SUMMER–15 EXAMINATION

Subject Code: **17435** **Model Answer** Page No: 24/ N

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.

Q. 1. A) Attempt any six of the following. (6X2=12)

i. Define transducer. State two examples of it. (2M)

Ans:-

Definition:- **1M**

Transducer is defined as a device which converts energy from one form to another. i.e. physical to physical , physical to electrical or electrical to physical.

Examples- (any two) **1M**

LVDT, bourdon tube, thermocouple etc.

ii.Distinguish between accuracy & precision. (on the basic of any two factor) (2M)

Ans:-

Comparison:-

Sr. No	Accuracy	Precision
1.	The degree of closeness with which an instrument reading approaches the true value of the quantity being measured is known as accuracy.	The measure of the degree to which successive measurements differ from each other is known as precision.
2	It indicates the nearness to the actual or true value of the quantity.	It is measure of reproducibility of measurements. i.e. given a fixed value of quantity.

iii. State any four applications of digital storage oscilloscope. **(2M)**

Ans:-

Applications :- (Any Four) **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.

iv.Define flow &Temperature. **(2M)**

Ans:- **Flow:-** Fluid in motion is called as flow**.** **1M**

Temperature:-It is defined as , it is a hotness or coldness of a body or an environment measured on a definite scale. **1M**

v. State the function of delay line. **(2M)**

Ans:-

Function :- ½ M each

- The purpose of delay line is to retard (Slow down) the input waveform at vertical deflecting plate until the trigger & time base start the sweep beam.
- All the electronic circuits which are used in the oscilloscope like attenuators, amplifiers, etc. take a certain time for the required operation. So, whenever a signal is transmitted through these circuits, certain time delay occurs.
- The time delay which takes place in the horizontal deflecting system is about 80 ns.
- So, a time delay of 80 ns or more should be added in the vertical deflection system. Generally, a time delay of 200 ns is provided to observe the leading edge of waveforms.

vi.Define signal generator. **(2M)**

Ans:-

Definition:-

The instrument which provides a controlled output waveform or a signal for use in testing or aligning, or in measurement on other circuits or equipment's is known as signal generator.

vii. Define primary & secondary transducer. **(2M)**

Ans:-

Definition:-

Primary transducer: **1M**

Primary transducers are detectors which sense a physical phenomenon.

The transducer which directly comes in contact with measurand and acts as a sensor to sense or detect the physical quantity is called primary transducers.

Secondary transducer: **1M**

The displacement given by the Bourdon tube is now applied to the core of the LVDT to convert this displacement into proportional electrical quantity voltage.

viii. Give example of any two material used for piezoelectric transducer. (**2M)**

Ans:- (any two 1M each)

Piezoelectric materials

Natural crystals	**Synthetic crystals**
1. Quartz crystal,	3. Barium, titanate
2. Rochelle salt	4. Lithium sulphate

B) Attempt any two of the following. (4x2= 8)

i. Explain the working principal of capacitance transducer with suitable diagram. (4M)

Ans:- Diagram: 2M

Working: 2M

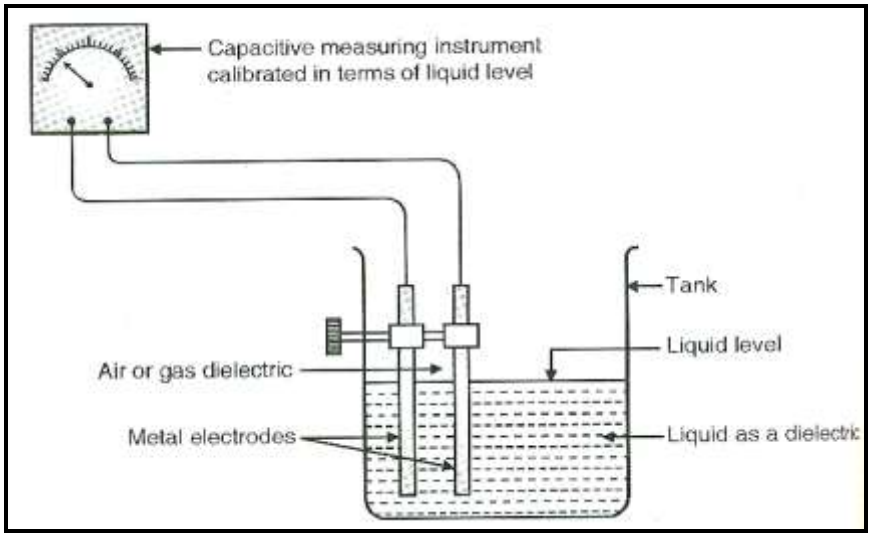


Figure:-Capacitance transducer

Working:-

The capacitance level detector operates on the equation of parallel plate capacitor, i.e.

$C = \epsilon A/d$

Where C= capacitance value in farad.

ϵ= dielectric constant.

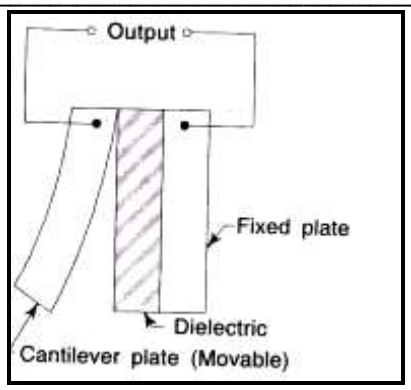
d = distance between two plate in m

A = common area of plate in m^2.

If A & d are constant then capacitance is directly proportional to dielectric constant i.e.

C directly proportional to dielectric constant (ϵ).

OR



Working:

- It consists of two plates, one fixed and the other free to move as the displacement is applied on it.
- The movable plate works as a cantilever plate, decreasing the distance between the two plates.
- Due to this decrease in distance the capacitance of a capacitor increases.
- The air between the two plates works as a dielectric medium.
- The capacitance of an air dielectric capacitor does not vary linearly with change in distance between the plates .
- For the linearity can be the closely approximated by keeping the change in the distance small or by having a medium of high dielectric constant in the space between the two plates.
- This type of capacitive transducer may be used to measure displacements.

ii. The expected value of voltage across a resistor is 80V. However the measurement gives a value of 79V. Calculate the absolute error & percentage error of the measurement. (4M)

Ans:-

Given:

Ae= 80V

Am = 79V

Absolute error =?

Percentage error=?

- Absolute error = e = Ae-Am …… **Formula 1M**

  = 80-79

  = 1V

  Therefor e = 1V …… **1M**

- Percentage error = $\frac{Ae-Am}{Ae}$ x 100…… **Formula 1M**

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

  = 1.2%

  Therefor % error = 1.2%.....**1M**

iii. Draw construction of PMMC instrument& explain its working principle. (4M)
Ans:-Diagram: 2M
Working principle : 2M

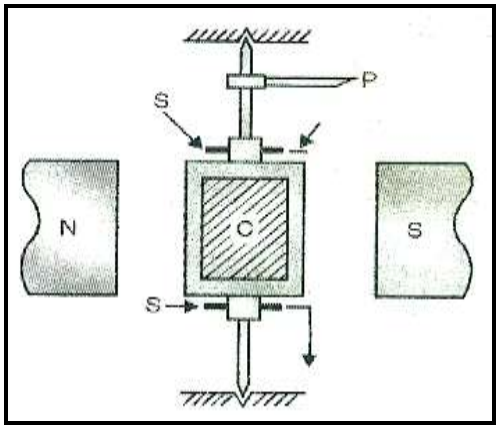


Figure:- Constructional diagram of PMMC

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.

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.

Q. 2. Attempt any four of the following. (4X4=16M)

a) Draw the block diagram of basic CRO. Explain its working. (4M)
Ans: Diagram: 2M

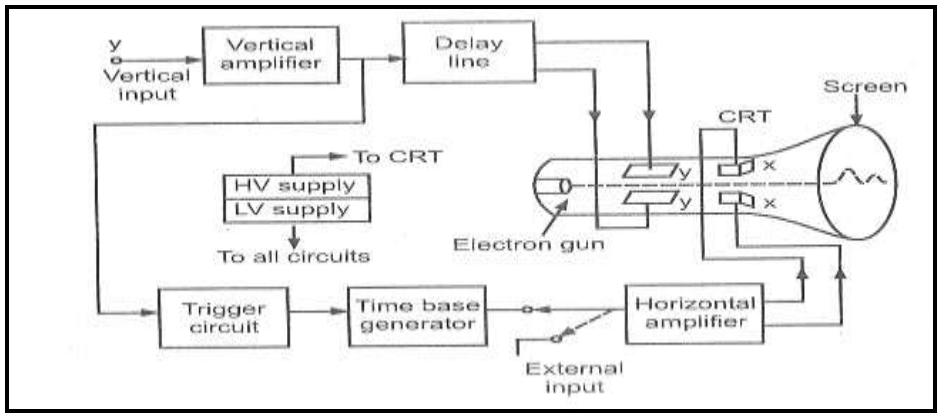


Figure:- Block diagram of CRO

Explanation: **2M**

- **Cathode ray tube**: -it is heart of CRO. It produces a sharply focused beam of electrons accelerated to very high velocity. This beam travels from its source i.e. electron gun to the front of CRT, where it strikes the fluorescent screen.
- **Vertical Amplifier**:- The input signal to be observed is applied to vertical amplifier. The gain of such amplifier is adjusted by calibrated input attenuator usually marked by volt/div. The o/p of this is fed to vertical deflection plate via delay line.
- **Delay line**:-The purpose of delay line is to retard (Slow down) the input waveform at vertical deflecting plate until the trigger & time base start the sweep beam.
- **Power supply**:- The power supply consist of high voltage tapping to operate CRT and low voltage for other circuit. H.V. is required for accelerating and focusing electron beam.
- **Time base Generator:** A time base generator is used to generate the saw tooth voltage required to deflect beam in the horizontal section. The circuit used to generate the saw tooth is called the continuous sweep generator. But the disadvantage of the sweep generator is that, it cannot follow the variations of fast varying signals, like voice signals or music signals. Hence this circuit has to be modified. The modified circuit is called the triggered Sweep Generator. The timing circuit of the time based generator gives the time/div control on the front panel.
- **Horizontal Amplifier:** The Horizontal amplifier is used to amplify the saw tooth voltage, before it is applied to the horizontal section. The block consists of a push- pull amplifier
- **Trigger circuit:** A trigger circuit is used to convert the incoming signal into trigger pulses, so that the input signal and the sweep frequency can be synchronized.
  The trigger circuit is activated by signals of a variety of shapes and amplitudes, which are then converted to trigger pulses of uniform amplitude, for the precision sweep operation.

b) Explain seeback effect & peltier effect. **(4M)**

Ans:-

Seeback effect: **2M**

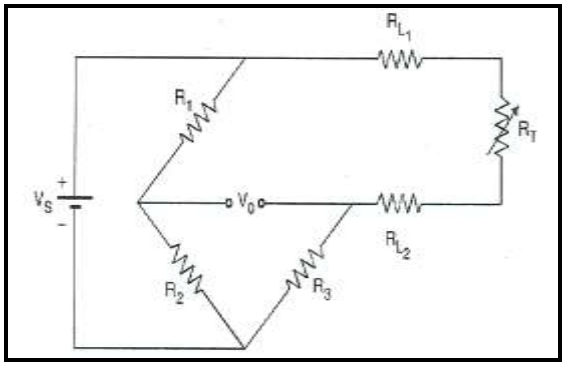
Seeback effect states that whenever two dissimilar metals are connected together to form two junctions, out of which, one junction is subjected to high temperature and another junction is subjected to low temperature then emf is induced proportional to the temperature difference between two junctions.

Peltier effect: **2M**

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.

c) Draw neat diagram of three wire RTD circuit. **(4M)**

Ans:-



d) A 1 mA meter movement with an internal resistance of 100Ω is to be converted in to 0-100mA. Calculate the value of shunt resistance required. **(4M)**

Ans:- Given

I_m = 1mA. R_m = 100Ω

I = 100mA $R_{sh=}$?

Now,

$m = \frac{I}{Im}$ ……..**Formula 1M**

$= \frac{100mA}{1mA}$

m = 100……..**1M**

$R_{sh} = \frac{1}{m-1} R_m$…… **Formula 1M**

$= \frac{1}{100-1}$ x 100

= 1.01Ω

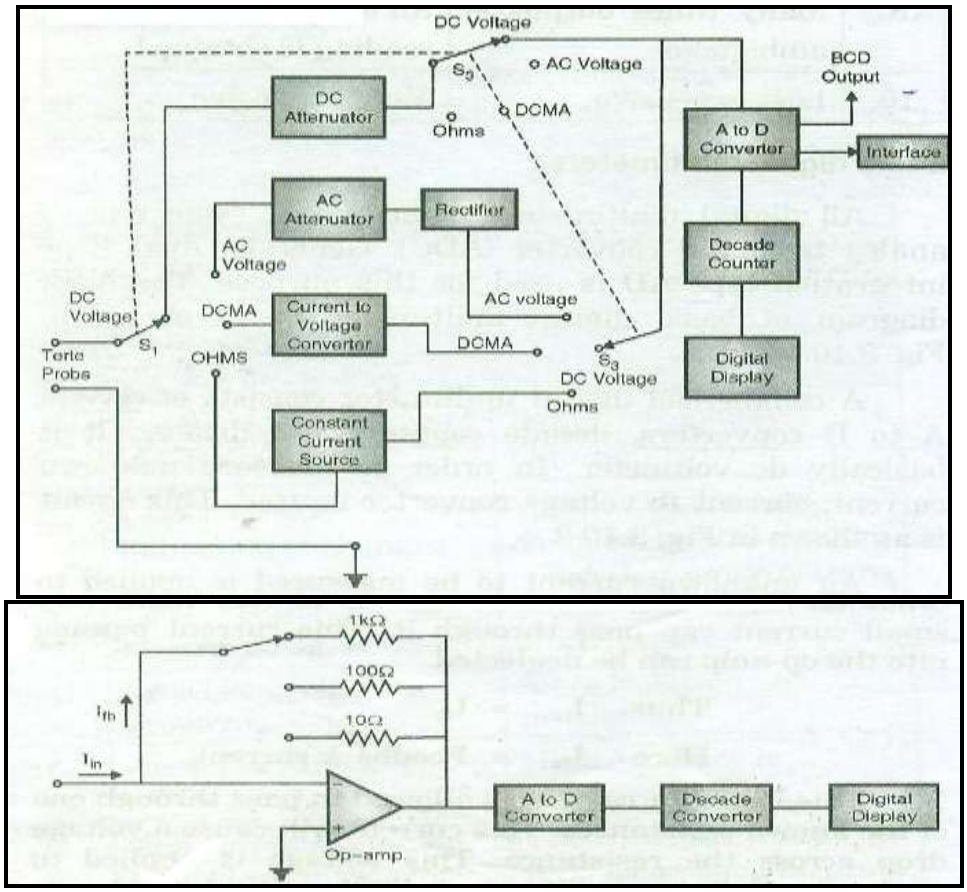
Therefor $R_{sh} = 1.01\Omega$…… **1M**

e) State four applications of function generator. **(4M)**

Ans:-Applications:- (any four) **1M each**

1. As trouble shooting tool to different analog & digital circuit.
2. As a source for alignment of different receivers.
3. If rise time of square wave is significantly low such a square wave is used to test the amplifier frequency response (Square wave testing).
4. Well synthesized arbitrary waveform like burst, sweep, cardiac, sawtooth, AM, FM, FSK, noise etc. are available on the function generator by reputed manufactures. These function generators are becoming versatile source in testing tools.

f) Draw the block diagram of digital multimeter and explain its working. (4M)
Ans:-Diagram:2M; Working:2M



Working- **(2)**

An unknown current to be measured is applied to one of the input terminals of op-amp. Let this input is. Since an input impedance of op-amp is very high; very small current can pass through it. This current passing into the op-amp can be neglected.

Thus I_{in} = I_{fb}

Here I_{fb} = Feedback current.

This feedback current is allowed to pass through one of the known resistances. This current will cause a voltage drop across the resistance. This voltage is applied to analog to digital converter and finally digital display is obtained. Thus output displayed on the digital display is directly proportional to unknown current.

In order to measure an unknown resistance; a constant current source is used. The current from this constant current source is allowed to pass through unknown resistance. Thus the proportional voltage is obtained. The output display is directly proportional to unknown resistance.

To measure the ac voltage; a rectifier and filter is used. This rectifier converts ac signal into dc signal. Now this dc signal is applied to A to D converter and to the digital display. The BCD output can be obtained from A to D converter. Similarly the output from digital multimeter can be used to interface with other equipments.

Q3) Attempt any FOUR of the following:- **16M**

a) List any four specifications of analog D.C ammeter and analog D.C voltmeter. (4M)

Ans: 1) Specifications of analog D.C ammeter: (any four specification: 2M)

- Repeatability: ±0.5%
- Response time: 1.5 to 3 seconds
- Range: 0-50A
- Self Shielding
- Accuracy: ±2%

2) **Specifications of analog D.C Volmeter: (any four specification: 2M)**

- Input Voltage: 0.50V DC
- Current Draw: 1mA
- Analog Scale: 0-50V
- Accuracy: 3% scale range
- Backlighting Amperage:- 16mA at 12V DC.
  20mA at 24V DC.
- Shunt type: internal.

b) Draw labeled block diagram of Video pattern generator. (4M)

Ans:

Diagram:- **4M**

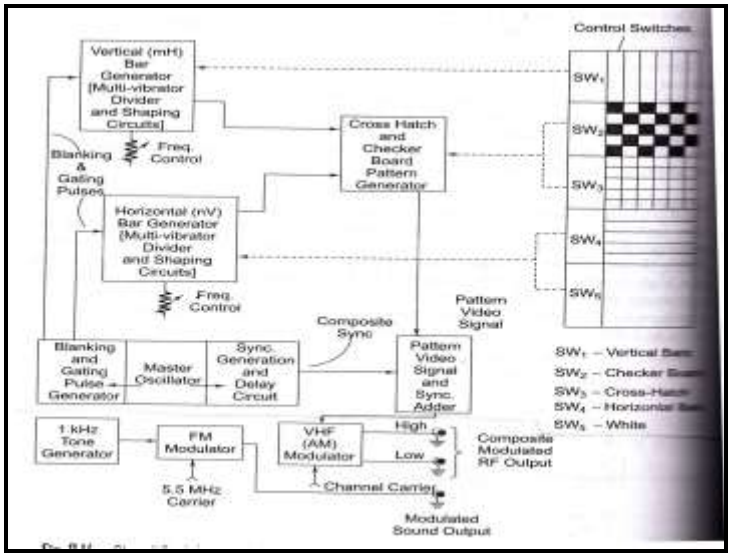


Figure:- Simplified block diagram of Video pattern generator

c) State any four advantages and disadvantages of Digital instruments. **(4M)**

Ans:

Advantages of Digital instrument:- (any four :2M)

- Digital instruments indicate readings directly in decimal number.
- Its output is in digital form so can be directly fade to memory devices like tape recorder ,printer, digital computer etc.
- It has high accuracy as compared to analog instrument.
- Its resolution is more than analog instrument.
- The output of digital instrument is free from observational errors like parallax and approximation of numbers.
- IT require very less power as compared to analog instruments .
- It use is more economical than analog instrument in measurement **system .**

Disadvantages of Digital instrument:- (any four :2M)

- Digital Instruments are Expensive
- They are not easily portable. They requires an external source of power. But the modern digital instruments are extremely portable.
- They are complex in nature.
- Speed of operation is limited due to Digitizing circuits.
- They don't always produce perfectly smooth outputs, which may be subjected to some quantisation noise and the use of external filters may be required in some cases.

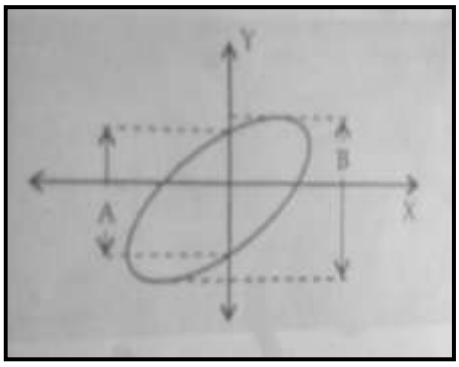
NOTE:- (Consider any other valid points).

d) Explain how phase can be measured on CRO using Lissajious Figure. **(4M)**

Ans:

Explanation:-

1. The Phase measurement can be done by using Lissajious Figures.
2. The CRO is set to operate in X-Y mode, then the display obtained on the screen of a CRO is called as Lissajious pattern (Figure), when two sine waves of the same frequency are applied to the CRO.(one vertical and one horizontal deflection plates).
3. Depending upon the phase shift between the two signals, the shape of the Lissageous figure will go on changing.
4. The Phase shift is given by $\Theta = \sin^{-1}(A/B)$ **1M**



A. The Lissajious pattern will be Ellipse if the sine waves of equal frequency but phase shift between 0° and 90° are applied to the two channels of CRO. The Lissajious will be as shown below- **1M**

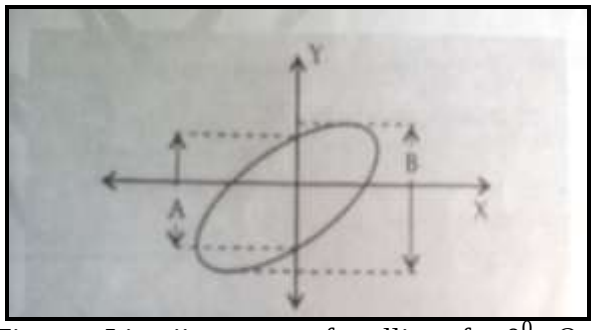
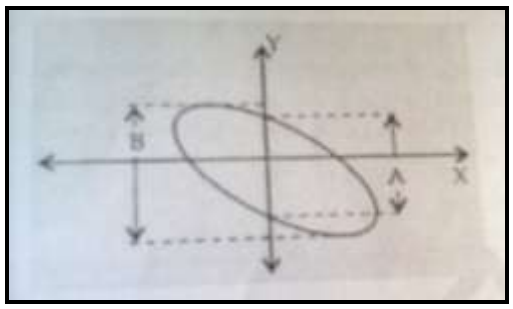
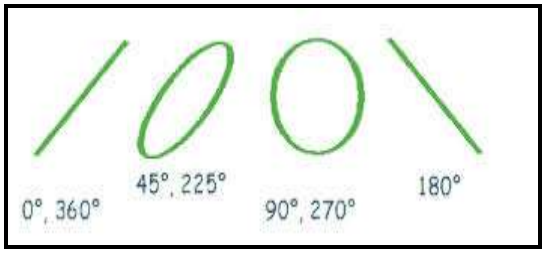


Figure:- Lissajious patter for ellipse for $0^0 < \Theta < 90^0$

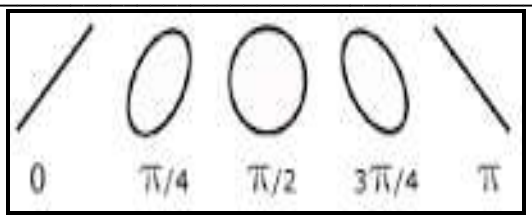
B. For the phase difference above 90° and less than 180°, the ellipse appears as shown below- **1M**



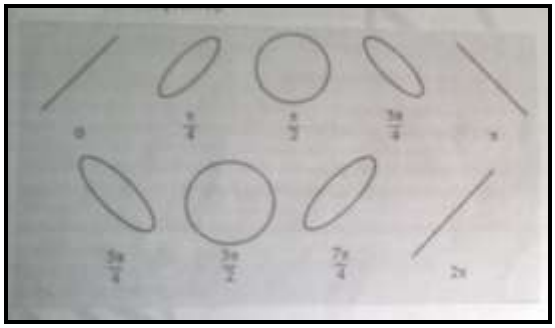
C. Different Lissajious Figures for the Phase Difference 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360° are shown below respectively. **1M**



OR



OR



e) Explain with neat diagram the working principle of time difference type ultrasonic flow meter. (4M)

Ans:

working Principle: **2M**

It is based on apparent change in the velocity of propagation of ultrasonic wave pulses in a fluid with a change in velocity of fluid flow.

Diagram :- **2M**

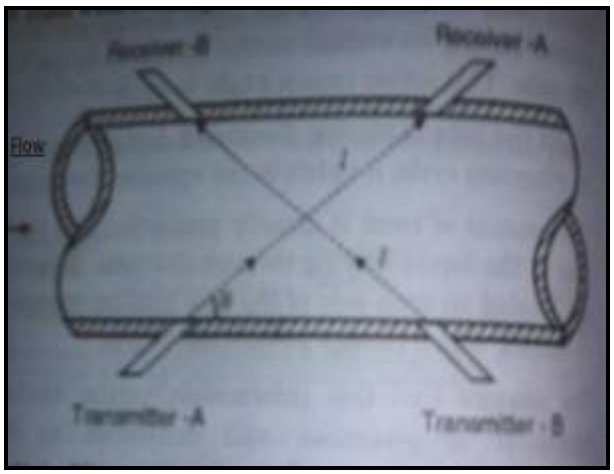
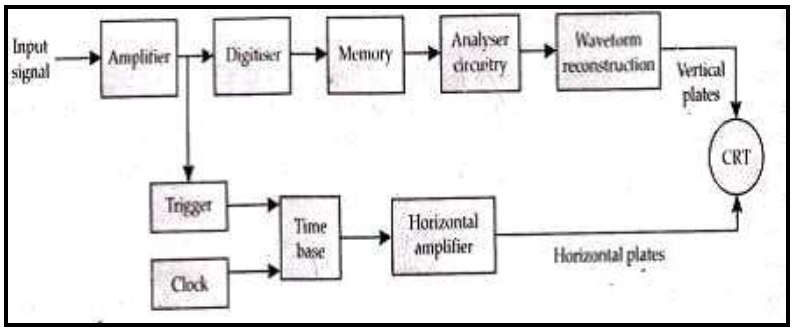


Figure:- Ultrasonic flow meter (Time difference type)

f) Draw neat labeled diagram of Digital Storage Oscilloscope. (4M)

Ans:

Diagram:- **4M**



OR

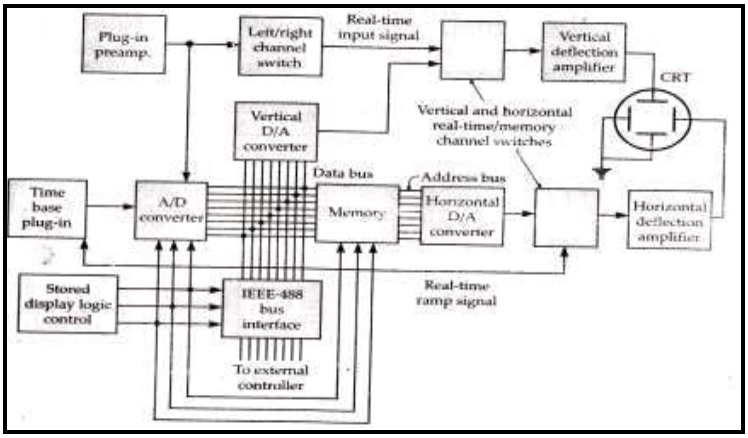


Figure:- **Digital Storage Oscilloscope**

Q 4) Attempt any Four of the following:- 16M

a) State the meaning of Time domain and Frequency domain instrument. State one example of each. (4M)

Ans:

Explanation:-

Time domain:- **1M**

- In general we observe electrical signals in amplitude versus time format where time is on X-axis and amplitude is on Y- axis, this is known as time domain.
- Example: CRO. **1M**

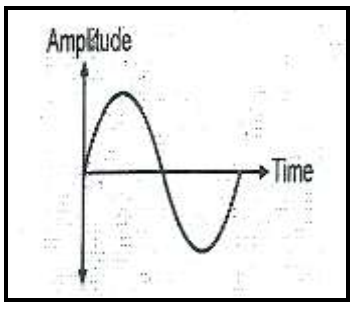


Fig: Waveform observed on CRO

Frequency domain:- **1M**

- We know that during long distance communication signal get distorted. The main advantage of time domain analysis is that we cannot differentiate the complex frequency signals or distorted signal.
- To overcome disadvantage of time domain, we observed the signal in amplitude versus frequency format is known as frequency domain.
- In frequency domain the complex frequency signal can be plotted as separate spectrum for each frequency so it becomes easy to analyse the information present
- Example: Spectrum analyzer. **1M**

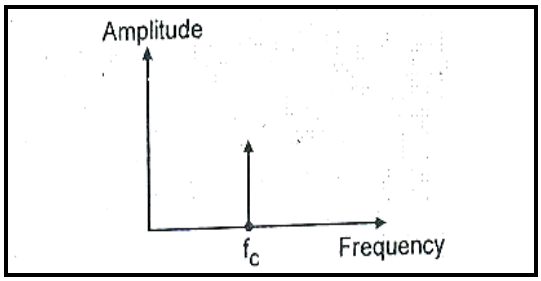


Fig: Waveform observed on Spectrum Analyzer

b) Differentiate logic Analyzer and Spectrum analyzer (on the basis of any four factors). (4M)
Ans:

Comparison:- (any four points 4M)

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) Draw the block diagram of Single beam dual trace CRO and explain its operation. (4M)

Ans:

Diagram :- **2M**

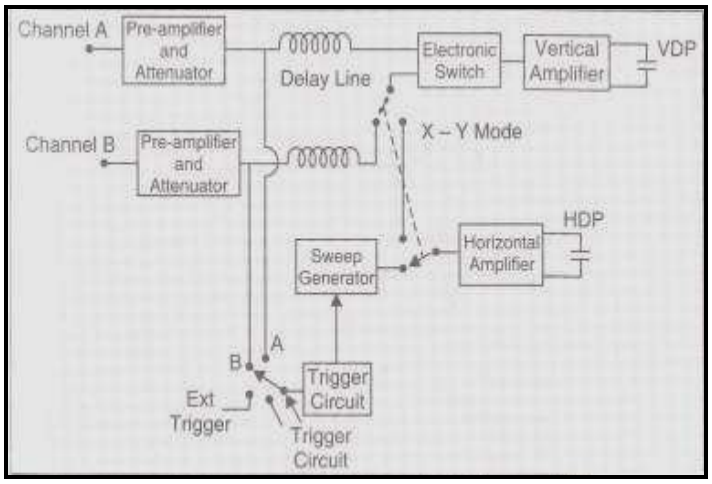


Figure:- **Block diagram of Single beam dual trace CRO**

Working:-(consider explanation, Any two mode 1M each)

- In this CRO a single beam is split into two to produce two images.
  A mode control system (s1) enables the electronic switch to operate in two modes Alternate and chop mode and x-y mode.

Alternate mode:

- When the switch (s1) is in alternate position ,the electronic switch feeds each signal alternatively to the vertical amplifier.
- The electronic switch alternately connects the main vertical amplifier to channels A and B and adds a different dc component to each signal
- This dc component directs the beam alternately to the upper or lower half of the screen.
- The switching takes place at the start of each new sweep of the sweep generator.
- The switching rate of the electronic switch rate ,so that the CRT spot traces the channel A signal on one sweep and the succeeding sweep.
- The sweep trigger signal is available from channels A or B and the trigger pick-off takes place before the electronic switch. This arrangement maintains the correct phase relationship between signal A and B.

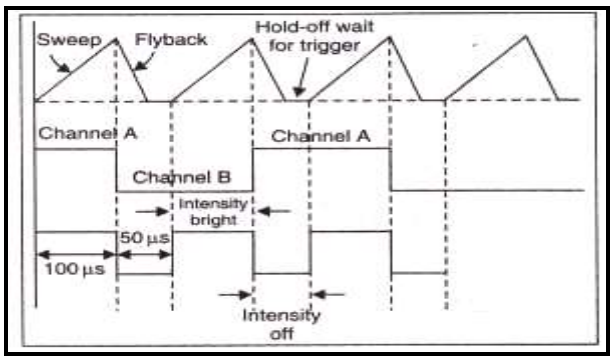


Figure: Time relation of the channel vertical amplifier in alternate mode

Chop mode:

- When the switch (s1) is in the chop mode position .the electronic switch is free running at the rate of 100-500 KHz , entirely independent of the frequency of the sweep generator.
- The switch successively connects small segments of A and B waveforms to the main vertical amplifier at a relatively fast chopping rate of 500 KHz .
  e.g. 1 MS segments of each waveform are to the CRT display.
- If the chopping rate is slow ,the continuity of the display is lost and it is better to use the alternate mode of operation.

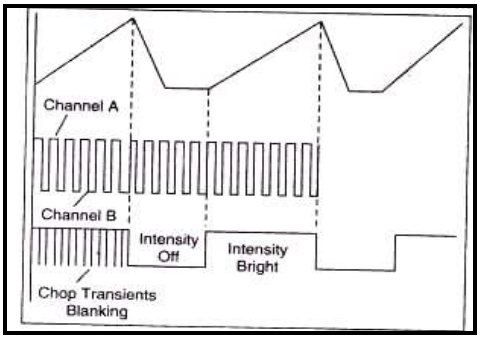


Figure: Time relation of dual channel vertical amplifier in CHOP mode

X-Y mode:

- In the x-y mode operation the sweep generator is disconnected and channel B is connected to the horizontal amplifier. Since both preamplifiers are identical and have the same delay time, accurate x-y measurements can be made.

d) Draw the block diagram of AF sine and Square wave generator and explain its operation. (4M)

Ans:

Diagram:- **2M**

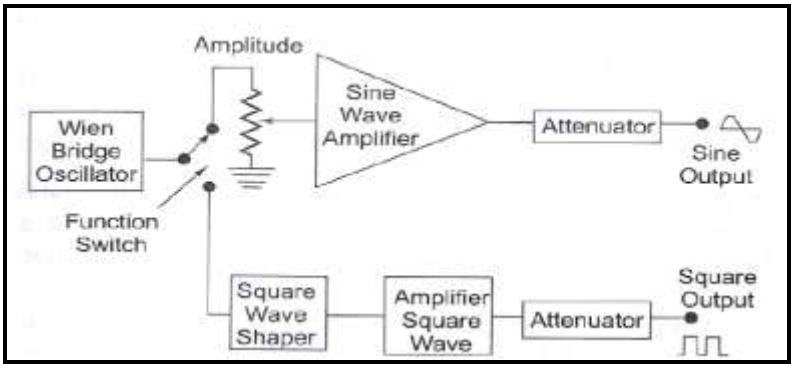


Figure:- AF sine and Square wave generator

Explanation: **2M**

- The frequency of the oscillations of Wein Bridge oscillator can changed by varying the capacitance in the oscillator.
- The output of the oscillator goes to a function switch which directs the oscillator output to either sine wave amplifier or to the square wave shaper.
- The attenuator varies the amplitude of the output which is taken through a push-pull amplifier. Schmitt Trigger is used as wave shaping circuit. That provides square waveform.

e) Illustrate the working of LVDT as a displacement transducer with the help of diagram. (4M)

Ans:

Diagram:- **2M**

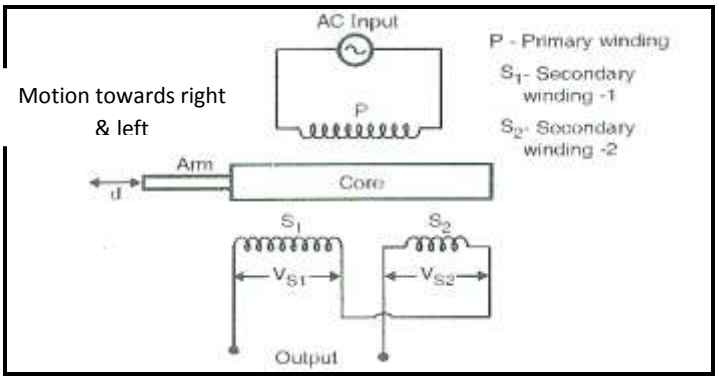


Figure:- LVDT as a displacement transducer

Working: **2M**

Case I: When there is no displacement.

- When there is no displacement attached to the core the core is at normal position, the flux linking with both the secondary winding are equal.
- Equal e.m.f. are induced in both secondary winding when the core is at null position $V_{S1}=V_{S2}$
- Hence the output voltage V_o at null position is zero.

Case II: When there is positive displacement

- When there is positive displacement applied to the core i.e. the core is moved to left of null position, more flux links with winding S_1 than winding S_2
- Here e.m.f. induced with winding S_1 is greater than winding S_2 that is $V_{S1}>V_{S2}$
- Hence the output voltage $V_o= V_{S1}-V_{S2}$ and the output voltage is in phase with the input primary voltage.

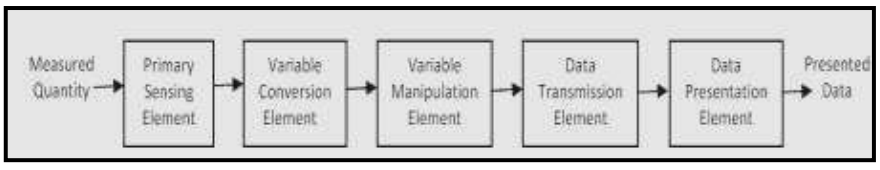
Case III: When there is negative displacement

- When there is negative displacement applied to the core i.e. the core is moved to right of null position, more flux links with winding S_2 than winding S_1.
- Here e.m.f. induced with winding S_2 is greater than S_1 that is $V_{S2}>V_{S1}$.
- Hence the output voltage $V_o= V_{S1}-V_{S2}$ and is 1800 out of phase with the input primary voltage.

f) Draw the block diagram of instrumentation system and state function of each block diagram. (4M)

Ans:

Diagram:- **2M**



OR

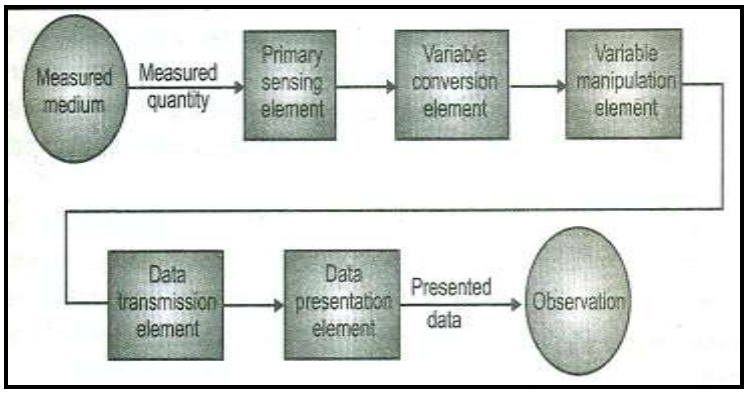


Figure:- Block diagram of instrumentation system

Functions of each block: **2M**

Primary sensing element:
This first receives energy from the measured medium and produces an output depending on measured quantity.

Variable conversion element:
Converts the output signal of the primary sensing element into a more suitable variable or condition useful to the function of the instrument.

Variable manipulation element:
Manipulates the signal represented by some physical variable, to perform the intended task of an instrument. In the manipulation process, the physical nature of the variable is preserved.

A data transmission unit:
Transmits the data from one element to the other.

A data presentation element:
Performs the translation function, such as the simple indication of a pointer moving a scale or the recording of a pen moving over chart.

Q5. Attempt any FOUR of the following: **16M**

a) Difference between RTD and Thermocouple(on the basis of any four factors) **(4M)**

Ans: **(each factor-1 marks)**

Sr No.	RTD	Thermocouple
1	The resistance of certain metal changes with temperature change. RTD utilizes these characteristics.	When two dissimilar metals are connected to each other to form two junctions and these junctions are exposed to different temperatures then current flows through the metals, an emf generates which is proportional to the difference in temperature at the junctions.
2	They need a bridge circuit, power supply.	There is no need of bridge circuit, power supply.
3	Cost is high.	Cost is low.
4	Temp range: -200 $^{\circ}$C to 650°C.	Temp range: -270°C to 2800°C.

b) Define wave analyzer and state any four applications of wave analyzer. (4M)

Ans: **(defination-2 marks,Applications-2 marks)**

Waveform analyzer: - It is the instrument used to measure the amplitude of each harmonic or fundamental. This is the simplest form of analysis in the frequency domain & can be performed with a set of tuned filters & a voltmeter.

Applications: **(any two relevant applications -1mark each)**

i) It is used in electrical measurement.
ii) It is used in sound measurement to measure amount of sound in machineries or in transmission.
iii) It is used in vibration measurement to measure amount of vibrations in machineries or in transmission.
iv) In electronic laboratories.

c) Draw the block diagram of frequency selective wave analyzer and state the function of each block. (4M)

Ans: (block diagram-2 marks, explaination-2 marks)

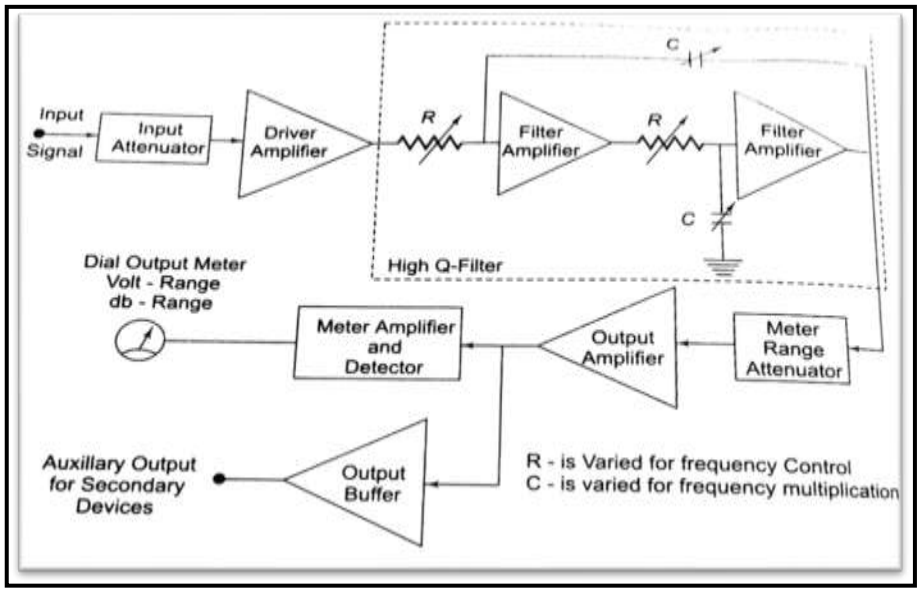


Fig. block diagram of frequency selective wave analyzer

- The wave analyzer consist of a very a narrow pass-band filter section can be tuned to a particular frequency.
- The complex wave to be analyzed is passed through an adjustable attenuator which serves as a range multimeter and permits a large range of signal amplitudes to be analyzed without loading the amplifier.
- The output of the attenuator is then fed to a selective amplifier, which amplifies the selected frequency.
- The driver amplifier applies the attenuated input signal to a high Q active filter. This high-Q filter is a low pass filter which allows the frequency which is selected to pass and reject all others.
- The magnitude of the selected frequency is indicated by the meter and the filter section identifies the frequency of the component.

- The capacitors are used for range changing and the potentiometer is used to change the frequency within the selected pass-band, hence this wave analyzer is also called a frequency selective voltmeter.
- The selected signal output from the final amplifier stage is applied to the meter circuit & un-tuned buffer amplifier.
- The main function of the buffer amplifier is to drive output devices.

d) Draw the schematic diagram of electromagnetic flow meter and describe its working. (4M)
Ans: (block diagram-2 marks, explaination-2 marks)

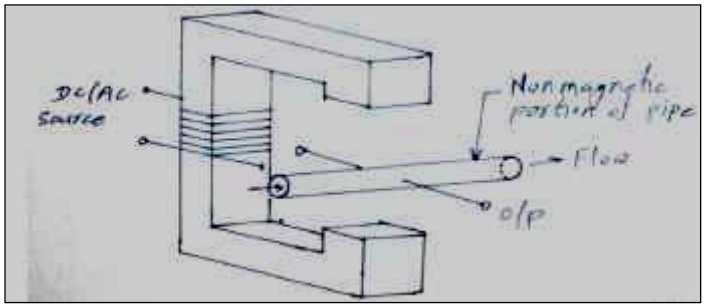


Fig. schematic diagram of electromagnetic flow meter

Working principle:-

- The operation of this type of flow meter is based on Faraday's law of electromagnetic
- Induction. The law state that whenever the conductor moves through a magnetic field ,an emf is
- Induced in the conductor proportional to the relative velocity between the conductor & the Magnetic field.
- It consists of a pipe, short section of which is subjected to a transverse magnetic field. The
- Conductive fluid is passed through this pipe. As fluid passes, its motion relative to field produces
- An emf proportional to velocity according to Faraday's law.
- This output emf is collected by the electrodes (kept at points of maximum potential
- Difference) and is given to external circuitry.

e) List any four types of thermocouples, it's material and it's temperature range. (4M)
Ans: (any four, 1 mark each)

Sr.No.	Type	Material	Temperature ranges
1	J type	Iron-constant	-196˚C to 760˚C
2	K type	Chromel –Alumel	-200˚C to 1260˚C
3	T type	Copper –Constant	-190˚C to 400˚C
4	R type	Pt(87%) Rh(13)-Platinum	-18˚C to 1400˚C
5	S type	Pt (90%) Rh(10%)-Pt	-18˚C to 1760˚C
6	E type	Chromel- constant	-196˚C to 999˚C

f) Differentiate between Active and Passive Transducer.(on the basis of any two factors) (4M)

Ans: (any two,2 mark each)

Sr.No.	Active Transducers	Passive transducers
1	Do not require external power supply for its operation.	Require external power supply for its operation.
2	It is also called as 'Self generating Transducers'.	It is also called as 'Externally powered Transducers'.
3	Operate under energy conversion principle.	Operate under energy controlling principle.
4	E.g. Thermocouples, Piezoelectric transducer etc.	e.g. Thermistors ,Strain gauges etc.

Q6. Attempt any FOUR of the following: 16M

a) Illustrate the working principle of Digital Frequency Meter. (4M)

Ans: (block diagram-2 marks, explaination-2 marks)

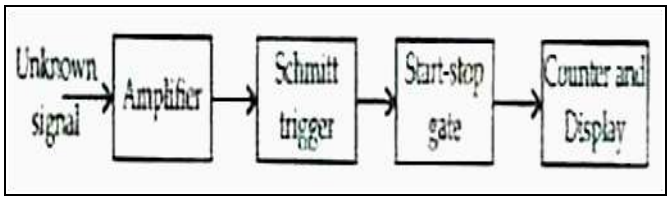


Fig. Digital Frequency Meter

Explanation:-

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.

b) Draw the circuit of basic Q-meter & explain its working. (4M)

Ans: (block diagram-2 marks, explaination-2 marks)

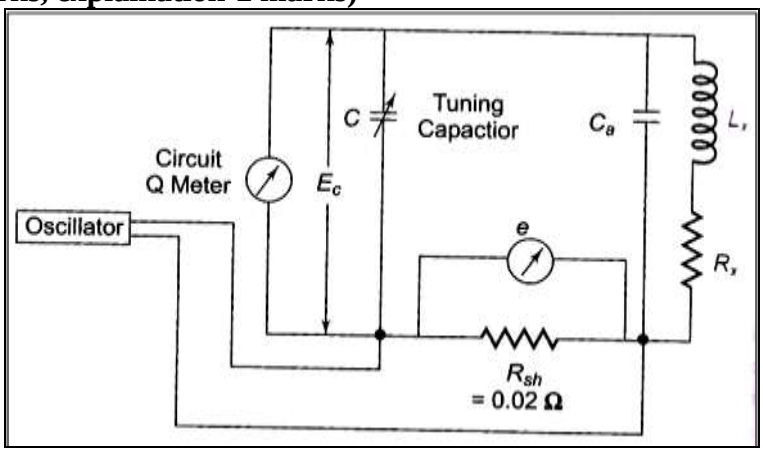


Fig. Q-meter

Q-factor is called as quality factor. It is the ratio of energy stored in the device to energy dissipated in the device.

Q meter is an instrument which is design to measure the value of Q directly and is useful for measuring the characteristics of coils and capacitors.

The principal of Q meter is based on series resonance, the voltage drop across the coil or capacitor is Q times the applied voltage.

If a fixed voltage is applied to a circuit a voltmeter across the capacitor can be calibrated to read Q directly.

At resonance $X_L = X_c$ and $E_L = I.\ X_L$, $E_C = I.\ X_C$, $E = I.R$

Where, E= Applied voltage $E_{C=}$ Capacitor voltage

$E_{L=}$ Inductive voltage $X_{L=}$ Inductive reactance

X_c= Capacitive reactance R= coil resistance

I= circuit current

Therefore $Q = X_L/R = X_C/R = E_C/C$

From the above equation, if E is kept constant the voltage across capacitor can be measured by a voltmeter calibrated to read directly in terms of Q.

c) Distinguish between single beam dual trace CRO and dual bean CRO. (on the basis of any four factors)
Ans: (any four,1 mark each)

Sr no.	Single beam dual trace CRO	Dual beam CRO
1	it has one cathode ray gun & one beam	It has two completely separate electron beams
2	It has one set of vertical deflection	It has two sets of vertical deflection plates.
3.	Electron switch switches two signals to vertical amplifier.	Because of separate beam electron switch is not required.
4	Only one vertical amplifier is used.	Two separate vertical amplifiers are used.
5.	Intensity of the beam is high	Intensity of the beam is low.

d) Name any dynamic characteristics of instrument and define any two. (4M)
Ans: (name-2 marks, any two defination-1 mark each)

1. **Speed of Response**
2. **Fidelity**
3. **Lag**
4. **Dynamic Error**

1) **Speed of Response**:
It is the rapidity with which an instrument responds to changes in the measured quantity.

2) Fidelity:
It is the degree to which an instrument indicates the changes in the measured variable without dynamic error.

3) Lag:
It is the retardation or delay in the response of an instrument to changes in the measured variable.

4) Dynamic Error:
It is the difference between true value of a quantity changing with time & the value indicated by the instrument, if no static error is assumed. It is also called as measurement error.

e) Draw the circuit of DC voltmeter & explain its working. (4M)
Ans: (Diagram-2 marks, explaination-2 marks)

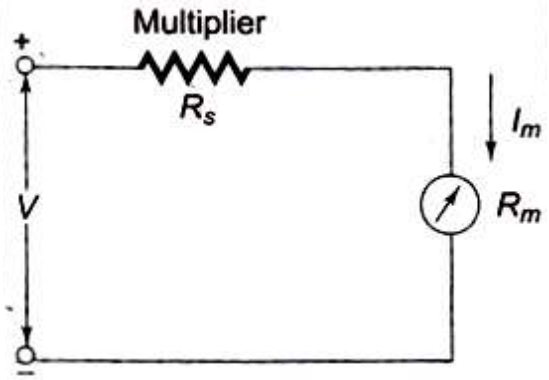


Fig. DC voltmeter

A DC voltmeter measures the potential difference between two points in a dc circuit,to measure the potential difference between two points, A DC voltmeter is always connected across them with the proper polarity. The of the multiplier is to limit the current through the movement so that the current does not exceed the full scale deflection value.

The value of the multiplier is calculated as follows:

From the Circuit:

$$V = I_m(R_s + Rm)$$

$$R_s = \frac{V - ImRm}{Im}$$

$$R_s = V/ I_m - R_m$$

f) The current resistor is 3A. But the measurement yields value of 2.9A. Calculate the relative and percentage accuracy. (4M)

Ans:

Q6 f) Given $Y_n = 3A$

$X_n = 2.9A$

① Relative accuracy

$A = 1 - \left(\frac{Y_n - X_n}{Y_n}\right)$ —— formula 1 mark.

$= 1 - \left(\frac{3 - 2.9}{3}\right) = 1 - \frac{0.1}{3}$

$\boxed{A = 0.966}$ —— 1 mark.

② Percentage accuracy

$a = A \times 100\%$. —— formula - 1 mark

$a = 0.96 \times 100\%$.

$\boxed{a = 96\%}$ —— 1 mark