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. **(Marks 12)**

i) Write any four advantages of electrical transducers.

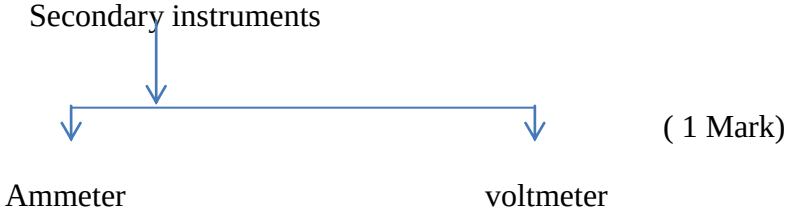
Answer:- **(Each 1 mark)**

1) Electrical amplification and attenuation can be done easily.
2) Effects of friction are minimized.
3) The electrical output can be easily used, transmitted and processed for measurement.
4) The power level required to control any electric system is very small.
5) Mass- inertial effects are minimized.

ii) Give two example of absolute instruments and secondary instruments.

Answer:-

(1 mark)



(1 Mark)

iii) State any four specification of CRO.

Answer :- Note: Values are optional (Each 1 mark)

1. Power supply :- 230 Volts ,single phase, 50 Hz.
2. Input impedance :- 1 mΩ / 35 pf
3. Maximum rated input voltage - 400 Volts
4. Time based – 2 ms / div to 5 s/div
5. Band width – 15 MHz.

iv) State PT -100. Give the significance of PT and 100

Answer:-

PT – 100:- The material used for RTD is platinum. It has 100 Ω resistance at 0^0 C. so the name PT-100.

PT: - means platinum **(1 mark)**

100:- means 100 Ω resistance at 0^0 C **(1 mark)**

v) Define Lissajous pattern. State its application.

Answer:-

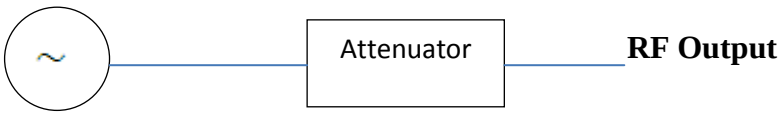
The CRO is said to operate in the X- Y mode. Then the pattern obtained on the screen of CRO is called Lissajous Pattern **(1 mark)**

Application :- (1 mark)

1. The phase measurement can be done.
2. Frequency measurement can be done.

vi) State with neat sketch operation of basic signal generator.

Answer:- (Block Diagram-1 Mark, Operation- 1 Mark)



Operation:-

1. It consists of two basic blocks an oscillator and an attenuator.
2. The Attenuator also provides amplitude control.
3. The output from generator is either amplitude modulated or frequency modulated.

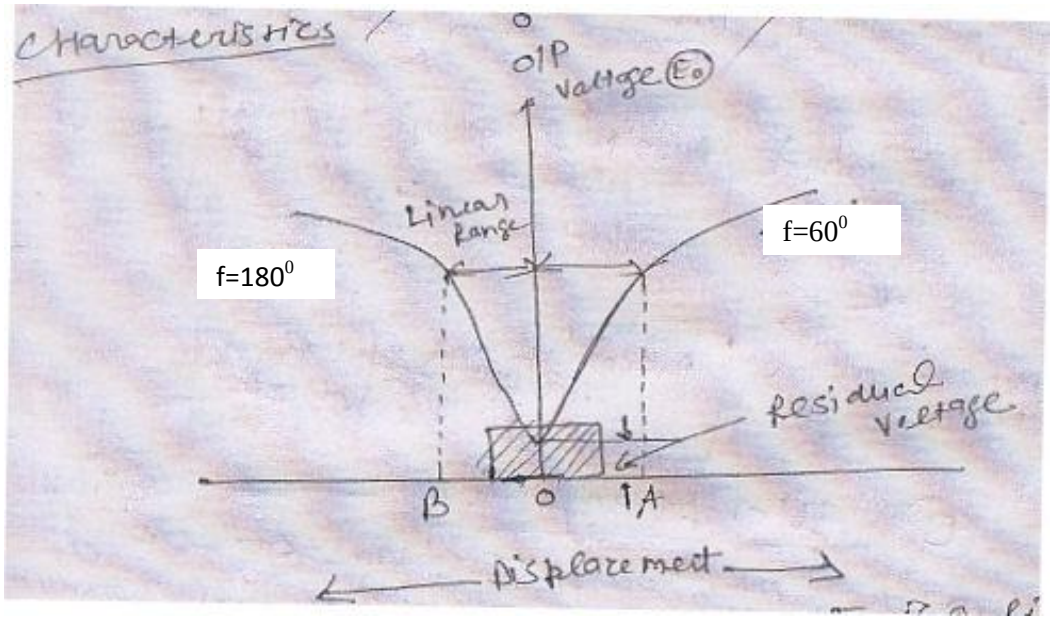
Q.1. b) Attempt any TWO of the following: (8 Marks)

i) Draw the input output characteristics of L.V.D.T. why it is called as differential transducer?

Answer: (diagrams- 3 Marks, Explanation – 1 Mark)

Variation of output voltage version displacement for various positions of core.

- Output voltage is pleated on the Y axis and Displacement of core is on X axis



- The output voltage of an LVDT is a linear function of core displacements; the curve starts to deviate from a straight line.
- Beyond this Range of displacements, the curve starts to deviate from a straight line.
- Practically due to harmonics present at primary for two displacements small voltage drop occurs at output is called Residual voltage.
  The output of the Transduces is the difference of the two voltages

$$E_O = ES_1 - ES_2$$

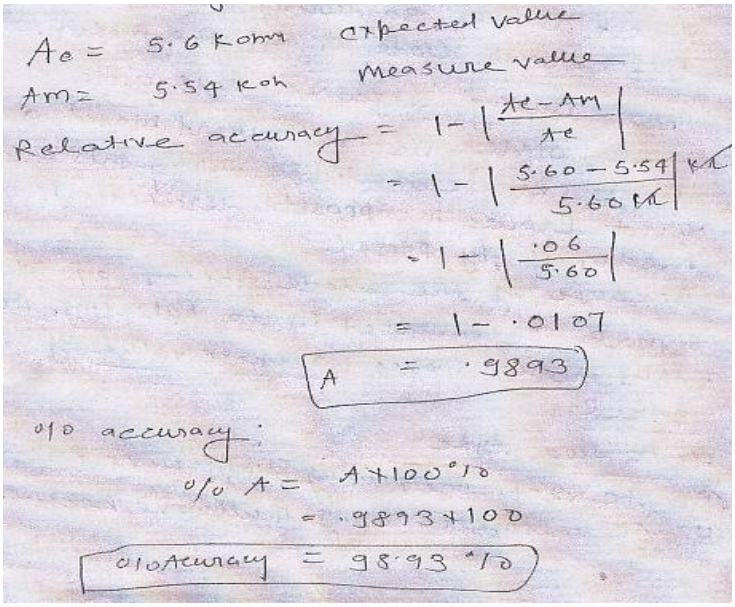
The differential voltages of two secondary windings of a Transformer are varied by positioning the Iron core through an externally applied force. Due to this Reason it is called as differential transducer.

ii) The value of Resistor is 5.6 K-ohms while measurement reads a value of 5.54 K-ohms

Calculate:

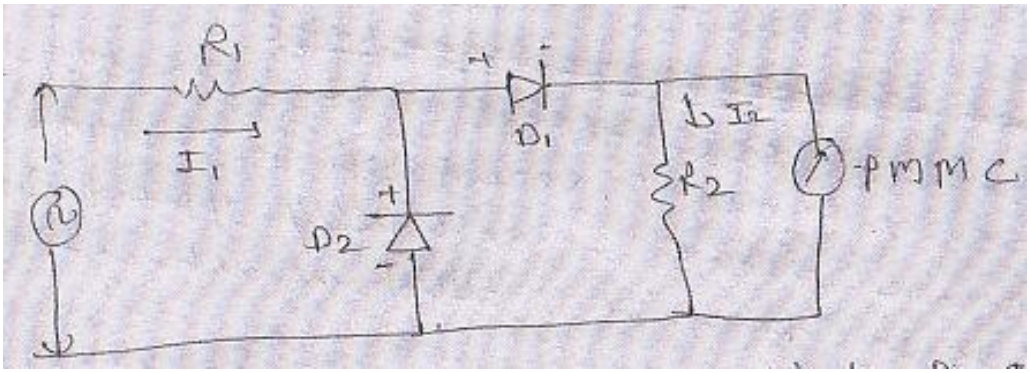
i) Relative accuracy
ii) % accuracy

Answer: **(2 Marks Each)**



iii) Draw the circuit diagram of Recitier type A.C voltmeter.state its principle.

Answer: **(Diagram – 2 Marks, principle- 2 marks)**



- For the Rectification action two diode D_1 and D_2 are used
- An AC input signal to be measured is applied

- Now during positive biased and diode D_2 is Reverse biased.so during this cycle the current passes through diode D_1 and the meter.
- During Negative half cycle of input signal didde D_2 is forward biased and diode D_1 is Revese biased. So during this cycle the current flow in opposite direction. It means mater is by passed.
- Because of the diode action an dc input signal is converted in to pulsating Dc thus meter shows average value of an input signal.

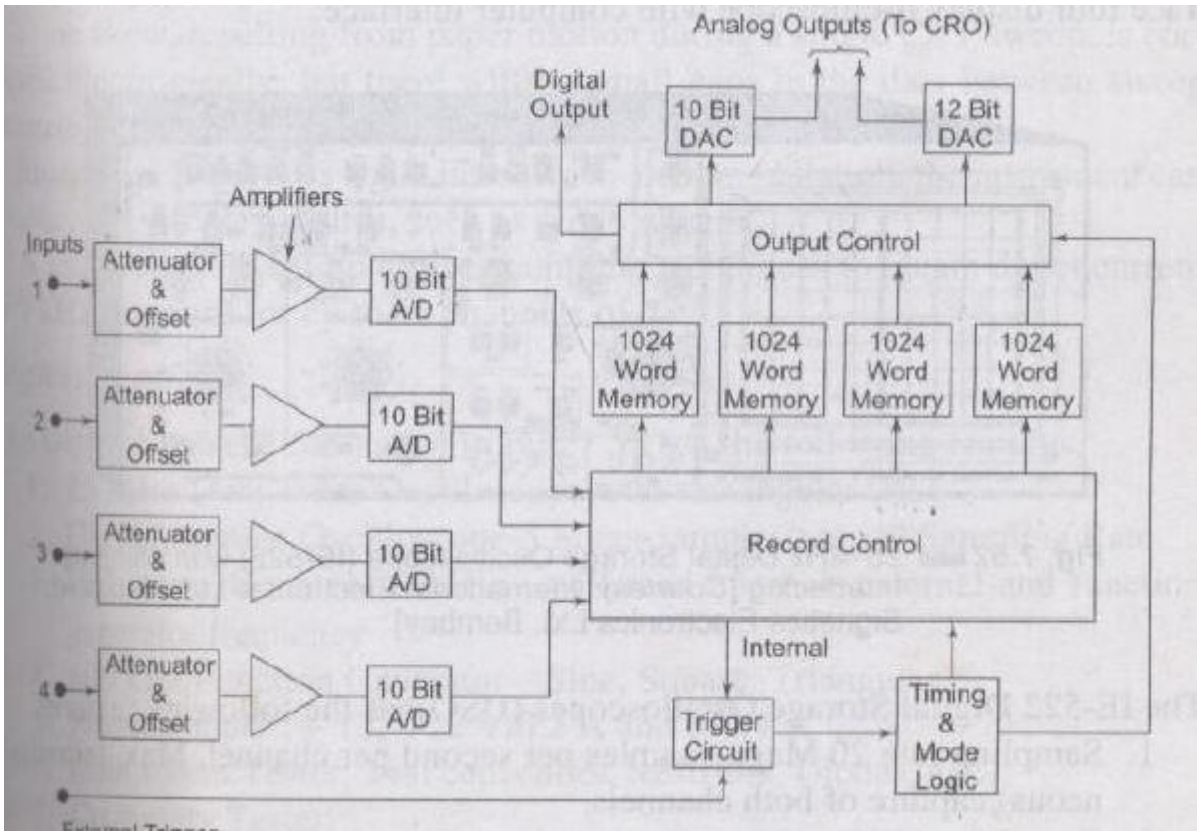
It is two type

i) Ac voltmeter using Half wave Rectifier
ii) Ac voltmeter using full wave Rectifier

Q2) Attempt any FOUR of the following: (16 Marks)

a) Draw the block diagram of digital storage oscilloscope.

Answer: (Diagram- 4 marks)



b) Give two advantages and two disadvantages of Electromagnetic flow meter

Answer: (For Each advantage- 1 Mark, Each Disadvantage- 1 mark)

Note : Consider any other relevant advantage and disadvantage.

Advantages of EM flow meter. **(Any Two)**

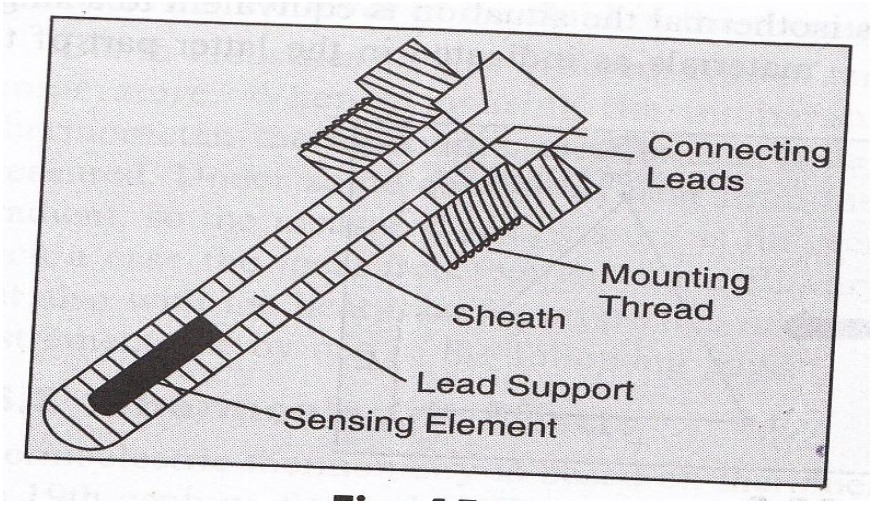
1) As there is no obstacles in path of fluid, no pressure loss.
2) Linear relationship between input flow rate & output voltage.
3) Output obtained is independent of viscosity, pressure and temperature.
4) It can handle slurries, greasy materials.
5) It directly convert flow rate into voltage.

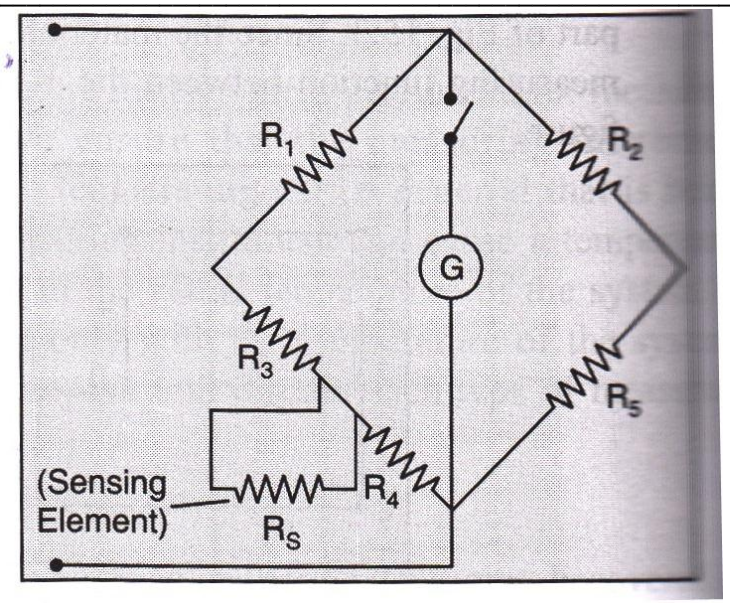
Disadvantages of EM Flow meter. (Any Two)

1) It must be explosion proof when installed in hazardous area
2) As it is useful for fluid with conductive property, hence it has limited use.
3) Cost is high.

c) Give construction, working principle of RTD with neat diagram

Answer: (Diagram- 2 marrks, Construction- 1 Mark, working principle-1 Mark)





Construction :-

- Figure shows platinum RTD. In which platinum is used as sensing element.
- This sensing element is enclosed in metal sheath.
- Leads are coming out for connectivity to bridge circuit to measure change in resistance.

Working:

Due to change in resistance as temperature changes RT makes the bridge imbalance.

RT is connected to bridge circuit At balance, ratio is

$$\frac{R2}{R3}x = \frac{R1}{R4 + RT + R5}$$

As RT changes bridge imbalances and galvanometer shows deflection.it is calculated as :

$$RT = RO\ (\ 1+ \alpha(\Delta\ t))$$

RTD has positive temperature coefficient and more linear. Means its resistance increases as temperature increase.

d) A 1mA meter movement with an internal resistance of 100Ω is to be converted into a 0-100mA ammeter. Calculate the value of shunt resistance required.

Answer:

Ish = $I-I_M$

= 100-1 = 99mA. (1 Mark)

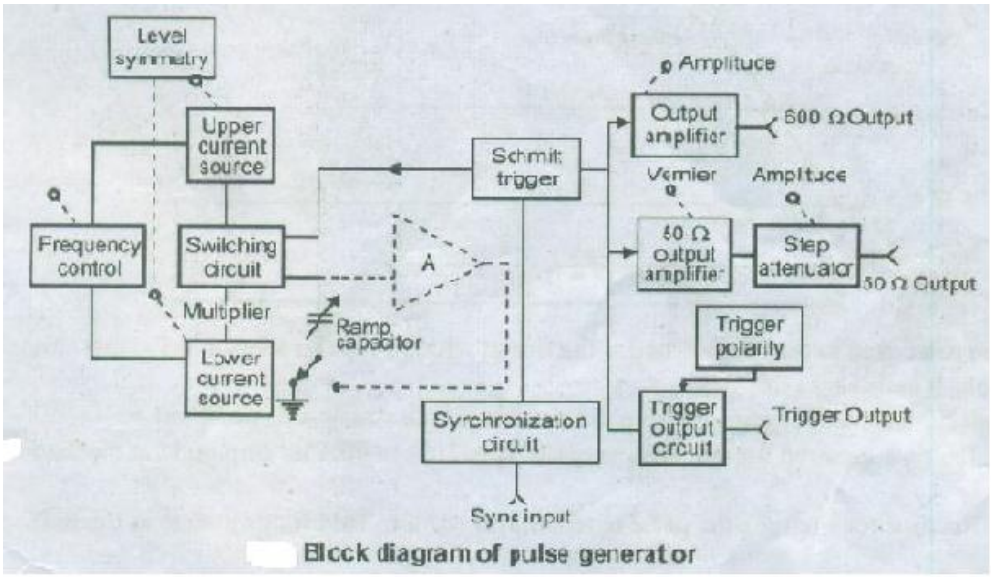
$$Rsh = \frac{ImRm}{Ish} x = \frac{ImA * 100\Omega}{99mA}$$ (2 Marks)

= 1.01Ω

The value of shunt Resistance is 1.01Ω (1 Mark)

e) Draw the block diagram of pulse generator.

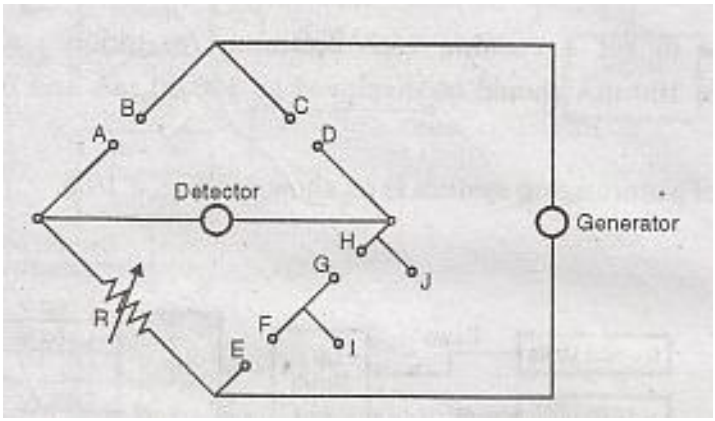
Ans: (Diagram 4 Mark)



Block diagram of pulse generator

f) Draw the block diagram of LCR-Q meter. Explain it.

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



This diagram is optional

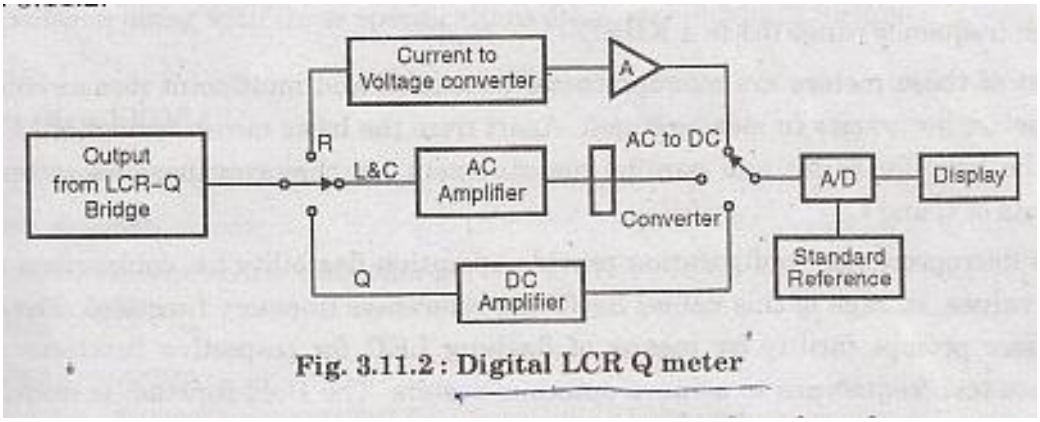


Fig. 3.11.2 : Digital LCR Q meter

Explanation:

It consist of bridge circuit & conversion circuit.The bridge is used for "DC" measurements as well as "AC" measurements. For "DC" measurements battery is used as a source and for "AC" measurements AF oscillator is used as generator. The upper channel is used for resistance measurements. Since the detected output at the bridge is current,this current is converted into voltage & then amplified. It is then converted into digital format with the help of A/D converter.

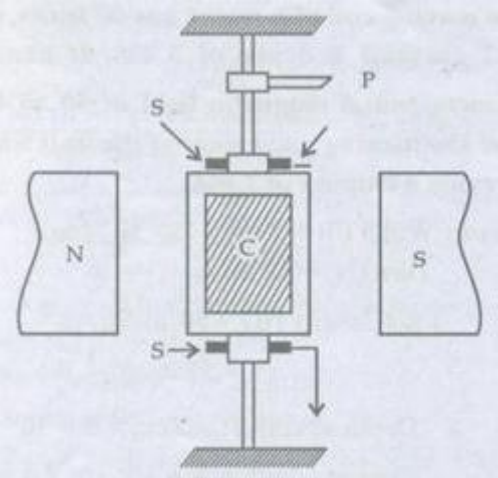
The middle channel is used for L,C measurements,since the detected output is AC to convert the signal to the digital information, firstly it is converted into DC level & amplified & applied to the A/D converter.

The lower channel gives direct voltage at detecter which is calibrated in terms of Q. It is then converted into digital signal and then displayed.

Q.3. Attempt any Four of the Following:- **(16 Marks)**

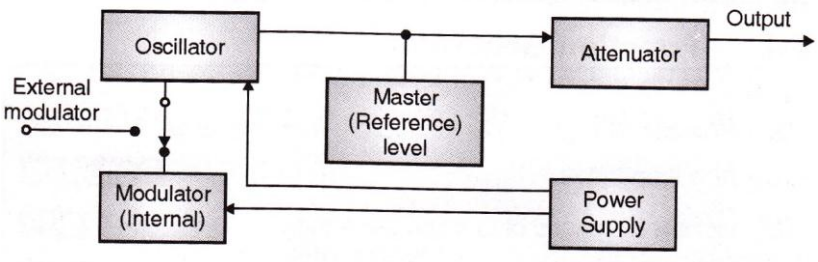
a) Draw a neat labeled diagram of PMMC instruments and state its, working principle.

Answer:- **(Diagram:2 Marks, working principle- 2 Marks)**



- When current passes through the coil a deflecting torque is produced. This deflecting torque is produced due to interaction between magnetic field produced by permanent magnet and magnetic field produced by moving coil.
- Due to this torque the coil deflects and this deflection is proportional to the current Flowing through the coil. The pointer attached to the coil indicated the magnitude of quantity being measured.
- The another torque is developed by the hair spring known as controlling torque. This torque help to stabilize the pointer.
- The pointer becomes stable at equilibrium, this is possible only when the controlling torque becomes equal to the deflecting torque.

b) Draw the block diagram of RF signal generator. Explain it's working.
Answer:- (Block Diagram 2 Marks, Working Principle – 2 Marks)



- RF signal generator contains a RF oscillator with the power supply , an amplifier a modulator and output control circuit .
- RF oscillator is used to generate frequency upto 40 GHz . It is usually Hartley oscillator or colpitts oscillator .
- The internal modulator modulates the signal generated by oscillator . In addition RF generator are provided with an external source of modulation to get the desired waveform.

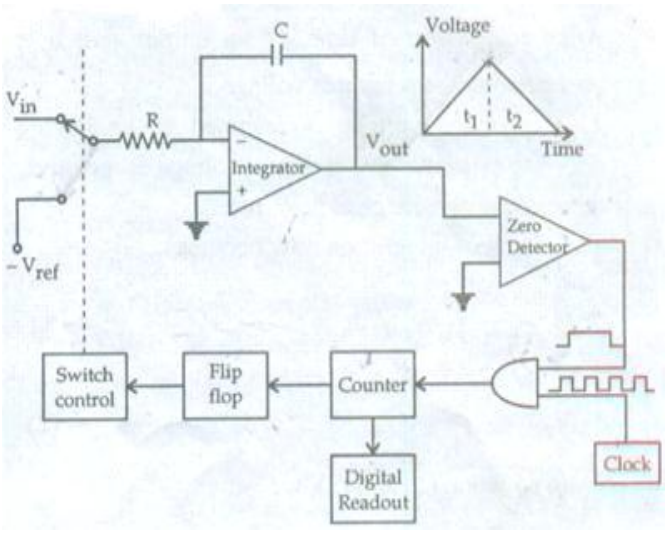
- This generator is always shielded by enclosing it in a metal box to prevent the emission of RF energy from any point except the output terminal. The modulating voltage may be either a sine wave, square wave or pulse for varying duration.

c) Draw the block diagram of digital voltmeter. Give any four application of digital voltmeter.

Answer : (Note:- consider any diagram of any one type of DVM

consider any other relevant application of DVM)

(Block Diagram – 2 marks, Each Application – ½ Marks)

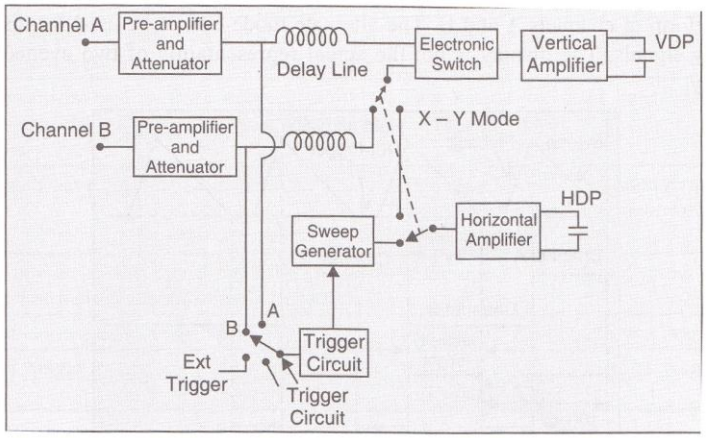


Application:-

- It is used to measure voltage in laboratory.
- In industry, to measure and display voltage of different process parameter.
- It is used to measure fault finding in electronic equipment.
- It is used to test the control panels in automation.

d) Draw the block diagram of single beam dual trace CRO and state it's concept.

Answer:- (Block Diagram – 3 Marks, concept- 1 Mark)



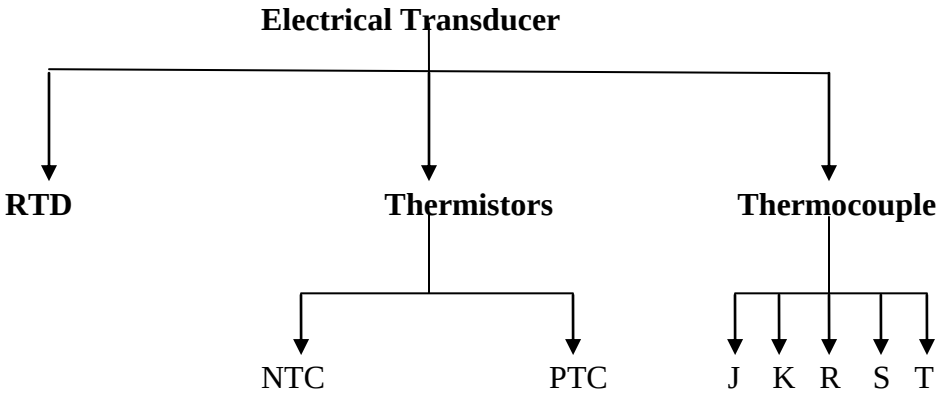
Concept:-

In dual trace CRO one electron beam is used to generate two traces. These can be deflected from two independent vertical sources. This helps to compare the two voltage waveforms at a time**.**

e) Give the Classification of temperature measuring transducers and define temperature.

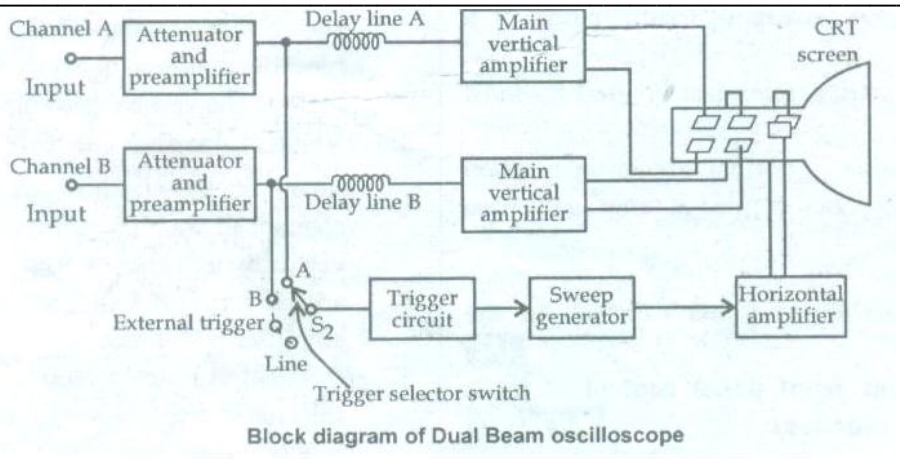
Answer:- (Definition – 1 Mark, Classification – 3 marks)

- It is a degree of hotness or coldness of a body or an environment on a definite scale**.**
- **Classification of temperature measuring transducers:-**



f) **Draw the block diagram of dual beam dual trace CRO and list and two application.**

Answer:- (Diagram- 3 marks, Each Application- ½ Mark)



Block diagram of Dual Beam oscilloscope

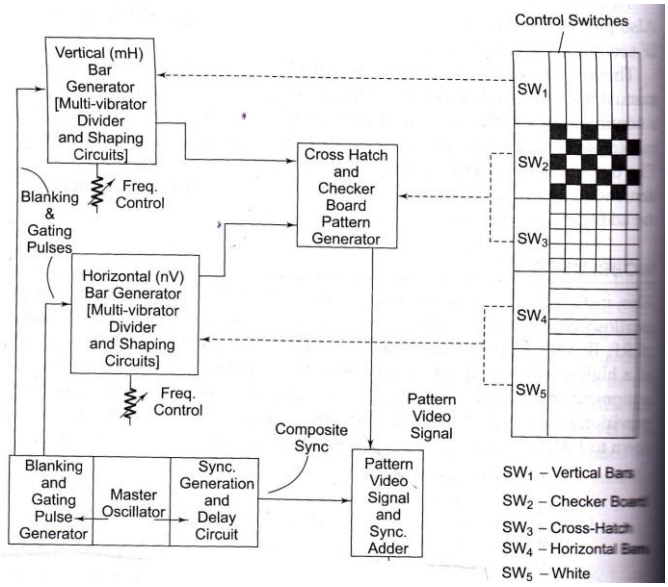
Application:-

- To compare voltages of two different signals
- To compare frequencies of two different signals
- To measure phase difference of two different frequencies.

Q.4. Attempt any Four of the Following:- **(16 Marks)**

a) Describe working with neat sketch of video pattern generator.

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



Explanation:-

A pattern generator provides video signals directly, and with RF modulation, on standard TV channels for alignment, testing and servicing of TV receivers. The Output signals is designed to produce simple geometric patterns like vertical and horizontals bars, check boards, cross-hatch , dots, etc.

The generator employs two stable chains of miltivibrator, dividers and pulse shaping circuits, one below the line frequency to produce a series of horizontal bars, and another above 15625 Hz to produce vertical bars. The signals are modified into short duration pulses, which when fed to the video section of the receiver along with the sync pulse train, produce fine lines on the screen.

Multivibrators produce a square wave video signal at m times the horizontals frequency to provide m vertical black and white bars. After m cycles, the horizontal blanking pulse triggers the multivibrators for synchronizing the bar signal on every line.

Similarly, square wave pulses derived either from 50Hz mains or from the master oscillator are used to trigger another set of multivibrator to generate square wave video signals.

Picture centering and aspect ratio can be checked with cross-hatch pattern by counting the number of square on the vertical and horizontal sides of the screen.

b) Give the comparison between wave analyzer and harmonic distortion analyzer.

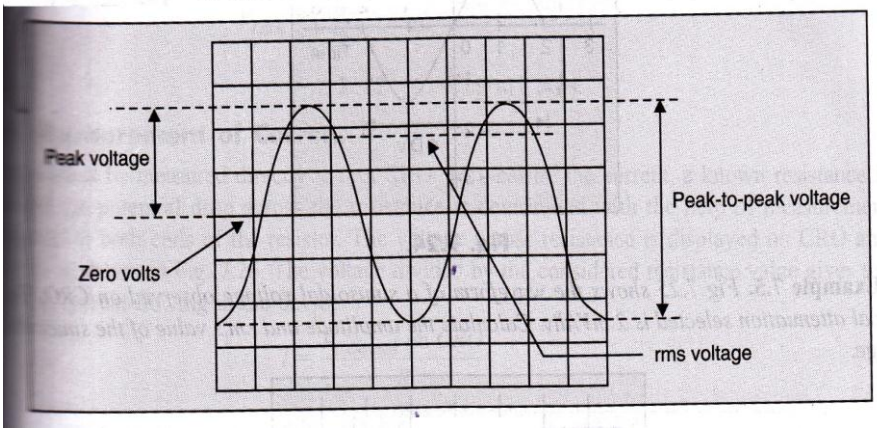
(Any Four point,1 mark Each)

Answer:- Comparison between wave analyzer and harmonic distortion analyzer

Wave Analyzer	**Harmonic distortion Analyzer**
1. It is an instrument to measure relative amplitudes of single frequency components in a Complex waveform	1. It is give measure of the energy present in a signal outside a specified frequency band.
2. Fixed frequency active filter is used	2. Notch filter is used
3. Range is 10Hz-40MHz	3. Range is 5Hz to 1MHz
4. Types of wave analyzer: Frequency selective Heterodyne	**4. Types of human distortion analyzer:** Heterodyne Human distortion analyzer Tuned circuit Fundamental separation HDA
5. Measures amplitude of one harmonic at a time.	**5.** Measures rms value of all the harmonics simultaneously**.**

c) Give the procedure to measure frequency and voltage using CRO in normal mode.

Answer:- Measurement of Voltage:- **(2 Mark)**



To measure the Voltage:-

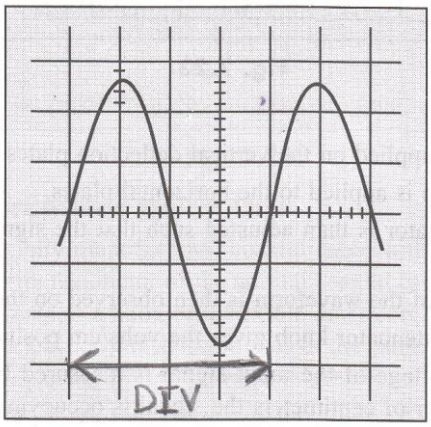
1) The input voltage is applied on the deflection plates.
2) An appropriate sweep is applied to the horizontal plates.
3) The amplitude attenuator is than adjusted such that the signal is displayed comfortably on the screen.
4) The amplitude trace of the waveform is then observed on the screen.
5) The position of the attenuator knob gives the volts/cm position or volts/division.
6) The peak to peak voltage of the input signal is measured by multiplying this position value with the number of centimeter the signal is occupying in the vertical direction.
7) The peak to peak voltage of the signal is given by,

$$V_{p-p} = \left(\frac{\text{volts}}{\text{div.}}\right) \times (\text{number of divisions})$$

$$\text{Amplitude } V_{\max} = \frac{V_{p-p}}{2}$$

$$\text{R.M.S value, } V_{\text{r.m.s}} = \frac{V_{p-p}}{2\sqrt{2}}$$

Measurement of frequency:- **(2 Marks)**



The waveform is displayed on the screen such that one complete cycle is visible on the screen. Note the Time/division on the front panel. Then the period of the waveform can be obtained as,

$$T = \frac{\text{Time}}{\text{Division}} \times \text{number of divisions occupied by one cycle}$$

Frequency

$$f = \frac{1}{T}$$

d) List any eight specification of function generator. (1 Mark Each)

Answer:- Note: Values are optional

Specification of function generator:-

1. Wave form generated:- Sine wave, Square wave, Pulse, Triangular, Saw tooth, or ramp waveforms.
2. Output voltage level:- 10 to 20 volts, peak to peak .
3. Output impedance:- Typically 50 Ω.
4. DC Offset :- range +5 Volts to – 5 volts
5. Frequency range:- 0.2 Hz to 20 MHz
6. Frequency stability :- 0.1 % per hour to and a logue 500 parb per million for digital.
7. Phase block capability
8. Modulation supported
9. Weight:- 1.5 Kg.
10. Operating temperature:- $+5^{0}$ C to 40^{0} C
11. Power supply requirement:- 230 V / 50 Hz
12. Variable symmetry control
13. External sweep input

e) Compare active and passive transducer (minimum four points) (1 Mark Each)

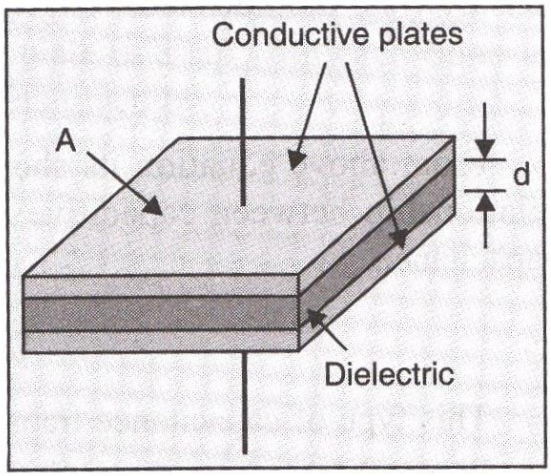
Answer:- Compare active and passive transducer:

Active transducer	Passive transducer
1. It is also known as self-generating type transducer.	1. It is also known as externally powered transducer.

2. Do not require external power supply for its operation.	2. Require external power supply for its operation.
3. Active transducer generate electric I or V directly in response to environmental stimulation	3. Passive transducer produces a change in some passive electrical quantity such as capacitance, resistance, inductance as a result of stimulation.
4. Works on energy conversion principle	4. Works on energy controlling principle.
5. For Example, Thermocouple, piezoelectric transducer etc.	5. For Example, Strain gauge, RTDs, Thermistors etc.

f) With neat diagram explain working principle of capactive.

Answer:- (Diagram- 2 Marks, Explanation – 2 Marks)



Explanation:-

The Capacitive transducer is the capacitor with variable capacitance. The capacitive transducer comprises of two parallel metal plates that are separated by the material such as air, which is called as the dielectric material. In the parallel plate capacitor. The distance between the two plates is fixed, but in variable capacitance transducers the distance between the two plates is variables.

$$\text{Capacitance} = \epsilon \frac{A}{d}$$

where, A = overlapping area of plate

d = Distance between two plates

ϵ = permittivity of medium

In the instrument using capacitance transducer the value of the capacitance changes due to change in the value of the input quantity that is to be measured. The capacitive transducer is used extensively for the measurement of displacement, pressure etc.
The capacitive of the variable capacitance transducer can change with the change of the dielectric material, change in the area of the plates and the distance between the plates. Depending on the parameter that change for the capacitive transducer.

Q5 Attempt any Four of the following: 16M

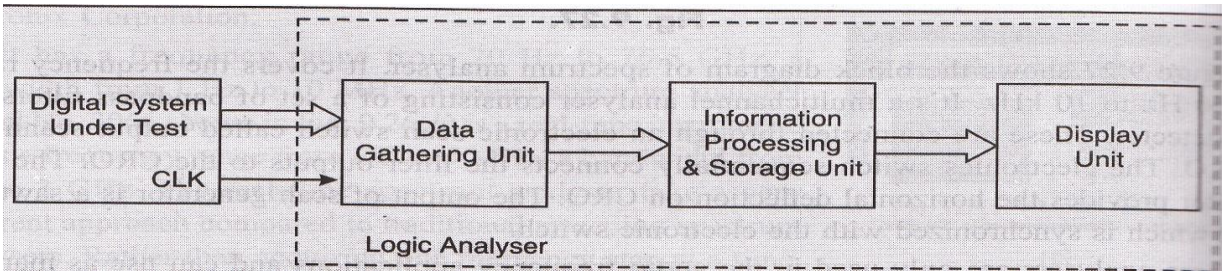
a) Compare time difference ultrasonic flow meter and Doppler type ultrasonic flow meter (minimum four points. 1 Mark Each)

Answer:

Sr. No.	**Time difference**	**Doppler type flow meter**
1.	It is transmission method	It is reflection method
2.	It based on time difference for ultrasonic wave	Based on Doppler principle
3.	Formula: $v = \frac{l}{2\Delta T cos\theta}$ **ΔT= Time difference** **L= length**	Formula: $v = \frac{\Delta f C_t}{2 f_0 cos\theta}$ **Δf=Frequency**
4.	Used for clean water/fluid flow	Used for dirty corrosive fluid

b) Describe working with labeled sketch of logic analyzer.

Answer: (Diagram – 2 Marks, Explanation- 2 Marks)



A block diagram of a typical logical analyzer. It has a data gathering unit information processing and storage unit and a display unit. The data gathering unit has

1) A pod slots for carrying data from the digital system under test to the logic analyzer and
2) A key pad the key pad is used to enter commands and set up the parameters that the logic analyzer will use.

   The display unit is a cathode ray tube (CRT) that displays the command menu for the operator and also displays the output data.

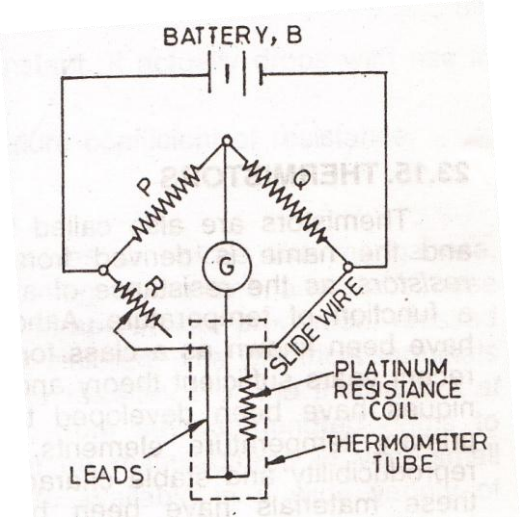
c) List characteristics of pulse of generator.

Answer: **(Any Four 1 Mark Each)**

1) Rise time & fall time
2) Overshoot
3) Ringing
4) Sag on pulse droop
5) Undershoot
6) Pulse repetition rate
7) Pulse jitter
8) Linearity
9) Settling time
10) Pulse width

d) Draw three wire system circuit of RTD **(4 Marks)**

Answer:



e) State the materials used to construct negative temperature coefficient thermistor and positive temperature coefficient thermistors.

Answer: **(2 Marks)**

Negative temperature coefficient: Sintered mixture of metallic oxides such as manganese, nickel, cobalt, copper, iron & uranium, aluminum, titanium, magnesium PTC thermistor are mode of polycrystalline materials. **(2 Marks)**

Positive temperature coefficient: PTC thermistor is made of polycrystalline materials. They are fabricated using mixture of barium titanate , titanium oxide, powdered barium carbonate & additives like tantalum silica & manganese

f) Compare active and passive transducer.

Answer: **(Any 4 , 1 Mark)**

Active transducer	Passive transducer
1. It is also known as self-generating type transducer.	1. It is also known as externally powered transducer.
2. Do not require external power supply for its operation.	2. Require external power supply for its operation.
3. Active transducer generate electric I or V directly in response to environmental stimulation	3. Passive transducer produces a change in some passive electrical quantity such as capacitance, resistance, inductance as a result of stimulation.
4. Works on energy conversion principle	4. Works on energy controlling principle.
5. For Example, Thermocouple, piezoelectric transducer etc.	5. For Example,Strain gauge, RTDs, Thermistors etc.

Q6 Attempt any four of the following **16 M**

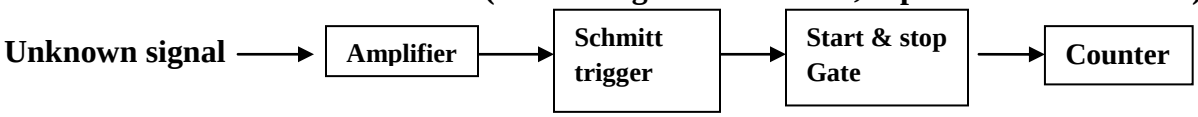
a) Compare analog instrument with digital instruments.

Answer: **(1 Mark each)**

Sr. no	**Analog instrument**	**Digital instruments.**
1	The instrument that displays analog signals is called as an analog instrument.	The instrument that displyas digital signals is called as an digital instrument
2	The accuracy of analog instrument is less	The accuracy of digital instruments is more
3	The resolution of analog of analog instrument is less	The resolution of digital instruments is more.
4	The analog instrument require more power	The digital instrument require less power.
5	Examples PMMC instrument DC voltmeter ,DC ammeter	Examples Logical analyzer, Digital analyzer, computer base instruments.

b) Draw the block diagram of digital frequency meter. Explain function of each block.

Answer: **(Block diagram- 1 ½ mark, explanation- 2 ½ marks)**



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

Schmitt trigger: Schmitt trigger converted the signal in to square wave having fast rise and fall times. The square wave is then differentiate 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, when the gate is open input pulse are allowed to pass throught it. A counter will count these pulse. When gate is closed input pulse are not allowed to pass through the gate. The counter will now stop counting.

Counter and display- The number of pulse during the period gate is open and counted by the counter. If this interval between start amd stop condition id known. The frequency of unknown signal is measured.

$$F=\frac{N}{t}$$

F= unknown frequency

N= number of counts displayed by counter.

t-: time interval between start and stop condition of the gate.

c) List any Eight specification of DSO

Answer: (Any Eight , 1 ½ Mark Each)

1. Sampling Rate
2. Pretrigger
3. Roll mode
4. Single Shot
5. Digital Sweep rate
6. Glitch detect
7. It support cursor movement
8. Trigger coupling
9. It has built in interface with RS 232 serial port

d) Define the following:

i) Accuracy

ii) Sensitivity

iii) Resolution

iv) Linearity

Answer:- (1 Mark Each)

1) **Accuracy**: It is the degree of closeness with which an instrument reading approaches the true value of the quantity being measured.

2) **Sensitivity**: Sensitivity is the ratio of change in output of an instrument to the change in input.

3) **Resolution**: It is the smallest change in the measured value to which the instrument will respond.

   It is smallest increment in the input value that can be detected by the instrument.

4) **Linearity**: As the ability of an instrument to reproduced its input linearity.

e) Give requirement of shunt in multirange ammeter.

Answer: **(4 Marks)**

The coil winding of basic movement is small & it is light in weight. So this coil enables small currents to pass through it. It is required to pass current range through coil then the construction become bulky. In order to avoid this resistor is connected in parallel with the basic movement. This resistor is called is shunt resistor. So major amount of current passes through it & a small current passes through the coil.

f) A 0-150v voltmeter has a guaranteed accuracy of 1 percent full scale reading. The voltage measured by this instrument is 83V. Calculate the limiting error in present.

Answer:

Answer:

the magnitude of limiting error of instrument is

$$\delta A = \varepsilon_r A_S$$

$$= \frac{1}{100} \times 150$$

$$\boxed{\delta A = \pm 1.5\ V}$$

the magnitude of voltage being measured is 83 V.

The percentage limiting error is

$$\%\ \varepsilon_r = \frac{\delta A}{83} \times 100$$

$$= \frac{1.5}{83} \times 100$$

$$\boxed{\%\ \varepsilon_r = 1.80 \text{ Percent}}$$ Answer.