. Write the function of each block.

Ans b. **(diagram – 2 marks, explanation – 2 marks)**

Block Diagram:

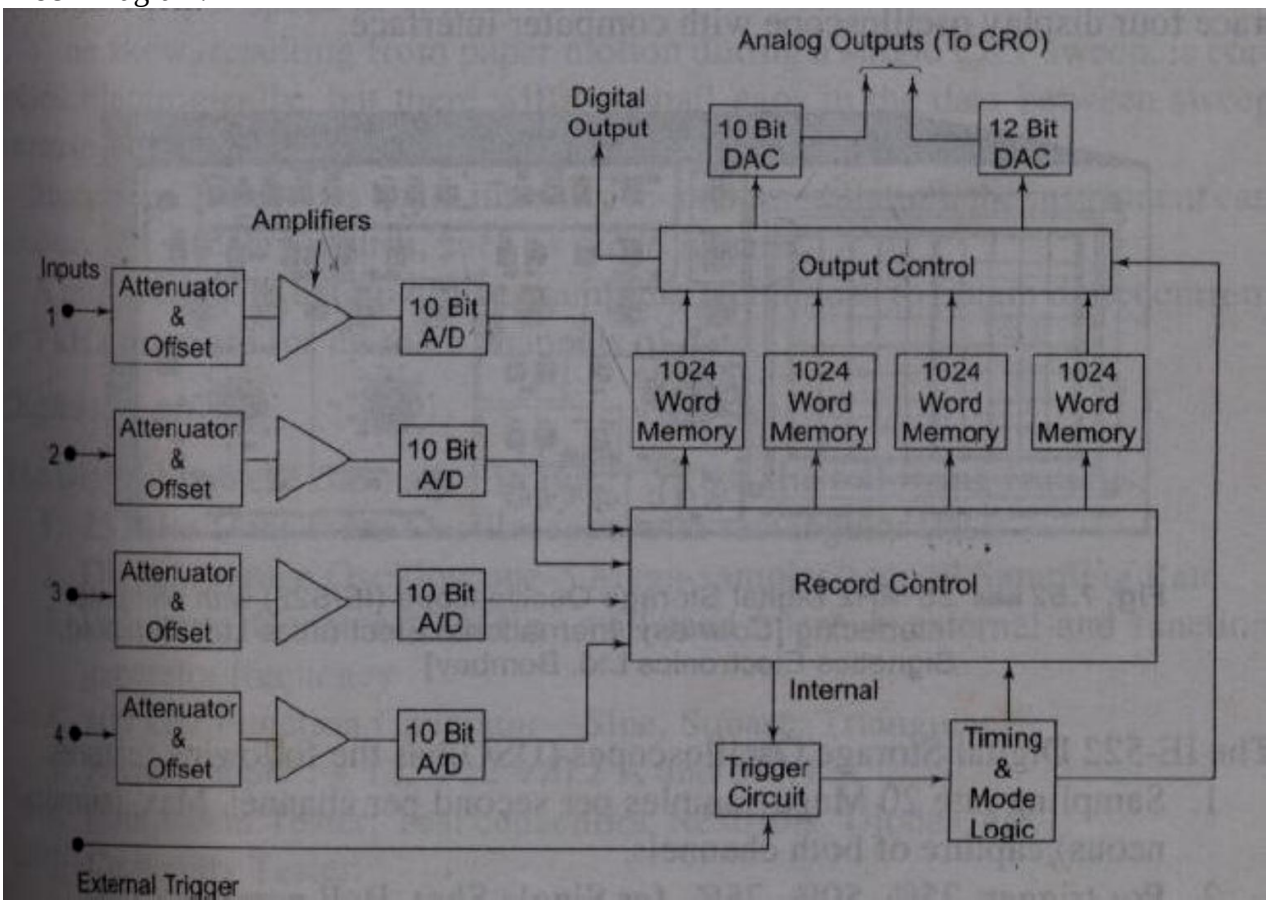


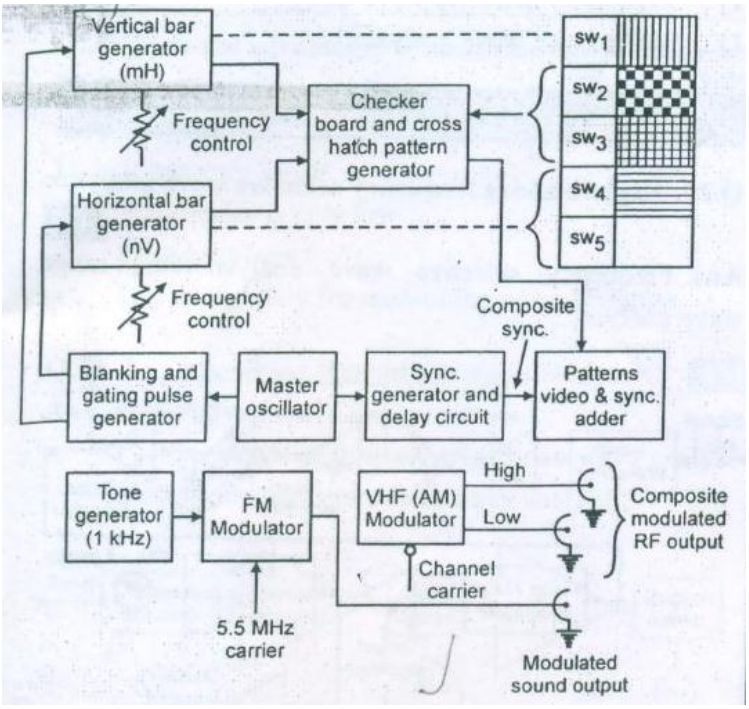
Fig. Block diagram of Digital Storage Oscilloscope

- The analog voltage input signal is digitized in a 10 bit A/D converter with a resolution of 0.1% (1 part in 1024) and frequency response of 25 kHz. The total digital memory storage capacity is 4096 for a single channel, 2048 for two channels each and 1024 for four channels each.
- The analog input voltage is sampled at adjustable rates (Upto 100, 000 samples per second) and data points are read onto the memory. A maximum of 4096 points are storable in this particular instrument. (Sampling rate and memory size are selected to suit the duration and waveform of the physical event being recorded.)
- Once the sample record of the vent is captured in memory, many useful manipulations are possible, since memory can be read out without being erased.
- If the memory is read out rapidly and repetitively, an input event which was a single shot transient becomes a repetitive or continuous waveform that can be observed easily on an ordinary scope(without going through DAC) to say a computer where a stored program can manipulate the data in almost anyway desired.

- Pre triggering recording allows the input signal preceding the trigger points to be recorded. In ordinary triggering the recording process is started by the rise of the input (or some external triggering) above some preset threshold value.
- As in digital recorder, DSO can be set to record continuously(new data coming into the memory pushes out the old data, once memory is full), until the trigger signal is received; then the recording is stopped, thus freezing data received prior to the trigger signal in the memory.
- An adjustable trigger delay allows operator control of the stop point, so that the trigger may occur near the beginning, middle or end of the stored information.

c. Draw a block diagram of pattern generator. Explain generation of cross hatch pattern.

Ans c. **(diagram – 2 marks, explanation – 2 marks)**



There are two bar generators i.e. vertical and horizontal.

- Each consists of stable chain of multivibrator, divider and pulse shaping circuits.
- One if the chain, operates below the line frequency and produces series of horizontal bars.
- Another chain works at frequency above 15.625 kHz and produces series of vertical bars.
- These signals with long duration are converted to short pulses using appropriate circuitry.
- These pulses in accordance with sync pulses produces fine line on TV screen.
- A trigger signal generated by horizontal blanking pulse is given to multivibrator in vertical bar generator.
- Then it produces square wave video signal which is m times horizontal frequency.
- Hence it produces m vertical black and white bars.
- Another multivibrator in horizontal bar generator is triggered by train of pulses derived from 50Hz main supply.
- It generates square wave video signal which is n times vertical frequency and produces horizontal black and white bars.

- The switches provided in between signal path of both multivibrator produces different patterns.
- If both mH and nV switch are OFF a blank white raster is produced.
- When only mH switch is ON, vertical bars are produced.
- When only nV switch is ON, horizontal bars are produced.
- When both mH & nV is ON, cross hatch pattern is generated.

d. Draw the block diagram of Logic analyzer. List the types or modes of displays in it.

Ans d. **(diagram – 2 marks, types – 2 marks)**

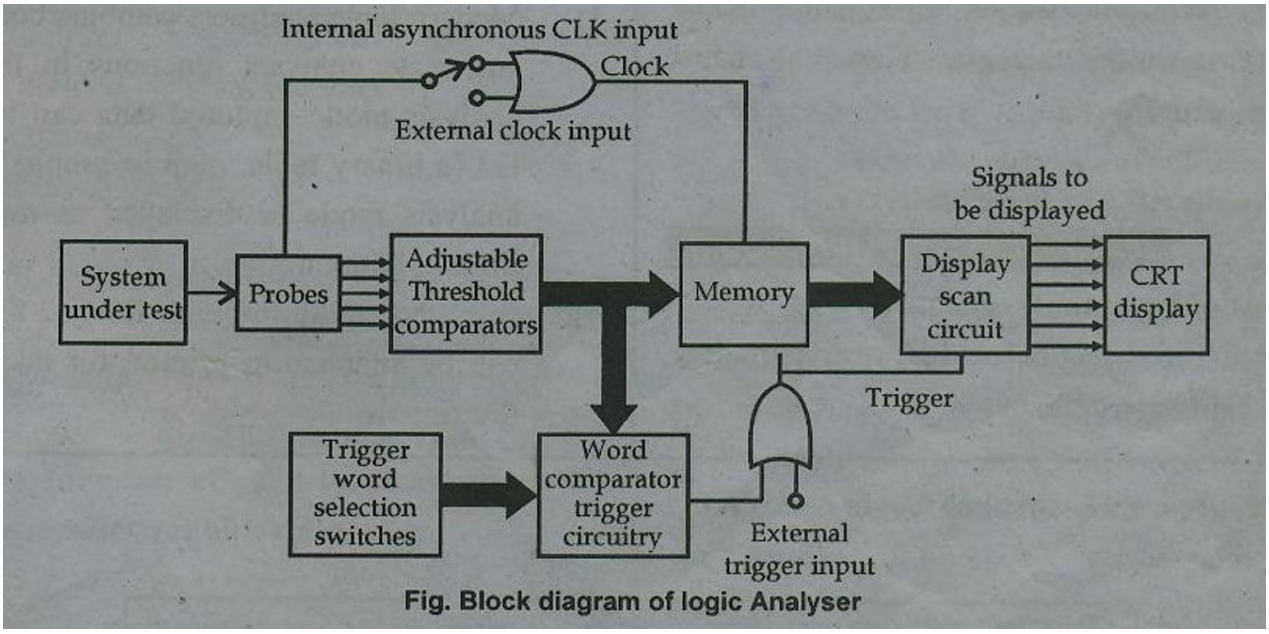


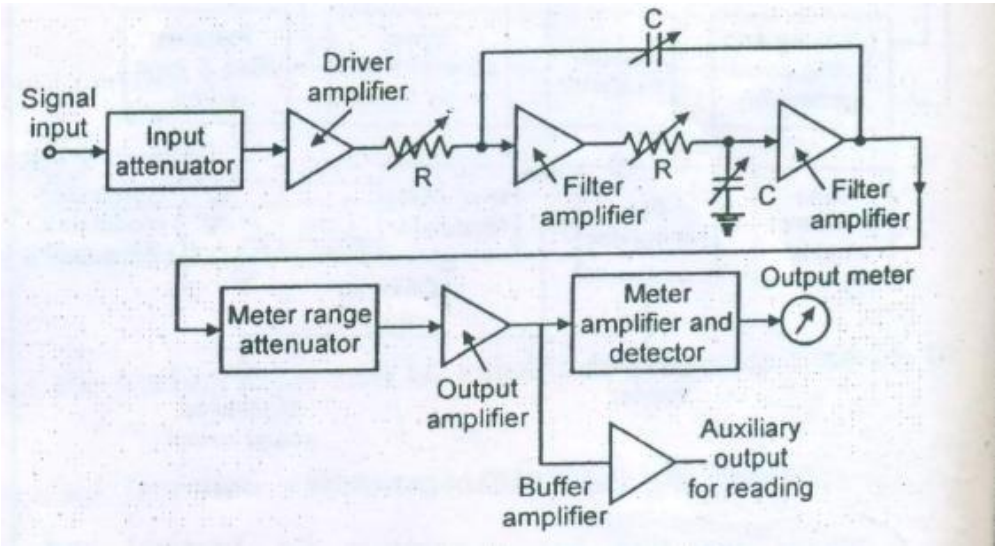
Fig. Block diagram of logic Analyser

The types or modes of display in logic analyzers are of two types:

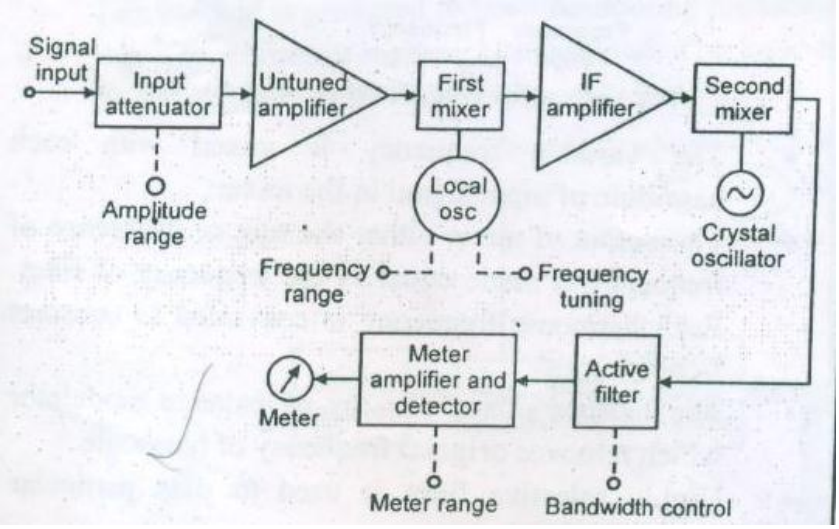
1. Logic Timing
2. Logic state

e. Draw a block diagram of wave analyzer. Write its principle.

Ans e. **(diagram – 2 marks, principle – 2 marks)**



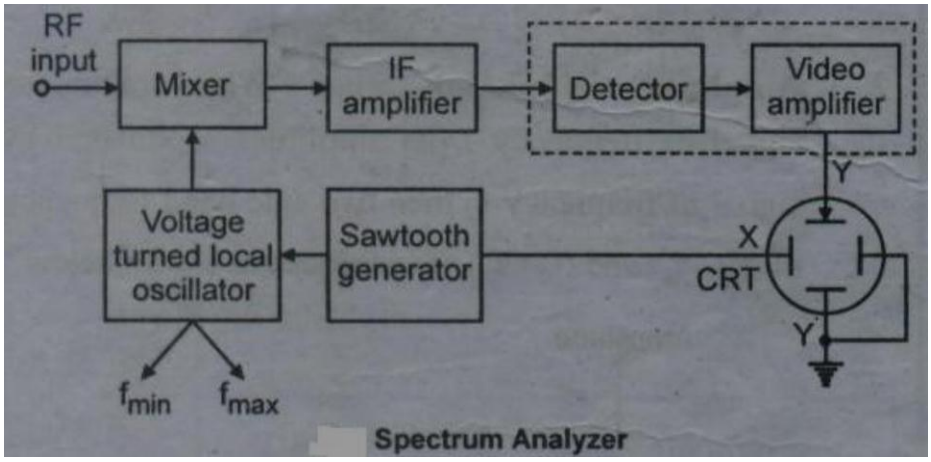
OR



A wave analyzer consists of a primary detector, which is a simple LC circuit. This LC circuit is adjusted for resonance at the frequency of the particular harmonic component to be measured. The intermediate stage is a full-wave rectifier to obtain the average value of input signal. The indicating device is a simple DC voltmeter that is calibrated to read the peak value of the sinusoidal input voltage. Since the LC circuit is tuned to a single frequency, it passes only the frequency to which it is tuned and rejects all other frequencies. A number of tuned filters, connected to the indicating device through a selector switch would be required for a useful wave analyzer.

f. Describe the operation of spectrum analyzer with neat diagram.

Ans f. **(diagram – 2 marks, operation – 2 marks)**



Spectrum analyzer consists of voltage tune oscillator, mixer, IF amplifier, detector, video amplifier, sweep generator and CRT.

The input signal applied to the circuit is used with oscillator signal, produces two different frequencies called intermediate frequency.

The voltage control oscillator (VCO) swept (toggle) between minimum and maximum frequency linearly. The sawtooth waveform plays important role in controlling the output voltage control oscillator.

The IF signal is then amplified by IF amplifier for further processing.
The information in signal is detected by detector and further amplified by video amplifiers. Then these signals are fed to the vertical deflecting plate of CRT.
The sawtooth waveform also supply signal to horizontal deflecting plates after the amplification.
The CRT produces amplitude versus frequency waveform on the screen.
In this type the signal are broken down into their individual frequency component

6. Attempt any four of the following: 16 marks

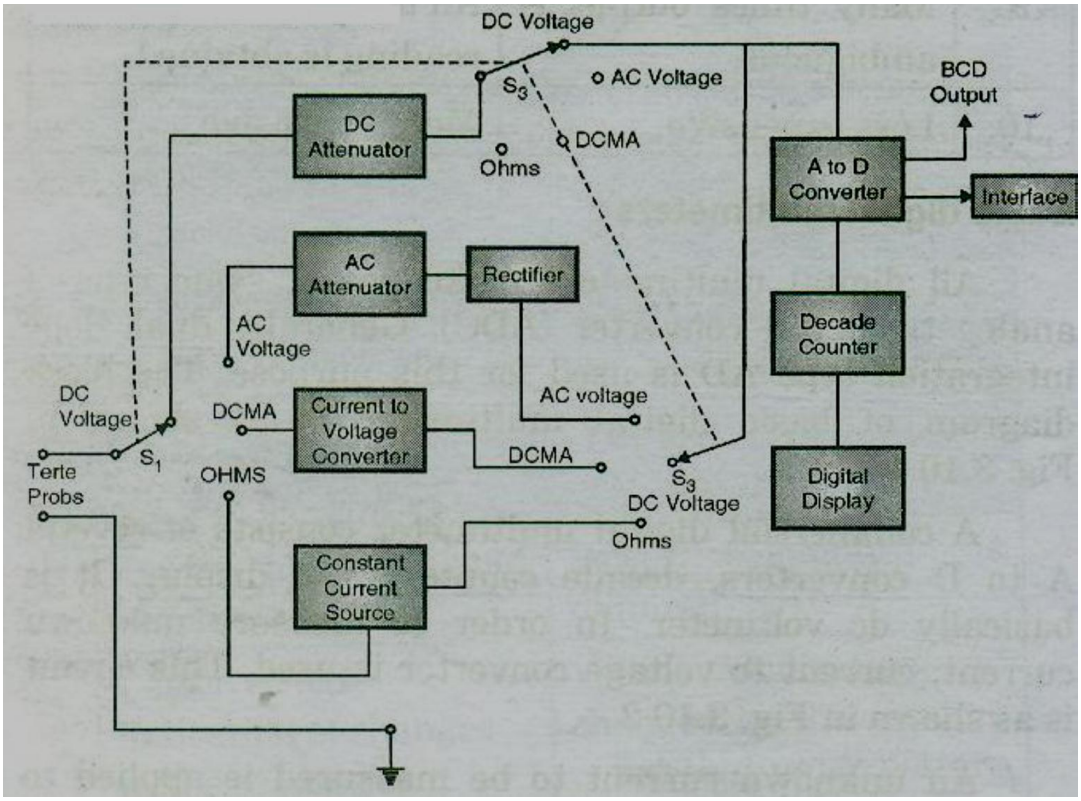
a. Compare analog and digital meters (any 4points)

Ans a**. (any four correct points – 1 mark each)**

Sr.No	Functions	Analog Multimeter	Digital
1	Display	Analog pointer is used	LCD display is used.
2	Resolution	Low resolution	High resolution
3	Functions available	Current, resistance, voltage measurement possible	Current, voltage, resistance, hfe measurement possible
4	Power consumption	More power required	Less power required.

b. Draw a block diagram of digital multimeter.

Ans b. **(diagram – 4 marks)**



c. What do you mean by 3 ½ digit display?

Ans c. **(correct explanation – 4 marks)**

The number of digit positions used in a digital meter determines the resolution. Hence a 3 digit display on DVM for a 0-1 range will indicate values from 0-999 mV with a smallest increment of 1mV.

Normally a fourth digit capable of indicating 0 or 1 (hence called a half digit) is placed to the left. This permits the digital meter to read values above 999 up to 1999, to give overlap between ranges for convenience, a process called over ranging. This type of display is called a 3 ½digit display.

d. Draw a block diagram of digital frequency meter. Explain its operation.

Ans d. **(diagram – 2 marks, explanation – 2 marks)**

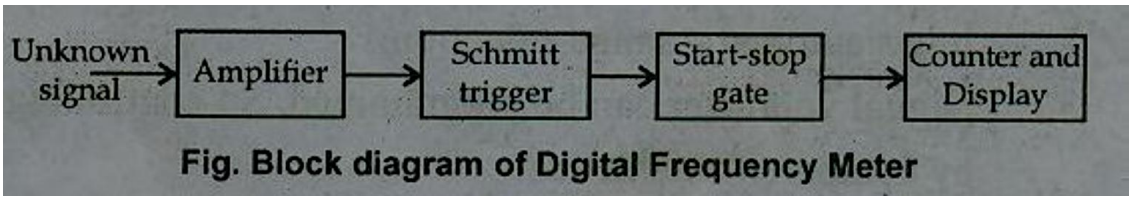


Fig. Block diagram of Digital Frequency Meter

- Frequency is defined as number of cycles per unit time interval. The signal whose frequency is to be measured is used as an event.
- The unknown frequency is first converted to train of pulses. One pulse represents one cycle of unknown signal. These pulses are directly proportional to the frequency to be measured.
- The signal whose frequency is to be measured is first amplified. The output of amplifier is applied to the Schmitt trigger.
- The Schmitt trigger converts the signal into square wave having fast rise and fall times.
- The square wave is then differentiated and clipped. Each pulse is proportional to each cycle of unknown signal.
- The output from Schmitt trigger is applied to start and stop gate. These pulses are applied to the switch.
- This switch is controlled by a signal having definite time interval. The main gate switch is closed for known time interval.
- When the gate is open, input pulses are allowed to pass through it. A counter will now start to count these pulses.
- When the gate is closed, input pulses are not allowed to pass through the gate. The counter will now stop counting.
- The number of pulses during the period gate is open are counted by the counter.
- If this interval between start and stop condition is known, the frequency of unknown signal is measured.
- F= N/t

  Where,

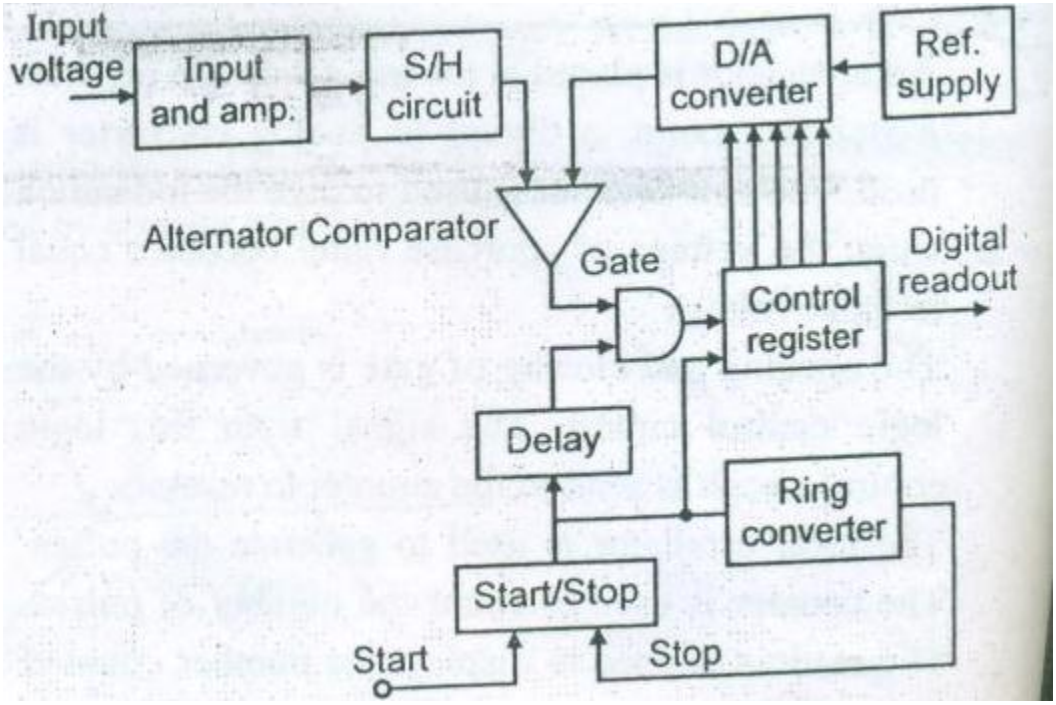
  F= Unknown frequency

N= Number of counts displayed by the counter.

t= Time interval between start and stop condition of the gate.

e. Explain SAR type digital voltmeter with neat labelled diagram.

Ans e. **(diagram – 2 marks, explanation – 2 marks)**



- Successive approximation DVMs are capable of 1000 readings per second.
- these instruments make use of successive approximation converter for analog to digital conversion. A simplified block diagram of such a DVM.
- In the beginning of measurement cycle, a start pulse is applied to the (start/ stop) multivibrator. This sets a MSB of control register high and all other bits low.
- Assuming a 8 bit control register, its reading would then be 10000000. This initial setting of control register causes the output of DAC to be one half the reference supply (1/2V).
- The converter output is compared with unknown input by the comparator.
- It produces an output which causes the control register to retain 1 at its MSB and converter register to retain 1 at its MSB and converter continues to supply its reference voltage of ½ V.
- The ring counter next advances one count, shifting a 1 in the second digit. MSB of the control register and its reading becomes 11000000.
- This makes D/A converter to increase its reference by one increment to 1/2V +1/4 V and another comparison with unknown input voltage takes place.
- If accumulates reference exceeds the unknown voltage the comparator produces and output that causes the control register to reset its MBS to 0.
- Finally when the ring counter reaches its last count, the measurement cycle stops and the digital output of control register represents the final approximation of the unknown input voltage.

f. Write any four specifications of DMM.

Ans f. **(any four correct specifications – 1 mark each)**

Specifications of DMM are as follows:

1. D.C. Voltage:

- Voltage range from + 20 V to + 1000V
- Accuracy about + 0.03%
- Resolution is about 10μV

2. AC Voltage:

- Voltage range from 200mV to 750 V
- Accuracy is frequency dependent.
- Resolution: 10μV

3. Resistance:

- Resistance range from 200Ω to 20MΩ
- accuracy: + 0.1% of reading

4. D.C. Current:

- Current range from + 200μA to 2 A.
- Accuracy + 0.3% of reading
- Resolution + 0.01μA

5. A.C. Current:

- Range from 200μA to 2A
- Accuracy depends on frequency.