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 judgment 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

Q.1 a) Attempt any SIX of the following: **12M**

(i) Give comparison between active transducer and passive transducer.

Ans:- (Any Two) **1M each**

Active Transducers	**Passive transducers**
1. Do not require external power supply for 2. its operation.	Require external power supply for its operation.
3. It is also called as 'Self generating 4. Transducers'.	It is also called as ' Externally powered Transducers'.
5. Operate under energy conversion 6. principle.	Operate under energy controlling principle
7. e.g. Thermocouples, Piezoelectric 8. transducer etc.	e.g. Thermistors, Strain gauges

(ii) List any two Static characteristics of instrument.

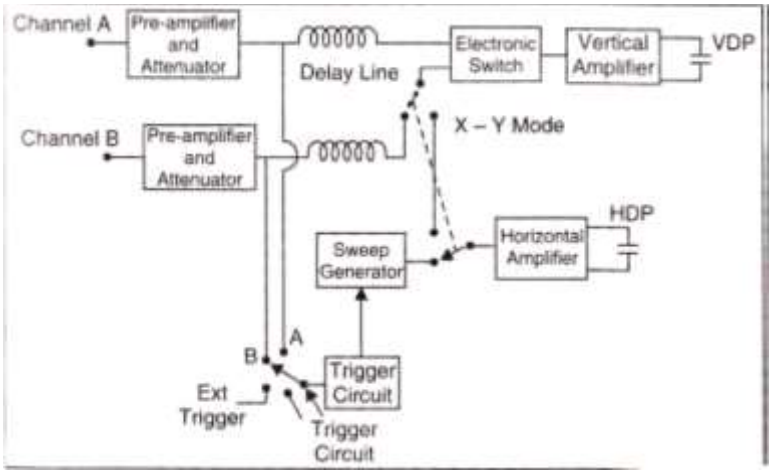
Ans:- (Any two) **1M each**

1. Accuracy
2. Sensitivity
3. Resolution
4. Static error
5. Reproducibility
6. Drift
7. Dead Zone.

(iii) Draw the block diagram of Dual Trace oscilloscope.

Ans:-

Diagram:- **2M**



(iv) List different Flow measurement techniques

Ans:- **(Any 2)** **1M each**

1. Variable head or differential meters
2. Variable area meters
3. Magnetic meters
4. Turbine meters
5. Target meters
6. Thermal flow meters
7. Vortex flow meters
8. Ultrasonic flow meters

(v) List out four Applications of CRO.

Ans:- **(Any Four)** **½ M each**

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 to test AF circuit for different distortion.
4) It is used to check faulty components.
5) It is used to check signals at radio and TV receiver.
6) It is used to check radiation pattern generated by antenna.

(vi) State any two Requirement of signal generator

Ans:- (Any 2) 1M each

1. An oscillator (sine wave generator) is one of the most basic electronic instruments. Generation of signals (AF or RF) is an important fact of electronic trouble shooting & development.
2. The signal generator is used to provide known test conditions for the performance & evolution of various electronic systems& for replacing missing signals in the systems being analysed for repair.

(vii) Define transducer and state any two advantages of electrical transducer.

Ans:- Definition of transducer:- 1M

It is defined as a device that converts energy from one form to another. The energy conversion may be electrical, mechanical, chemical, optical, thermal, and nuclear.

Advantages of electrical transducer:- (Any Two) ½ M each

- It converts one form of energy in to electrical quantity.
- It can directly convert to long distance.
- No need of any other analog converter.
- Easy to use.
- Less mechanical assembly.
- Generate more accurate output than mechanical transducer.
- Output can be easily amplified**.**

(viii) Give the classification Transducers.

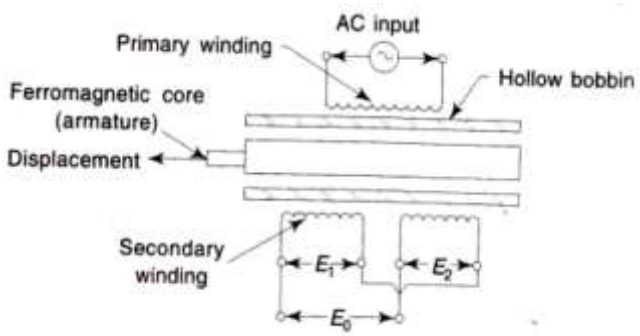
Ans:- (Any Two) 1M each

1. Primary & secondary transducer.
2. Active & passive transducer.
3. Analog & Digital transducer.
4. Transducer & inverse transducer.
5. Electrical &mechanical transducer.

Q.1(b) Attempt any <u>TWO</u> of the following: 8M

(i) What is the working principle of LVDT? State its applications.

Ans:- Diagram 2M



Working Principle:- **1M**

- When the core is in the neutral position, voltage induced in the secondary windings are equal and opposite and the net output is negligible.
- As the core is moved in one direction from the neutral position the differential voltage, i.e. the difference of the secondary voltage, will increase while maintaining an in phase relationship with the voltage from the source.
- Now the core is moved in the other direction from the neutral position, the differential voltage will again increase but will be 180^0 out of phase with the voltage from the input source.
- By comparing the magnitude and phase of the voltage with the input source, the amount and direction movement of the core and hence of displacement may be determined.

Applications:- **Any 2** **½ m each**

1. It is used to measure the linear displacement.
2. Useful in force, pressure and weight measurement as a secondary transducer.
3. Useful for measurement and control of thickness of metal sheet.
4. Useful for measurement of tension in cord.
5. Useful for measurement weight or pressure exerted by liquid in the tank.

(ii) State the formula for % error and relative accuracy. What is error and list out its type?
Ans:-

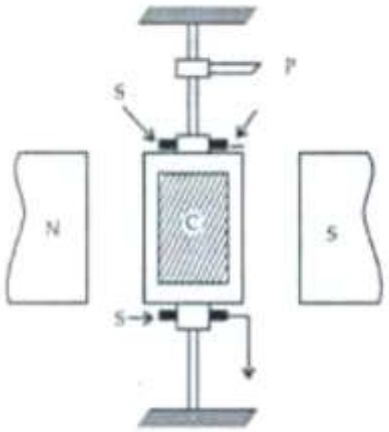
Formula for Percentage (%) error = (Absolute error / True value)*100 **1M**
Formula for Relative Accuracy = 1- ((True value- Measured value)/ True value) **1M**
Definition of Error : An error is the deviation of the true value from the desired value. **1M**

Types of errors: **(Any two)** **½ m each**

1. Gross errors
2. Systematic errors
    - Instrumental errors
    - Environmental errors
    - Observational errors
3. Schematic errors
4. Random errors

iii) With neat sketch explain the working principle of PMMC.

Ans:-Diagram **2M**



Working principle - **2M**

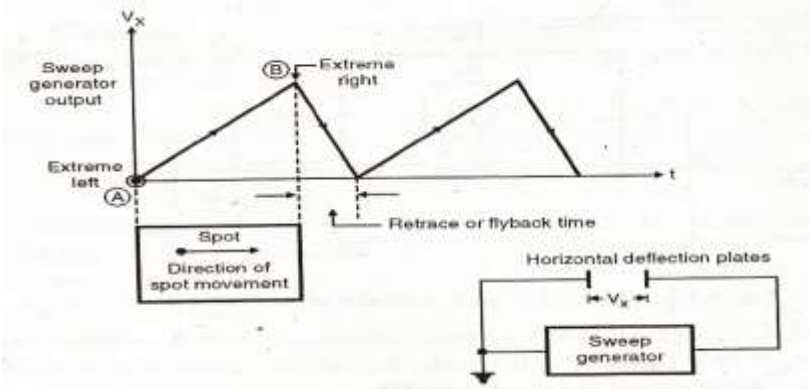
A current carrying conductor placed in magnetic field experiences a force.
It is given by the expression, F = BIL
Where, F = Force in Newton
B = Flux density in Tesla
I = Current in ampere
L = Length of conductor in meter.

The PMMC instrument is most accurate type instrument for d.c. measurement. The working principle of PMMC is same as the D'Arsonval movement. If a current conductor is placed in permanent magnetic field perpendicular to it, then a force is experienced by a conductor which is proportional to the magnitude of current.

Q2. Attempt any FOUR of the following: **16M**

(a) Explain the deflection of electron beam in CRT with diagram.

Ans:- Diagram:- **2 M**

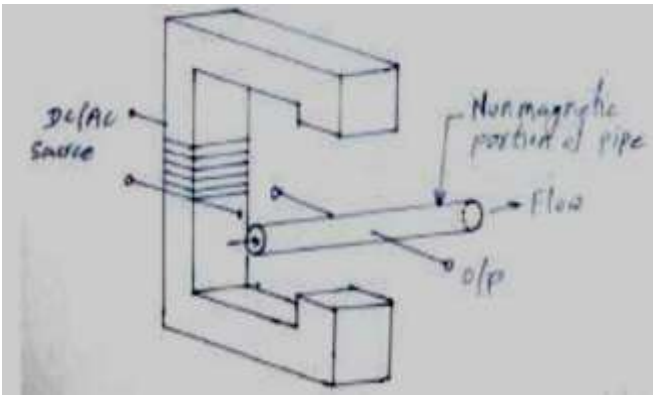


Explanation:- **2 M**

- A saw tooth waveform is applied to the right plate of the horizontal deflection plate while the left is connected to ground.
- This sawtooth waveform is generated by a special until inside the oscilloscope called as the "sweep generator".
- Let us assume that the voltage applied between the vertical deflection plates is zero that is no input signal is not being applied.
- A saw tooth waveform is applied between the horizontal deflection plates. At instant 'A' the saw tooth voltage is zero and the electron beam is on the extreme left of the screen.
- As the voltage V_x increases the potential on the right plate start increasing. An electrostatic field is developed the field strength of which increases with increase in V_x. Due to this the electron beam is pulled towards the right hand side of the screen.
- As the sawtooth voltage V_x increase linearly with time, the field also increase and the beam travels at a uniform speed from left to right.
- As the sawtooth voltage reaches the peak point (B). The beam will reach extreme right end of the screen. The time taken by the voltage V_x to rise from 0 to peak which corresponds to the time taken by the sport to move from left to right is called "Trace Time".
- Then the voltage V_x reduces suddenly from its peak value to zero, The electrostatic filed collapses and electron beam is return back to the extreme left side of the screen. This is called as flyback or retrace .
- The beam is blanked out during the retrace time so that the retrace is not visible on the screen.

(b) Describe the working principle and construction of electromagnetic flowmeter.

Ans:- Diagram **2 M**



Construction &Working principle :- **2M**

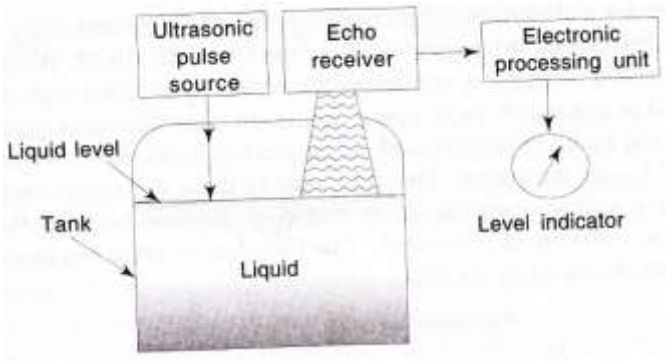
- The operation of this type of flow meter is based on Faraday's law of electromagnetic induction.
- It consists of a non-metallic portion of pipe which is non-conducting.
- A pair of electrodes are mounted opposite to each other.
- The pipe is placed within the electromagnet, which produces magnetic field, which is generated by the current flowing to the coil wounded on the electromagnet.
- Coil is powered by a D. C supply.

- As fluid passes, its motion relative to field produces an emf proportional to velocity according to Faraday's law.

(c) Explain the working principle of ultrasonic level detector.

***Important Note:- This question is out of Curriculum. Level measurement is not there in EV group Curriculum*.**

Ans:- Diagram **2 M**



Working Principle:- **2 M**

- Ultrasonic level detectors operate either by the absorption of acoustic energy as it travels from source to receiver or by the attenuation (frequency change) of a vibrating diaphragm face, oscillating at 35 to 40 KHz.
- It operates by generating an ultrasonic pulse and measuring the time it takes for the echo to return, When an ultrasonic transmitter is mounted at the top of the tank, The pulse travels in air at a speed of 331 meter/second at 0^0 C.
- The time travels is an indication of the depth of vapour space above the liquid in the tank.

(d) Convert a basic D' Arsonval movement with an internal resistance of 50 Ω and full scale deflection current 2 mA into multi range dc voltage with voltage ranges of 0-10V, 0-50V, 0-100V , 0-250 V.

Ans: **4M**

Given · $R_m = 50\Omega$
$I_m = 2mA$

i) For range (0–10V) —— 1M

$R_{S_1} = \frac{V}{I_m} - R_m = \frac{10V}{2\times10^{-3}} - 50\Omega$

$R_{S_1} = 4.95\ k\Omega$

ii) For range (0–50V) —— 1M

$R_{S_2} = \frac{V}{I_m} - R_m = \frac{50V}{2\times10^{-3}} - 50\Omega$

$R_{S_2} = 24.95\ k\Omega$

iii) For range (0–100V) —— 1M

$R_{S_3} = \frac{V}{I_m} - R_m = \frac{100}{2\times10^{-3}} - 50\Omega$

$R_{S_3} = 49.95 k\Omega$

iv) For range (0–250V) —— 1M

$R_{S_4} = \frac{V}{I_m} - R_m = \frac{250}{2\times10^{-3}} - 50\Omega$

$R_{S_4} = 124.95\ k\Omega$

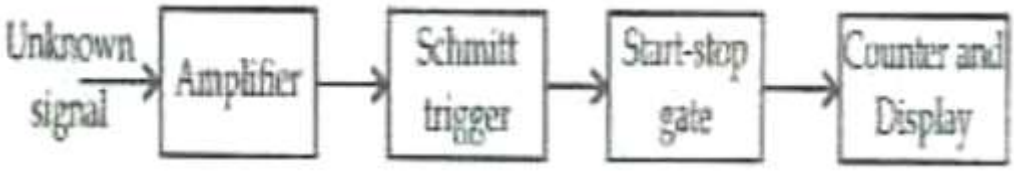
(e) List the application of spectrum analyzer.

Ans:- Application Of Spectrum Analyzer (Any four) **01M each**

1) Amplitude Modulation
2) Frequency Modulation
3) Pulse Modulation
4) Noise Measurement
5) Measurement of harmonic distortion
6) It can used for R.F interference testing

(f) With neat schematic diagram illustrate the working principle of Digital Frequency Meter.

Ans:- Diagram (or any other equivalent diagram) **2 M**



Explanation:- **2 M**

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.

Amplifier:

- The signal whose frequency is to be measured is first amplified. The output of amplifier is applied to the Schmitt trigger

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.

Start- Stop gate:

- 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.

Counter and display:

- 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.

Q.3. Attempt any Four of the following **16M**

(a) Draw the circuit diagram of rectifier type ac voltmeter. Explain its working.

Ans:- Diagram **2 M**

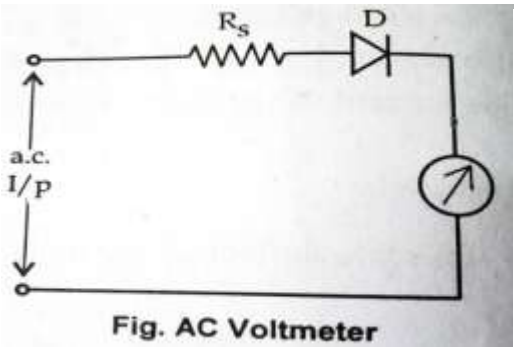


Fig. AC Voltmeter

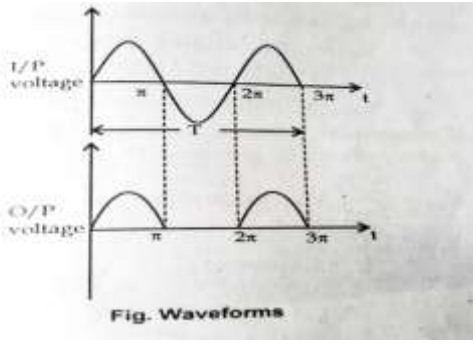


Fig. Waveforms

Explanation **2 M**

- The AC input is given to the circuit which is rectified by diode D.
- As only one diode is used there, the circuit work as a half wave rectifier which conducts only in positive half cycle.
- It is assumed that the diode has zero forward resistance & infinite reverse resistance.
  Therefore, the value of R_s is given by.

$$R_s = \frac{Vdc}{Ifsd} - R_m$$

- In waveform where T= time period.
- The output produced by the rectifier is given as-

$$V_{dc} = \frac{1}{2\pi}\int_0^{\pi} V_m \sin \omega t \, d\omega t$$

$$= \frac{1}{2\pi}(-V_m)[\cos \omega t]_0^{\pi}$$

$$= \frac{-V_m}{2\pi}[-1-1] = \frac{2V_m}{2\pi}$$

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

We know that,

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

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

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

$$\therefore \boxed{V_{dc} = 0.45\, V_{rms}}$$

- Since the voltage expression in terms of rms value, the meter scale is calibrated in terms of rms value. Meter shows the average value of sinusoidal output

(b) Draw the block diagram of logic analyzer and Explain it.

Ans:- Diagram **2M**

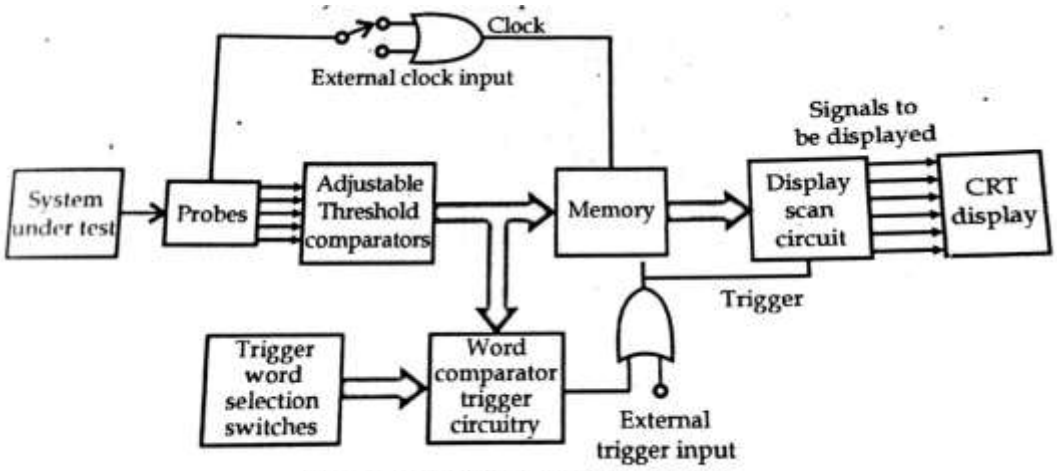


Fig. Block diagram of logic Analyser

Working:- **2 M**

- Logic analyzer is device which is capable of displaying number of signals compatible with TTL and CMOS logic level.
- The different logic families i.e. TTL, CMOS, NMOS etc. Have different threshold voltages and hence adjustable threshold comparator are used. Each signal is connected to each line of the logic analyzer.
- The reference signal of each comparator is set to a voltage which is equal to the logic threshold voltage of the logic family under test.
- The logic analyzer memory consists of RAM. The clock signals i.e. internal or external clock input is connected to the memory.
- On receiving clock signal, the logic analyzer samples the data present on input signals. These samples are stored in the memory.
- When the memory receives a trigger signal then the samples are stored in it and displayed on the CRT display.
- This trigger signals may be provided externally or it may be provided from the word recognizer circuitry.
- We can set binary word using switches or through keyboard in the word recognizer circuit. The word recognizer circuit compares this word with the binary input word. When the two words match, it sends a trigger signal to the memory. When the memory receives a trigger signal, it sends the samples to a CRT display.
- There are two operating modes i.e. synchronous and asynchronous.
  In Asynchronous sampling mode, the internal clock is used to sample and transfer input data to memory. While in synchronous the output is display.

(c) Define resolution and sensitivity of digital meter.

Ans:- **Each definition 2M**

Sensitivity:-

- It is smallest change in input which a digital meter should be able to detect.
- It is full scale value of the lowest range multiply by resolution of the meter.
- S= $(\text{Full Scale})_{min}$ x R…… where S= Sensitivity.

Resolution:-

The number of digit position used in digital meter determines the resolution. If the number of full digit on a digital meter is n, then its resolution is given by,

R= $1/10n$……. Where R= resolution.

(d) Draw block diagram of horizontal deflection system and draw waveform across each block.

Ans:- Diagram with waveforms- **4 M**

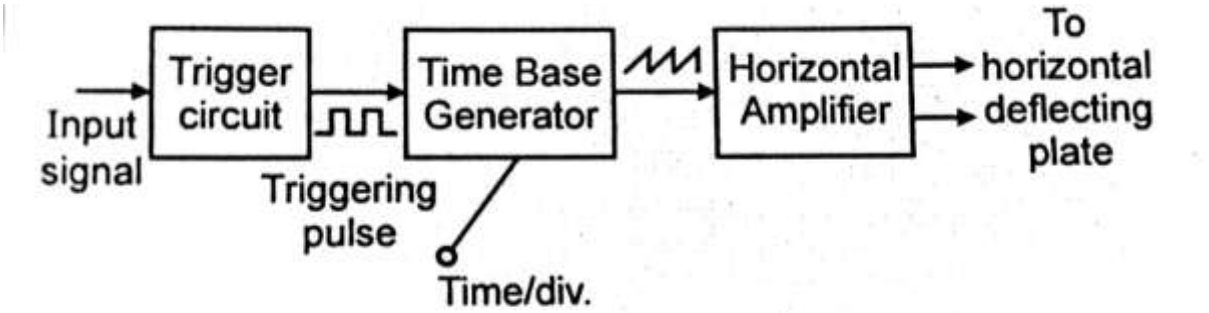
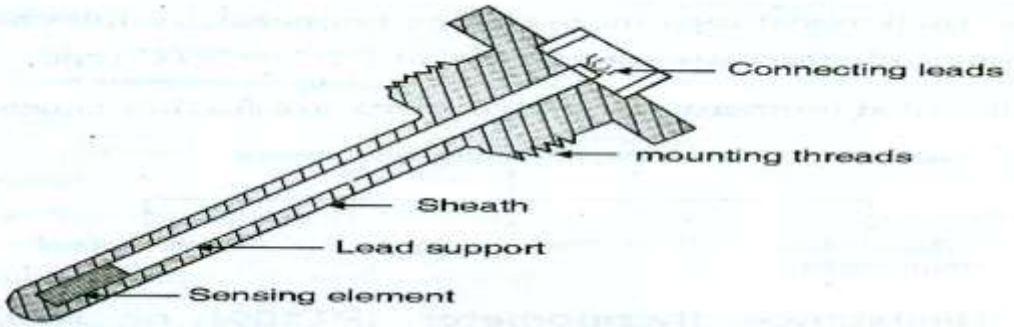


Fig. Block diagram of horizontal deflecting circuit.

(e) Give the construction and working principle of RTD with neat sketch.

Ans:-Diagram **2M**



Working principle:- **1M**

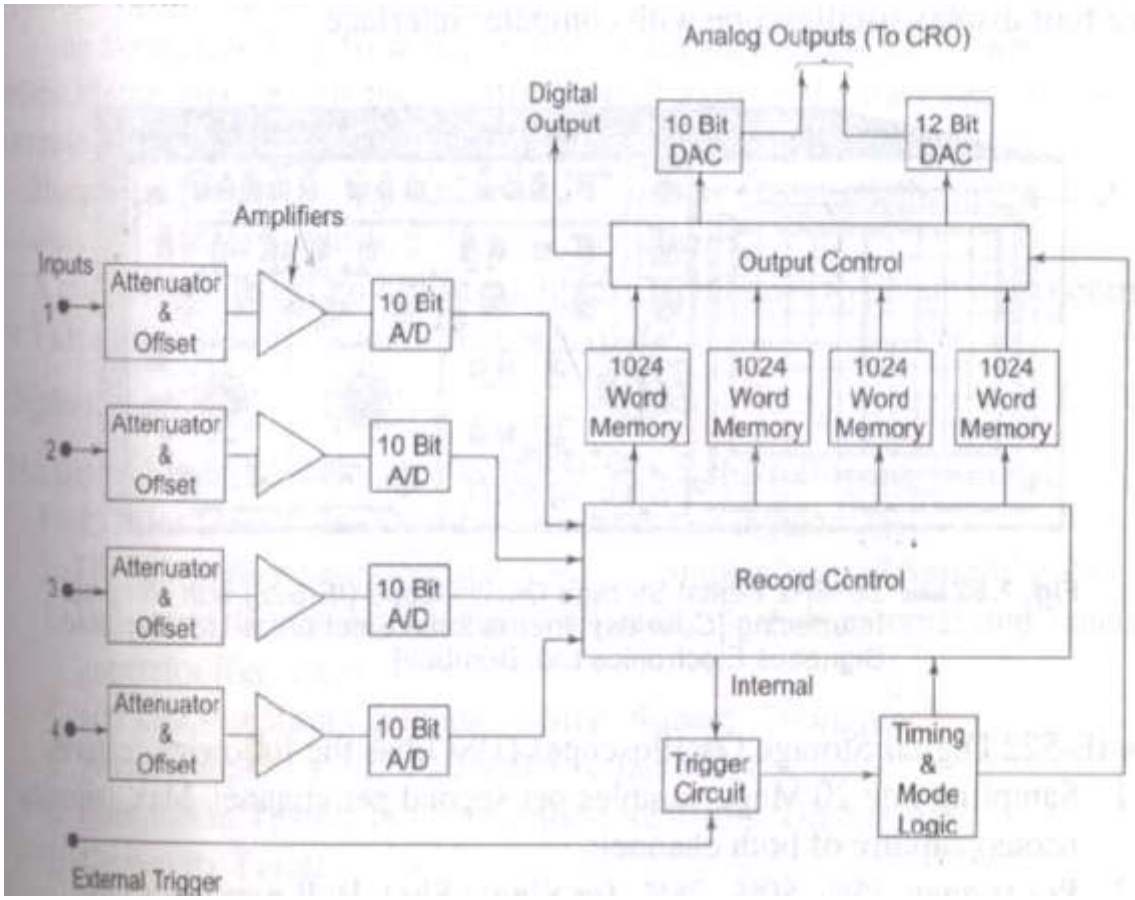
A pure metallic element or wire with large positive temperature co- efficient (PTC) changes its resistance with changes in temperature. The element is used as resistance thermometer.

Construction:- **1M**

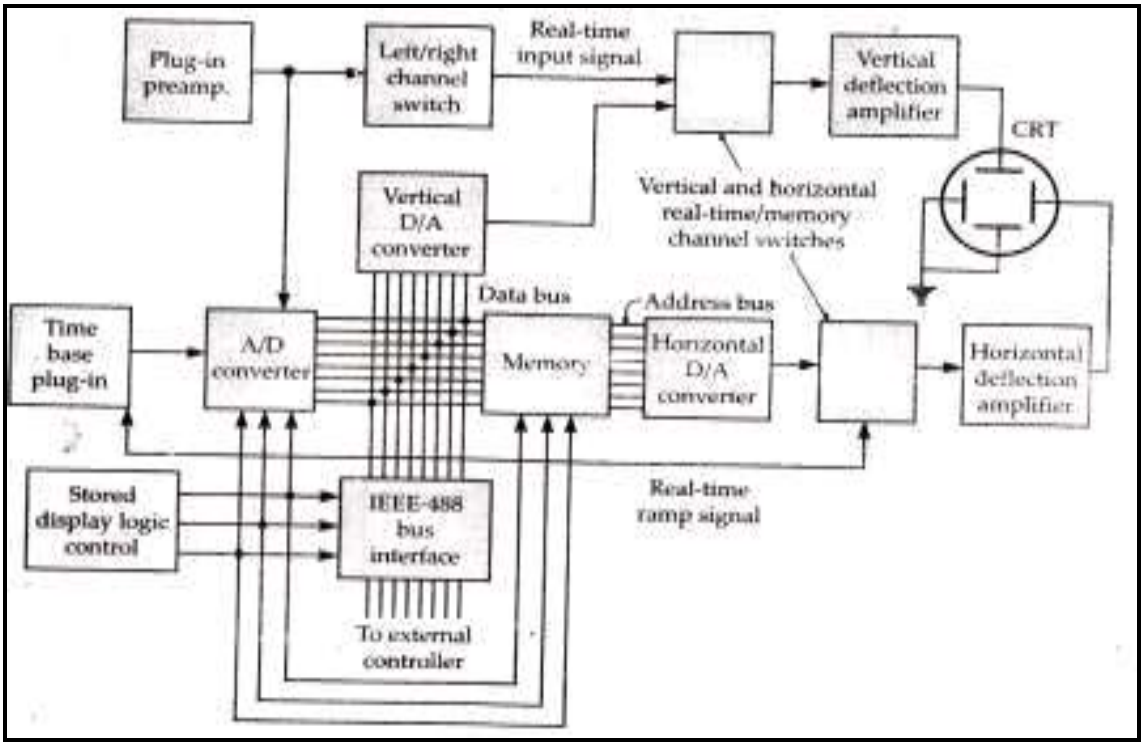
In this platinum material is used as a sensing element. It is generally long spring like shape enclosed in metal sheath. It is inserted in a medium whose temperature is to be measured. Leads are provided an drawn out for connectivity to the bridge circuit to measure resistance. Mounting threads are provided for perfect installation of the thermometer.

(f) Draw the neat block diagram of DSO. List its applications.

Ans:-Diagram **2M**


Analog Outputs (To CRO)
Digital Output
10 Bit DAC
12 Bit DAC
Amplifiers
Inputs
1
2
3
4
Attenuator & Offset
10 Bit A/D
Output Control
1024 Word Memory
1024 Word Memory
1024 Word Memory
1024 Word Memory
Record Control
Internal
Trigger Circuit
Timing & Mode Logic
External Trigger

OR



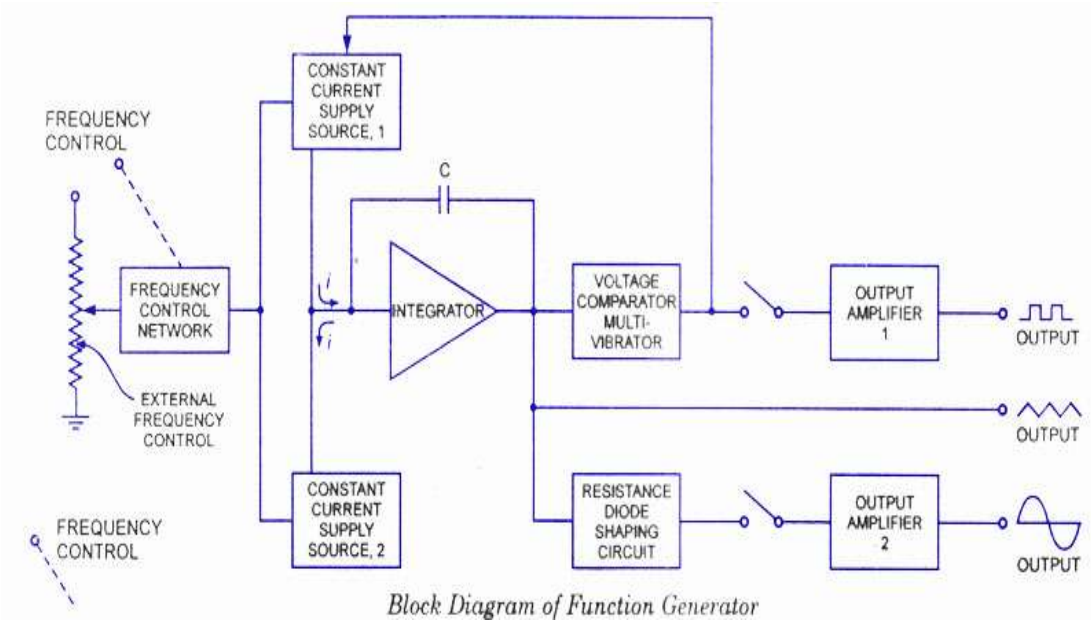
Applications :- (Any two) **2M**

- It can be used to measure ac as well as dc voltages and currents. It can calculate the mean value, peak value, peak to peak value, duty cycle, etc.
- It can be used to measure frequency, time period, time interval between two signals, and phase for periodic as well as non-periodic signals.
- It is used to give the visual representation for a target of radar such as aero plane, ship etc.
- In medical fields, it is used to display cardiograms that are useful for diagnosis of heart of the patient.
- It can be used to determine the modulation characteristic and detect the standing waves in transmission lines.
- It can be used to observe the V- I Characteristics of diodes, transistors.
- It can be used to observe the B-H curves, P-V diagrams.
- It can be used to observe the radiation pattern generated by the transmitting antenna.
- In modern DSO it is possible to add, subtract the waveforms.

Q 4 . Attempt any Four of the following: **16M**

(a) Draw and explain working principle of function generator.

Ans:-Diagram **2M**



Block Diagram of Function Generator

Working Principle:- **2M**

- 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.

$$V_o = -\frac{1}{C}\int i.dt$$

- 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.

(b) Differentiate between logic analyzer and spectrum analyzer.

Ans:-Any four points **01M Each**

Sr.No	Parameter	Logic Analyzer	Spectrum Analyzer
1.	**Waveforms observed**	At a time number of waveforms can be observed. (up to 64 waveforms can be observed)	At a time only a single waveform can be observed
2.	**Compatibility**	They are compatible with different logic families like TTL,CMOS, NMOS.	They are not compatible with different logic families.
3.	**Types**	1.logic timing analyzer 2.logic state analyzer	1.scanning type 2.Non-scanning type.
4.	**Function**	Troubleshooting of digital systems	Frequency domain analysis of various systems.
5.	**Working domain**	Digital	frequency
6.	**Uses**	To detect glitches and to check system is working properly or not.	For observing AM, FM, measurement of Harmonic Distortion.
7.	**Application**	IC testing, Hardware/Software troubleshooting.	Measurement of antenna pattern, Biomedical, Radar etc.

(c) Explain the method of frequency measurement using Lissageous pattern.

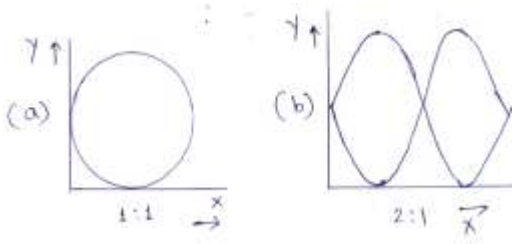
Ans:- **(Diagram 2M,Explanation 2M)**

Explanation:-

One of the quickest methods of determining frequency is by using Lissagous patterns produced on the screen .this pattern results when sine waves are applied simultaneously to both pairs of the deflection plates. If one frequency is an integral multiple (harmonic) of the other, the pattern will be stationary and is called a Lissagous figure.

In this method of measurement a standard frequency is applied to one set of deflection plates of the CRT tube while the unknown frequency is simultaneously applied to the other set of plates. The resulting pattern depends on the integral & phase relationship between two frequencies.

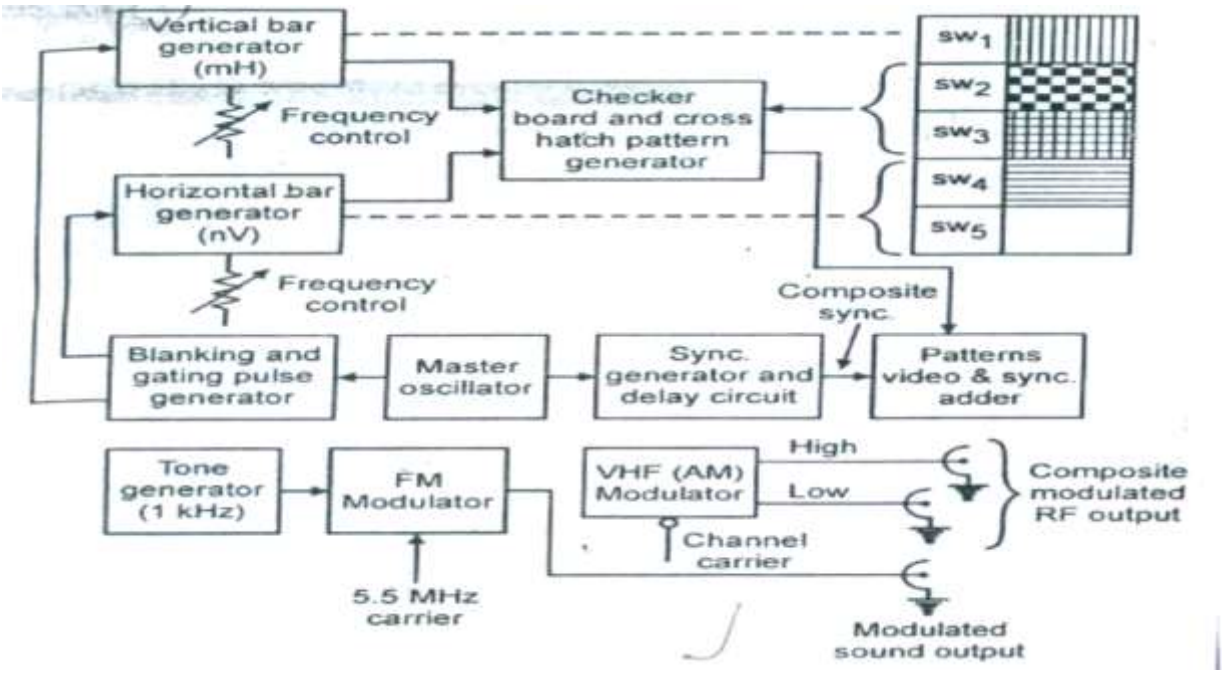
Keep frequency f_h constant and vary frequency f_v , noting that the pattern. Spins in alternate directions and change shape. The pattern will stand still whenever f_v and f_h are in an integral ratio.
The $f_v = f_h$ pattern stands still and is a single circle or ellipse. (As per fig a)
When $f_v=2f_h$ a two loop horizontal pattern is obtained. (As per fig b)



To determine the frequency from any Lissagous figure, count the number of horizontal loops in the pattern, divide it by the number of vertical loops and multiply this quantity by f_h (known frequency).
f_v = (fraction)× f_h
Fraction= (No. of loops touches to horizontal tangent) /(no of loops touches to vertical tangent)

(d) Draw the block diagram of pattern generator.

Ans:-Diagram **4M**



(e) Identify active and passive transducer from following.

(i) Thermocouple

(ii) RTD

(iii)Piezoelectric

(iv)LVDT

Ans:- **1M each**

Sr. No	Active Transducer	Passive Transducer.
1.	Thermocouple	RTD
2.	piezoelectric	LVDT

(f) What is piezoelectric effect? How it is used in transducer? List the material used for it.

Ans:-Piezoelectric effect:- **1M**

"when a pressure or force or vibrations applied to the crystalline material like quartz crystal or crystalline substance then an e.m.f is generated across the material or vice versa".

Use:- **2M**

The piezoelectric element used for converting mechanical movement into electric signals.

The construction is done in such a way so as to get capacitive action. The piezoelectric elements used for converting mechanical movements into electrical signals.

The mechanical deformation generates charges and this charge appears as a voltage across the electrodes.

The voltage is given by

V= Q/C

where, V= e.m.f. across electrode

Q= charges

C= capacitance

Operating principle

When force or pressure is applied to the piezoelectric material like quartz crystal or barium titanate, then an emf is generated across the material or vice versa.

Materials used:- **1M**

1. Natural crystals- Quartz crystal, Rochelle Salt.
2. Synthetic Crystals- Barium titanate, Lithium Sulphate etc.

Q.5. Attempt any FOUR of the Following: **16M**

a) Differentiate between RTD and thermistor with respect to the following points:

(i) Material
(ii) Working Principle
(iii) Cost
(iv) Range of Measurement

Ans:- **Each point 1 Mark**

Paramete	RTD	Thermistor
Material	Made of Metals which are good conductors of Electricity Platinum	Mode of metallic sintered oxides such cobalt and uranium
Working Principle	It has positive Temperature Coefficient Of Resistance	It has both positive and Negative Temperature co efficient
Cost	High	Less
Range of Measurement	Works in temperature range -100• to 650• C	Works in temperature range -50• C to 300• C

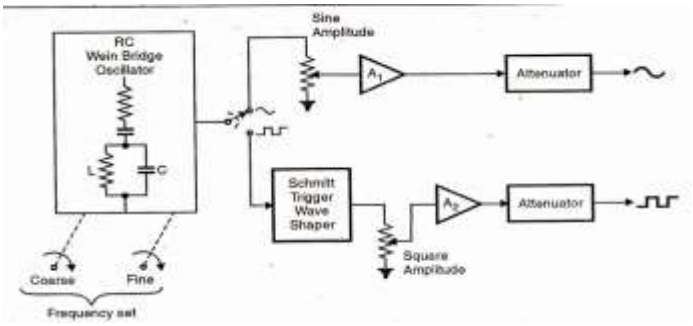
b) State the application of spectrum analyzer.

Ans:- Application Of Spectrum Analyzer:(Any Four) **1M each**

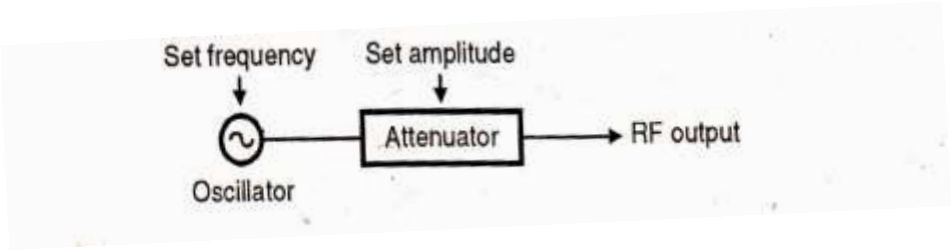
1. Amplitude Modulation
2. Frequency Modulation
3. Pulse Modulation
4. Noise Measurement
5. Measurement of harmonic distortion
6. It can used for R.F interference testing

c) Explain with diagram , AF sine wave generator.

Ans:- Diagram: **2M**



OR



Explanation:- **2M**

1) It consists of two basic blocks, an oscillator and an attenutor.
2) The variable frequency wein bridge oscillator produce the frequency of interest set by user it is amplified and available at output as sine function.
3) The offset variation and duty cycle variation facilities also can be added into the design.

(d) What is Seeback effect? What is Peltier effect? Give one example of each.

Ans:- Seeback effect : **1M**

Seeback effect states that whenever two dissimilar metals are connected together to form two junctions, out of which, one junction is subjected to high temperature and another junction is subjected to low temperature then emf is induced proportional to the temperature difference between two junctions.

Example: Thermocouple **1M**

Peltier effect : **1M**

Peltier effect state that two dissimilar metals closed loop, Id current forced to flow through the closed loop then one junction will be heated and other will become cool.

Example: Thermocouple **1M**

(e) Write the advantage and disadvantage of electromagnetic flow meter.

Ans:- Advantage (Any Two) **1 Mark each**

1) Provides wide linear range.
2) Ability to measure reverse flow.
3) Gives rapid response to flow changes.
4) No obstruction is created to flow.

Disadvantage (Any Two) **1 Mark each**

1) Cost is high if heavy slurries as handed.
2) Used only for conductive fluids.
3) It must be explosion proof when installed in hazardous electrical area.
4) Not suitable for low velocities.

(f) How resistive transducers are classified according to their movement? Explain its working.

Ans: Classification **2M**

1. Linear Potentiometer
2. Angular Potentiometer

Working **2M**

Resistive transducers are those in which the resistance changes due to a change in some physical phenomenon. This is because both alternating and direct currents and voltage are suitable for resistance measurements.

$$R=\frac{\rho L}{A}$$

Where R= resistance
L = Length of Conductor
A = Cross – sectional area
ρ = Resistivity of conductor

Resistance is directly Proportional to the Length (L)
Resistance is inversely proportional to the Area (A)

Q.6 Attempt any FOUR of the following: **16M**

(a) Distinguish between analog and digital instruments. (Any four points).

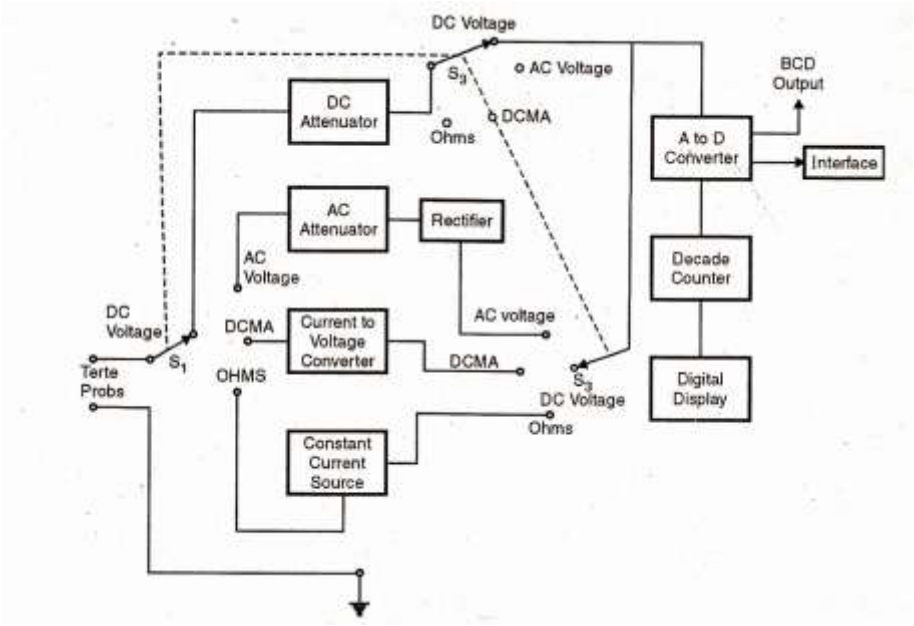
Ans :- (Any four points). **1 Mark for each point**

Sr NO	Analog Instrument	Digital Instrument
1	The instrument that displays analog signals is called as an analog instrument.	The instrument that displays digital signals is called as Digital Instrument.
2	Accuracy of analog instrument is less.	The accuracy of digital instrument is more compared to analog instrument.
3	The resolution of analog instrument is less.	The Resolution of Digital instrument is more.
4	Analog instruments are cheap.	Digital instruments are Expensive.
5	Example PMMC instrument.	Logical Analyzer.

(b) Draw the block diagram of digital multimeter. State any four advantages.

Ans:-

Block diagram **2M**



Advantages:- **2M**

1) They are available in smaller sizes.
2) They are having higher accuracy.
3) They are having high input impedance so there is no loading effect.
4) The output can be interfaced with external equipment.

(c) State the Need of synchronization between horizontal and vertical deflection in CRO.

Ans:-

Need of synchronization between horizontal and vertical deflection in CRO **4M**

The main function of the vertical deflection system is to provide an amplified signal of proper level to drive the vertical deflection plates without any distortion.

Horizontal deflection system consists of three main block such as Time base generator. Trigger Circuits and horizontal amplifier.

Whenever a signal is transmitted through these circuits certain time delay occurs. Some part of the output of the vertical amplifier is applied to the trigger circuits the trigger circuit provides a trigger pulse to the time base generator the output of the time base generator is applied to the horizontal amplifier. This causes a considerable time delay for the signal to reach the horizontal deflecting plate. Avoiding this delay need of synchronization is required.

(d) **Define:**
(**i) Accuracy**
(ii) Precision
(iii) Sensitivity
(iv)Resolution

Ans:- **Each definition 1M**

(**i) Accuracy:-**

It is degree of closeness with which an instrument reading approaches the true value of the quantity being measured.

OR

The accuracy of a measurement indicates the nearness to the actual / true value of the quantity.

(ii) **Precision:-**

It is a measure of the Reproducibility of the measurement that is given a fixed value of variable.

OR

Precision is a measure of the degree to which successive measurements differ from each other.

(iii) **Sensitivity:-**

Sensitivity is the ratio of change in output of an instrument to the change in input.

$$\text{Sensitivity} = \frac{\text{Change in output}}{\text{Change in input}}$$

(iv)**Resolution**:-

It is the smallest change in the measured value to which the instrument will respond.

OR

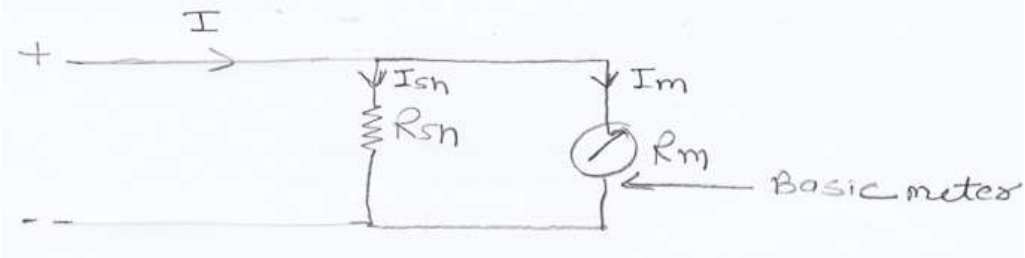
Resolution defines the smallest measurable input change.

e) How basic analog DC ammeter operates with proper example justify its range extension method.
Ans:-

Operation **2M**

The basic ammeter circuits consists of D' Arsonval galvanometer. The coil winding of basic movement is small and it is light in weight, so this coil enable small current to pass through it .In order to avoid this a resistor is connected in parallel with the basic movement this register is called as shunt resistor .

Example **2M**



I = Total current to be measured
R_{sh}= Shunt resistor
I_{sh} = current passing through the shunt Resistor.
R_m= internal Resistance of the coil
I_m= Full scale deflection
$I_{sh} * R_{sh} = I_m * R_m$

$$R_{sh} = \frac{Im \cdot Rm}{Ish}$$

$I = I_{sh} + I_m$

$$R_{sh} = \frac{Im \cdot Rm}{I - Im}$$

$m = \frac{I}{Im}$ multiplying power of the shunt

The current range of basic analog DC ammeter is in increased by using different shunt Resistor. Such as R_{sh1}, R_{sh2} etc .These shunt Resistor are in parallel with the meter Resistance.

(f) The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79V. Calculate:

i) Absolute error

ii) Relative accuracy

iii) % error

iv) % accuracy

Ans:-

Given,

Ae=80V

Am=79V

i) **Absolute error :-** **1M**

$e = A_e - A_m$

$e = 80 - 79$

$e = 1V$

ii)Relative accuracy :- **1M**

$$A = 1 - \left| \frac{Ae - Am}{Ae} \right|$$

$$A = 1 - \left| \frac{80 - 79}{80} \right|$$

$$A = 1 - \frac{1}{80}$$

$A = 0.9875$

iii) **% Error :-** **1M**

$$\% \text{ error} = \frac{Ae - Am}{Ae} \times 100$$

$$= \frac{80 - 79}{80} \times 100$$

% error= 1.25%

iv) % Accuracy :- **1M**

% accuracy = A×100%

=0.9875×100

% accuracy =98.75%