MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

SUMMER– 18 EXAMINATION
Model Answer

Subject Name: Electronic Instruments & Measurements Subject Code: 17317

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

1. Attempt any five : 20

a) Classify instruments and give example of each.

Ans:-Relevant classification with at least one example of each- 1mks each

1. Absolute instrument :-
a) Tangent Galvanometer
b) Rayleighs current balance
c) Absolute electrometer
2. Secondary Instrument :
a) Indicating instruments: ammeter, voltmeter, wattmeter etc.
b) Recording instruments
c)Integrating instruments:: Ampere-hour meter: kilowatthour (kWh) meter, kilovolt-ampere-hour (kVARh) meter.

b) Draw and explain working of PMMC instrument.

Ans: Construction- 2 mks, working- 2 mks

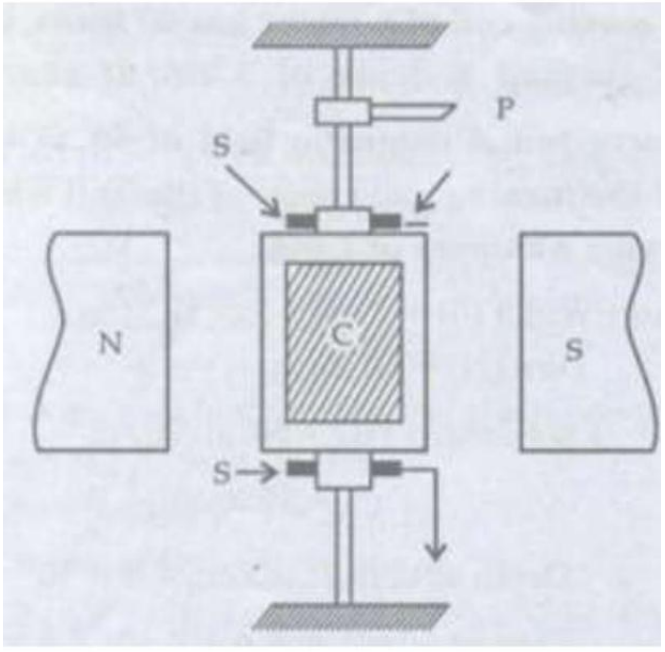


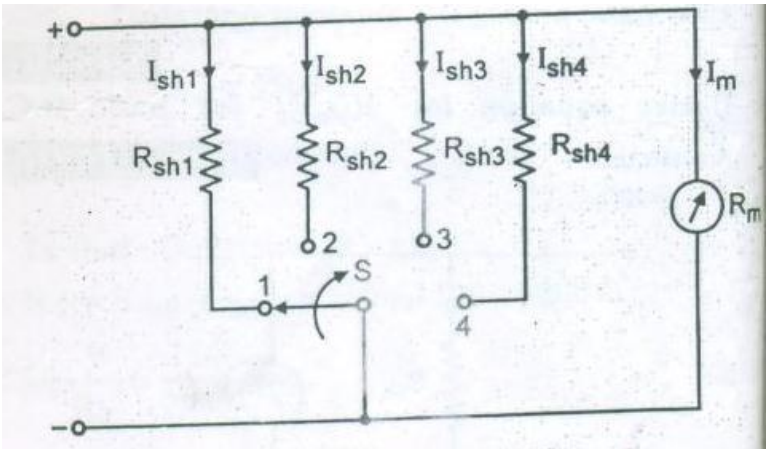
Fig: PMMC Instrument

Working: 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 helps to stabilize the pointer. The pointer becomes stable at equilibrium; this is possible only when the controlling torque becomes equal to the deflecting torque.

c) Explain how shunt resistor type DC ammeter is measures current.

Ans Diagram- 2mks, measurement method-2 mks



(i) D.C ammeter with single range is set by shunt resistor R_{sh}

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

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

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

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

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

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

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

(viii) This type of multirange are used for range upto 50A for R_{sh_1}.

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

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

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

for R_{sh_2}

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

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

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

Similarly

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

d) List advantages of digital instruments over analog instruments (any 4)

Ans. Relevant 4 advantages- 4mks

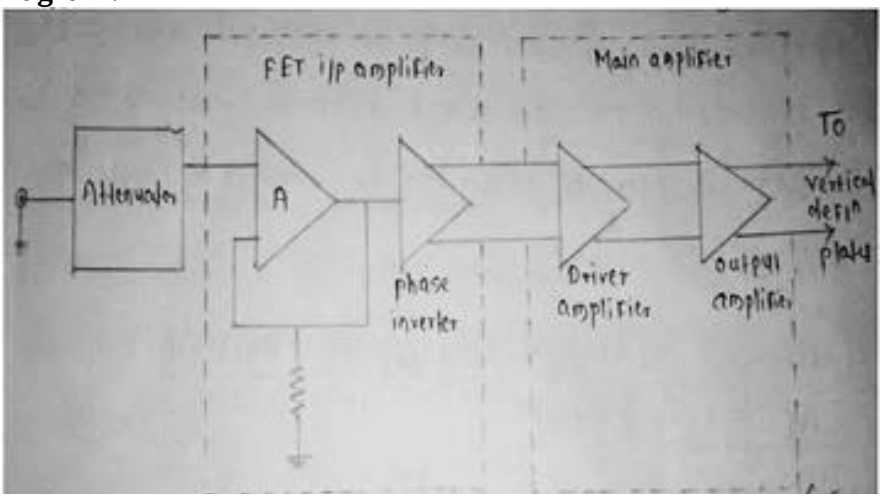
Advantages of digital instruments over analog instruments:

1. They are having high input impedance, so there is no loading effect
2. They are having higher accuracy
3. An unambiguous reading is obtained
4. The output can be interfaced with external equipment
5. They are available in smaller size

e) Draw the block diagram of vertical deflection system and explain.

Ans : Proper diagram- 2mks ,explanation- 2 mks

Block Diagram:



Explanation:

The main function of vertical deflection system is to provide an amplified signal of proper level to drive the vertical deflection plates without any distortion. The i/p stage of pre-amplifier, consists of FET source follower. The FET source follower has high impedance. This impedance FET amplifier from attenuator. The FET source follower i/p stage is followed by BJT emitter follower. This is done in order to match the medium impedance of FET amplifier with low i/p impedance of phase inverter. Two anti -phase o/p signals are provided by FET amplifier, in order to drive push-pull amplifier o/p. The push-pull o/p stage delivers equal signal voltage of opposite polarities to vertical deflecting plates of CRT.

f) List different applications of CRO.

Ans : Any 4 applications- 4mks

Applications of CRO:

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

g) Define signal generator and state necessity of signal generator.

Signal Generator: A signal generator is an electronic device that generates repeating or Non-repeating electronic signals in either the analog or the digital domain.

Need:

1. The generation of signals is an important activity of electronic development and troubleshooting. Therefore a signal generator is a vital electronic instrument in laboratory test setup which provides signals for general test purposes.

2. It is used to provide known test conditions for the performance evaluation of various electronic systems and for replacing missing signals in systems being analyzed for repair.

2. Attempt any four : 16

a) Define :

i. Accuracy
ii. Sensitivity
iii. Resolution
iv. Speed of response.

Ans:- Each definition -1 mks

i. Accuracy: The degree of closeness with which an instrument approaches the true value of the quantity being measured is known as accuracy.

ii. Sensitivity: The ratio of change in output of an instrument to the change in input is known as sensitivity. Sensitivity = Change in output/ Change in input.

iii. Resolution : Resolution is the least incremental value of input or output that can be detected, caused or otherwise discriminated by the measuring device

OR

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

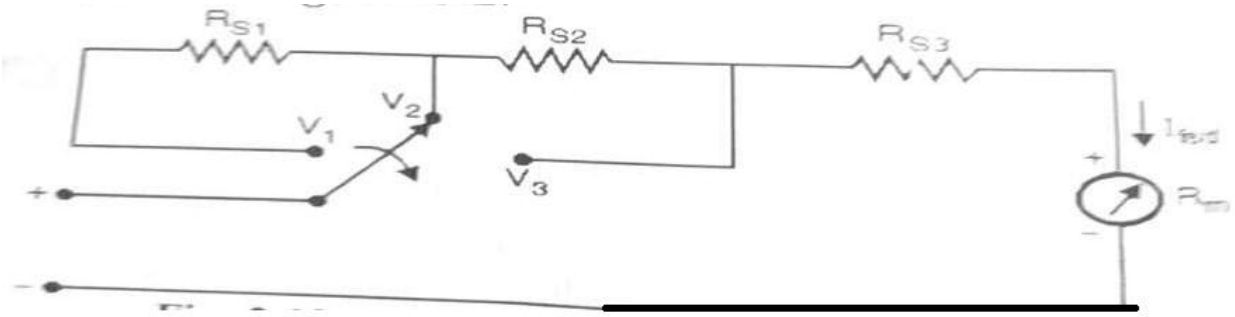
iv. Speed of response : The rapidity with which instrument responds to make changes in the measured quantity is called as speed of response.

b) Explain working of multirange DC voltmeter.

Ans. Diagram-2 mks, working-2 mks

A multi-range DC voltmeter gives different voltage ranges. To convert the basic DC voltmeter into a multi-range voltmeter, the number of resistances (multipliers) is to be used. These multipliers may be connected in shunt or in series.

The different full scale voltage ranges may be obtained by using individual multiplier resistors or by potential divider arrangement. The no .of these resistors is equal to no. of ranges required.



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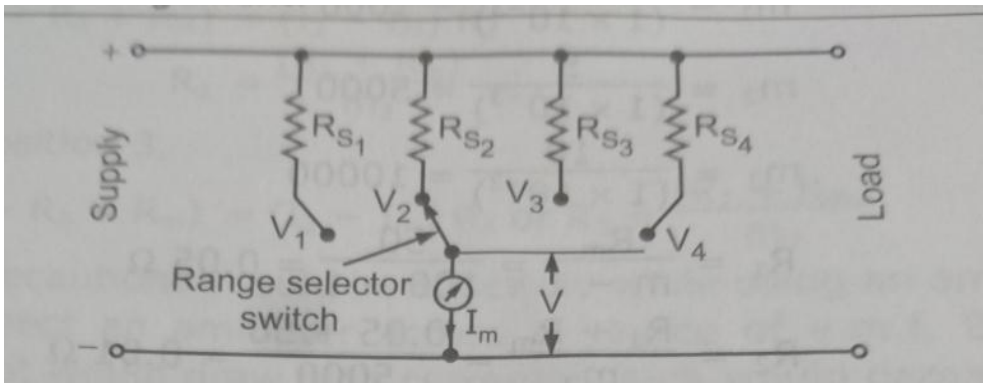


c) Compare Analog instruments with digital instruments (4 points)

Ans: 4 points of comparison- 4mks

Sr. No.	Parameter	Analog instrument	Digital instrument
01	Principle	The instrument that	The instrument that

		displays analog signals is called as an analog instrument	displays digital signals is called as an digital instrument
02	Accuracy	Low	High
03	Resolution	Low	High
04	Power required	Require more power	Require less power
05	Cost	Cheap	costly
06	Portability	Portable	Less
07	Observational error	Considerable Observational error	Free from Observational error
08	examples	PMMC instrument, analog ammeter, analog voltmeter.	DMM, DVM

d) **Explain measurement of 'Time' and 'Frequency' using CRO.**

Ans:- Each method-2 mks

Time period measurement:

- This interval is the distance between two points within one cycle or several cycles of the waveform.
- In order to do the measurement first align the reference point on a graticule line using horizontal position control.

$$Tinterval = number\ of\ divisions \times \left(\frac{time}{div}\right)$$

Frequency measurement:

- The period and frequency of periodic signals are easily measured.
- The period is the time between two identical points of successive cycle of the waveform.

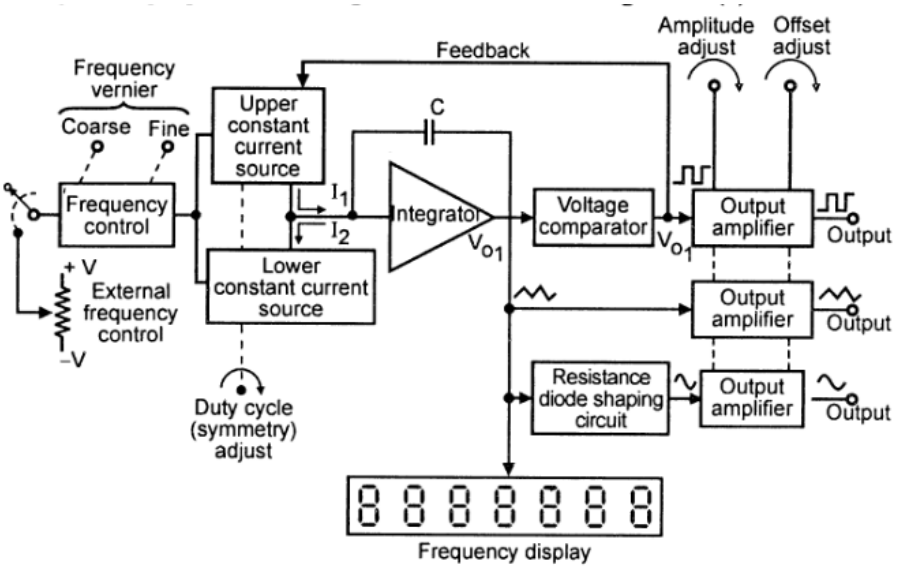
$$Period = Number\ of\ divisions\ \times poisition\ of\ \frac{time}{div} knob$$

- The frequency is inversely proportional to the period.

$$\boldsymbol{Frequency = \frac{1}{period}}$$

e) Draw and explain block diagram of function generator.

Ans :- Diagram-2 mks,explanation-2 mks

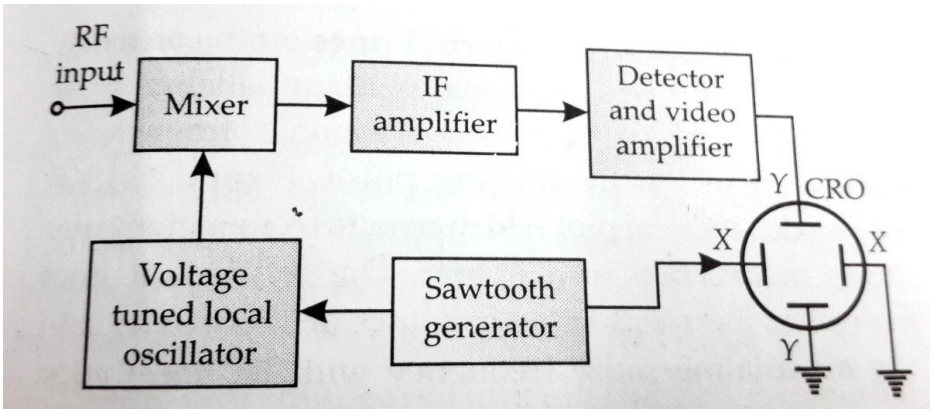


Working: The frequency is controlled by varying the capacitor in LC or RC circuit. In this instrument the frequency is controlled by varying the magnitude of current which drives the integrator. The instrument produces sine, triangular and square waves with a frequency range of 0.01 Hz to 100 kHz.The frequency controlled voltage regulates two current sources.The upper current source supplies constant current to the integrator whose output increases linearly with time, according to the equation of the output signal voltage . An increase or decrease in the current increases or decreases the slope of the output voltage and hence controls the frequency.The voltage comparator multivibrator changes states at a pre- determined maximum level of the integrator output voltage.

This change cuts off the upper current supply and switches on the lower current supply. The lower current source supplies a reverse current to the integrator, so that its output decreases linearly with time.When the output reaches a pre-determined minimum level, the voltage comparator again changes state and switches on the upper current source.The output of the integrator is a triangular waveform whose frequency is determined by the magnitude of the current supplied by the constant current sources.The comparator output delivers a square wave voltage of the same frequency the resistance diode network alters the slope of the triangular wave as its amplitude changes and produces a sine wave with less than 1% distortion.

f) Draw and explain block diagram of spectrum analyzer

Ans : Diagram- 2mks, explanation-2 mks



Explanation:

- Spectrum analyzer consists of voltage tune oscillator, mixer, IF amplifier, detector, video amplifier, sweep generator and CRT. The input signal applied to the circuit is used with oscillator signal, produces two different frequencies called intermediate frequency. The voltage control oscillator (VCO) swept (toggle) between minimum and maximum frequency linearly. The sawtooth waveform plays important role in controlling the output voltage control oscillator.
- The IF signal is then amplified by IF amplifier for further processing. The information in signal is detected by detector and further amplified by video amplifiers. Then these signals are fed to the vertical deflecting plate of CRT. The sawtooth waveform also supply signal to horizontal deflecting plates after the amplification. The CRT produces amplitude versus frequency waveform on the screen. In this type the signal are broken down into their individual frequency component

3. Attempt any FOUR : 16

a) Give the classification of error and explain in brief.

Ans : Classification- 2mks, explain-2mks

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

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

i. **Systematic errors**: these errors occur due to shortcoming of the instrument such as defective or worn part or aging or effect of environment on the instrument.

iii. **Random error**: these errors are due to unknown causes, these error remain since the systematic and gross error are removed, generally these error are very small in nature.

2. **Dynamic error**: the difference between true value of a quantity changing with time and value indicated by instrument if no static error is assumed is called as dynamic error. Also called as measurement errors.

b) Derive the equation of torque of PMMC instruments.

Ans : Proper derivation- 4mks

Deflecting Torque Equation: Torques which deflect the pointer from its zero position is known as deflecting torque. The deflecting of pointer is directly proportional to quantity to be measured. The deflection torque produced due to current flowing through coil. Let length of coil be L meter and width of coil be 'd' meter. Assume, I is the current flowing through coil having N turn. B is consider as flux density produce in air gap. Therefore the force exerted by coil is

F= BiL

The deflecting torque is given by

Td = Force x distance

Td = F x S

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

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

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

N,B, A are constants for a galvanometer

Therefore deflecting torque = = G i

G = NBA = NB (l*d)

G is called displacement constant of a galvanometer

c) State the disadvantages of digital instruments.

Ans. **Any** 4 disadvantages- 4mks

i. They are costly and complex in nature.
ii. Speed of operation is limited due to digitizing circuits
iii. The LCD display depends on a battery or external power source. When the battery is low, the display will be dim, making it difficult to read.
iv. In case of fluctuations or transients, it can record an error.
v. Warming of the meter during its use can change its properties leading to errors in measured value.
vi. The A/D converter has a limitation on word length which can cause quantization noise giving rise to error in measured value.
vii. There is a voltage limitation. If it is increased beyond the limit, the meter will be damaged.
viii. The digital nature makes it unsuitable for adjusting tuning circuits or peaking tunable responses.

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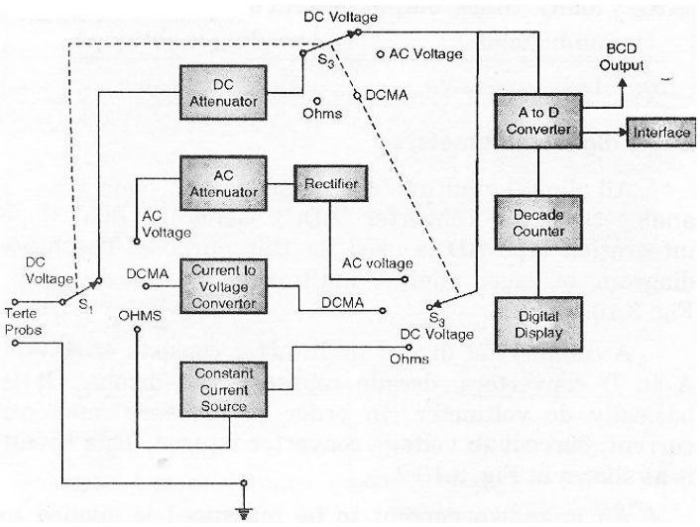
d) Draw and explain block diagram of Digital Multimeter (DMM).

Ans : Diagram- 2mks, explanation- 2 mks

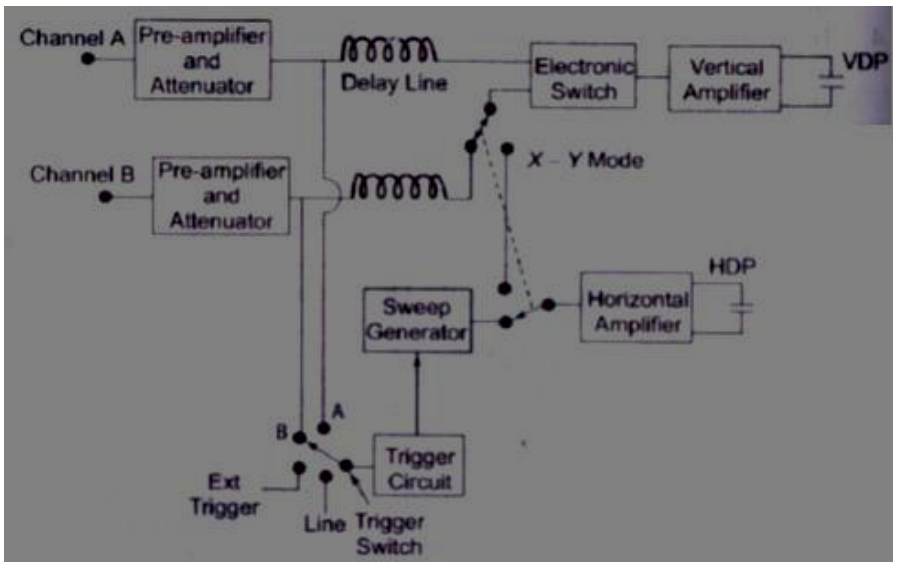


Working:

The digital multimeter is an instrument which is capable of measuring a.c. voltages, d.c. voltages, a.c. and d.c. currents and resistances over several ranges. The current is converted to voltage by passing it through low shunt resistance. The a.c. quantities are converted to d.c. by employing various rectifier and filtering circuits. While for the resistance measurements the meter consists of a precision low current source that is applied across the unknown resistance while gives d.c. voltage. All the quantities are digitized using analog to digital converter and displayed in the digital form on the display. The basic building blocks of digital multimeter are several AID converters, counting circuitry and an attenuation circuit. Generally dual slope integration type ADC is prefprred in the multimeters. The single attenuator circuit is used for both a.c. and d.c. measurements in many commercial multimeters.

e) Draw and explain Dual beam Dual trace CRO.

Ans:- Diagram- 2 mks, explanation- 2mks



Explanation-

Ina dual beam CRO, there are two separate vertical input channel A and B. They use separate preamplifier and attenuator stages.

Because of this arrangement it is possible to control the amplitude of each input independently.

It has one horizontal deflection plate so sweep for both the signals in the same. This indicates that a common time base is used for both the beams.

So, one sweep can be synchronized at one time also both the signals should have same frequency or frequency should be related harmonically to obtain the beams on the CRT Screen.

The sweep generated can be triggered by Channel A & Channel B or external Signal or LINE frequency signal.

f) What do you mean waveform analyzer ? State the necessity of waveform analyzer.

Ans : Wave analyzer- 2mks,need-2 mks

Wave analyzer:-Wave analyzer is an instrument which is used to measure the magnitude of the various harmonics of a complex waveform. It is an instrument that is designed to measure the relative amplitudes of single frequency components in a complex or distorted waveform.

Wave analyzer need: Signal analysis of both random and periodic signal in the frequency domain is used extensively in electronic and telecommunication. The frequency stability and special purity of signal sources can be measured by the use of these signal analyzers. These signal analyzer can be used along with a frequency generator or a source of white or pseudo-random noise to measure the frequency response of amplifiers, filters or other networks. The operational characteristics of a trans receiver and communication system are determine by measuring various parameters, such as spectral purity of the carrier wave, spectral power distribution of the amplitude or frequency modulated wave, signal distortion and the system signal to noise ratio.

4. Attempt any FOUR : 16

a) Classify 'standards' of measurement and explain each standard.

Ans : Classification- 2mks,explanation-2 mks

Classifications:-

1) International standards:

International standards are fixed and develop by international agreement.
These standards are maintained at International Bureau of Weights and Measures in France.

This standard gives different unit having best accuracy.
To preserve best accuracy these standards are periodically check by absolute measurement.
These standards are used to calibrate primary standard only.
These are not available to ordinary user for measurement.

2) Primary standards

These standards are preserved and maintained by National Standard Laboratories which are located at different part of the world.

E.g.-NBS (National Bureau of Standards) located at Washington.
These standards are periodically calibrated by International standards.

3) Secondary standards

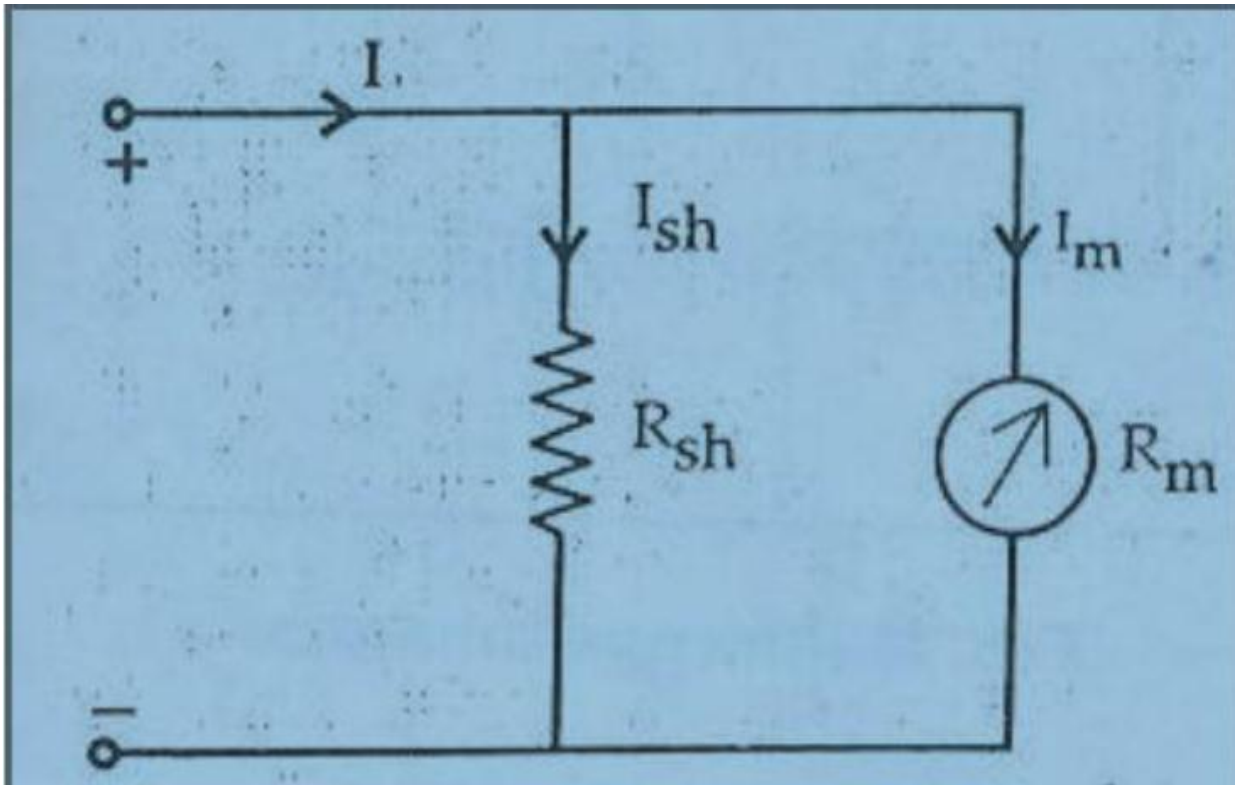
These standards are also called as basic standards.
These standards are used by industries and calibration laboratories.
Each industry has its own laboratory.

4) Working standards

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

b) Derive expression for shunt resistance of DC ammeter.

Ans : -Proper derivation- 3 mks , diagram- 1 mks



Explanation:

- The basic movement of dc ammeter circuit consists of D' Arsonval galvanometer.
- The coil winding of basic movement is small and light therefore it carries very small current.
- When large current is to be measured it is necessary to bypass a major part of the current through a resistance called shunt.
- For measurement of large current by using same movement a shunt resistor is connected as shown in circuit.
- The value of shunt resistor is very small so that most of the current pass through it and only small current allow to pass through the coil.
- The voltage across the shunt and movement must be same.

- Vsh=Vm
- IshRsh=ImRm
- Rsh=ImRm/Ish
- Rsh=ImRm/(I-Im)

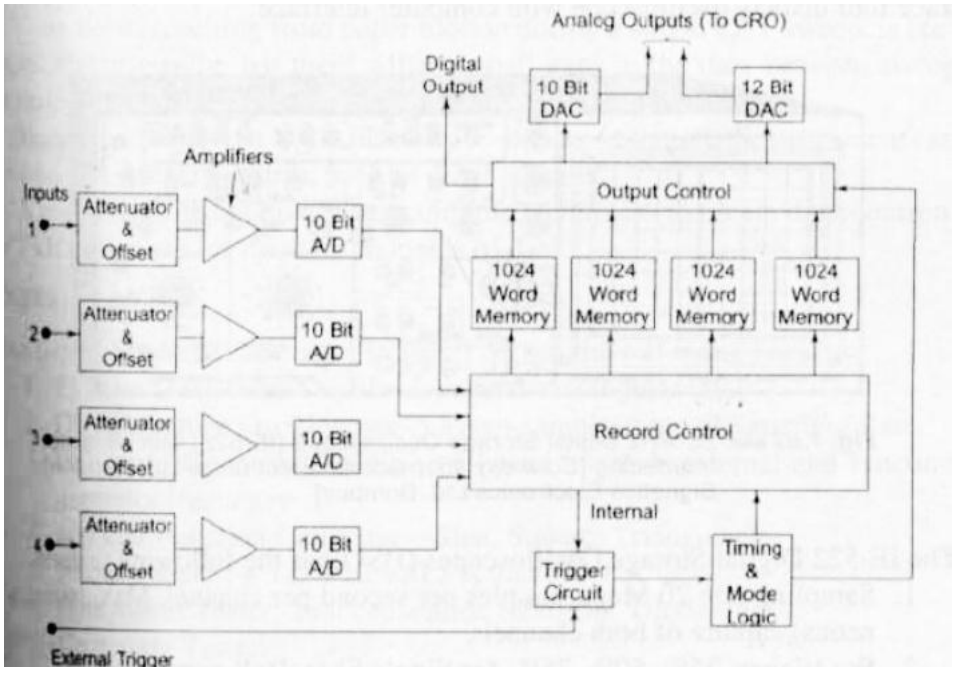
c) **List different applications of digital instruments**.

Ans:- **4** applications- 4mks

1. Digital frequency meter
2. Digital voltmeter
3. DMM
4. LCR-Q meter
5. DSO
6. Phase meter
7. Logic analyzer

d) Draw neat labeled block diagram of digital storage oscilloscope and applications of DSO.

Ans : Diagram- 3mks, 2 applications- 1mks



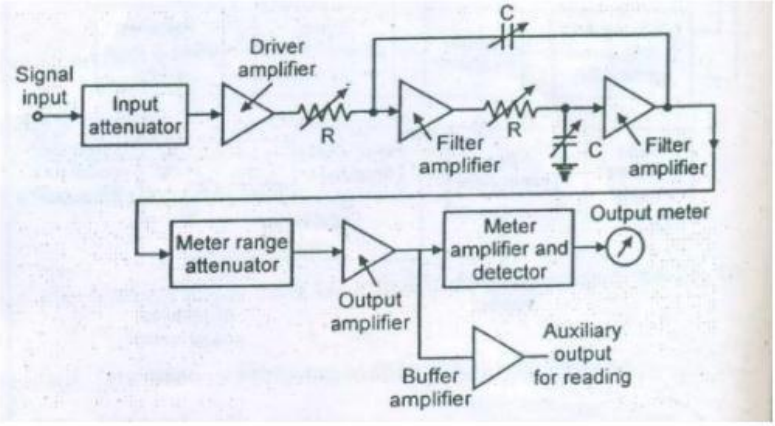
Applications of DSO :

1. It can be used to measure both AC and DC voltages and currents. It can also calculate RMS value, peak value, peak to peak value etc.
2. It can be used to measure frequency, time period, time interval between two signals.
3. It can be used to measure inductance and capacitance.

4. It is used to observe the V-I characteristics of diodes and transistors.
5. It is used to observe radiation pattern generated by the transmitting antenna.
6. It can be used to determine the modulation characteristics and detect the standing waves of transmission lines.

e) Explain working of frequency selective wave analyzer.

Ans:-:-Diagram- 2mks, working-2mks



Working principle:A wave analyzer consists of a primary detector, which is a simple LC circuit.

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

f) Draw and explain logic analyzer and state any two applications.

Ans : Diagram- 2mks, explanation- 1mks, any 2 applications- 1mks

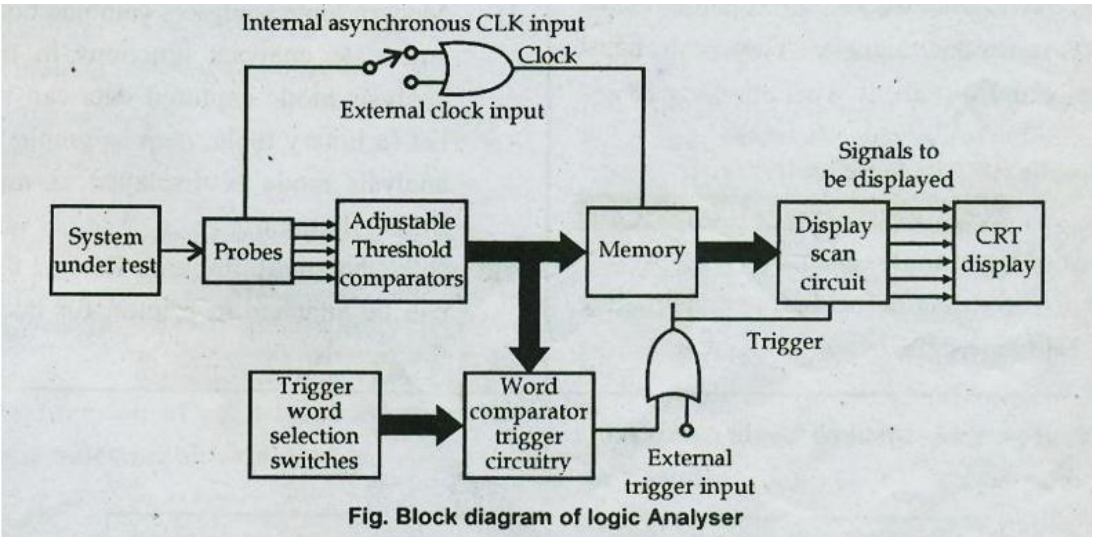


Fig. Block diagram of logic Analyser

Explanation:

- A logic analyzer is an electronic instrument that captures and displays multiple signals from a digital system or digital circuit.
- The normal oscilloscope deals with time domain, spectrum analyzer with frequency domain and logic analyzer with digital domain.
- Logic analyzer is basically a multichannel oscilloscope.
- The probes connect the logic analyzer to the system under test.
- The logic analyzer memory consists of a RAM. The clock signal 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 for each input channel. The analyzer can store from 256 to 1024 samples.
- When the memory receives a trigger signal then the samples are stored in it and displayed on the CRT display.
- We can set a 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 2 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.
- Applications of logic analyzer
- They are used for the trouble shooting and analysis of complex digital system.
- It can be used to observe up to 64 signals at a time while the oscilloscope can be used to observe 4 channels at a time.

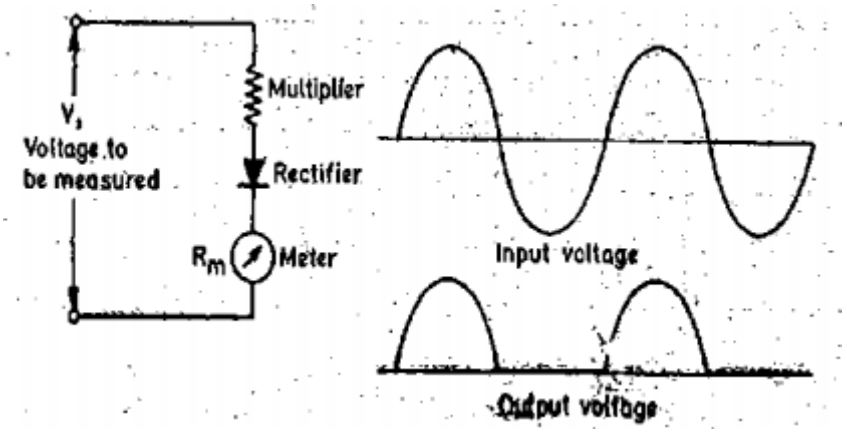
Applications- 1.Real time application
2. Troubleshooting and analysis of digital systems
3. Compatible with printer using RS 232 and IEEE 488 interface

5. Attempt any four of the following: 16

a) Draw and explain half-wave rectifying type AC voltmeter .

ANS: (Circuit diagram 2M, Explanation2M)

Note: Any relevant diagram can be consider



Explanation:

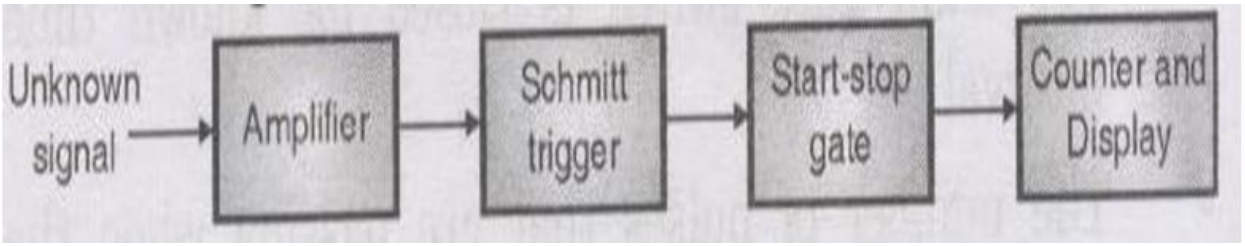
The PMMC movement used in d.c. voltmeters can be effectively used in a.c. voltmeters. The rectifier is used to convert a.c. voltage to be measured, to d.c. This d.c., if required is amplified and then given to the PMMC movement. The PMMC movement gives the

deflection proportional to the quantity to be measured. In this circuit diagram halfwave rectifier is used to convert ac into dc.

b) Draw and explain the block diagram of digital frequency meter.

Ans: (Block Diagram 2M, Explanation 2M)

Block diagram of Digital Frequency Meter



Explanation:

Frequency is defined as number of cycles per unit time interval. The signal whose frequency is to be measured is used as an event.

Theunknownfrequencyisfirstconvertedtotrainofpulses.Onepulserepresentsonecycleofunknownsignal.Thesepulsesaredirectlyproportionaltothefrequencytobemeasured.

Amplifier:

Thesignalwhosefrequencyistobemeasuredisfirstamplified.TheoutputofamplifierisappliedtotheSchmitt trigger.

Schmitttrigger:

- TheSchmitttriggerconvertsthesignalintosquarewavehavingfastriseandfalltimes.
- Thesquarewaveisthendifferentiatedandclipped.Eachpulseisproportionaltoeachcycleofunknownsignal.

Start-Stop gate:

- TheoutputfromSchmitttriggerisappliedtostartandstopgate.Thesepulsesareappliedtotheswitch.
- Thisswitchiscontrolledbyasignalhavingdefinitetimeinterval.Themaingateswitchisclosedforknowntimeinterval.
- Whenthegateisopen,inputpulsesareallowedtopassthroughit.Acounterwillnowstarttocountthesepulses.
- Whenthegateisclosed,inputpulsesarenotallowedtopassthroughthegate.Thecounterwillnowstopcounting.

Counteranddisplay:

- Thenumberofpulsesduringtheperiodgateisopen arecountedbythecounter.
- Ifthisintervalbetweenstartandstopconditionisknown,thefrequencyofunknownsignalismeasured.

F= N/tWhere,
F= Unknownfrequency
N=Numberofcountsdisplayedbythecounter.
t=Timeintervalbetweenstartandstopconditionofthegate.

OR

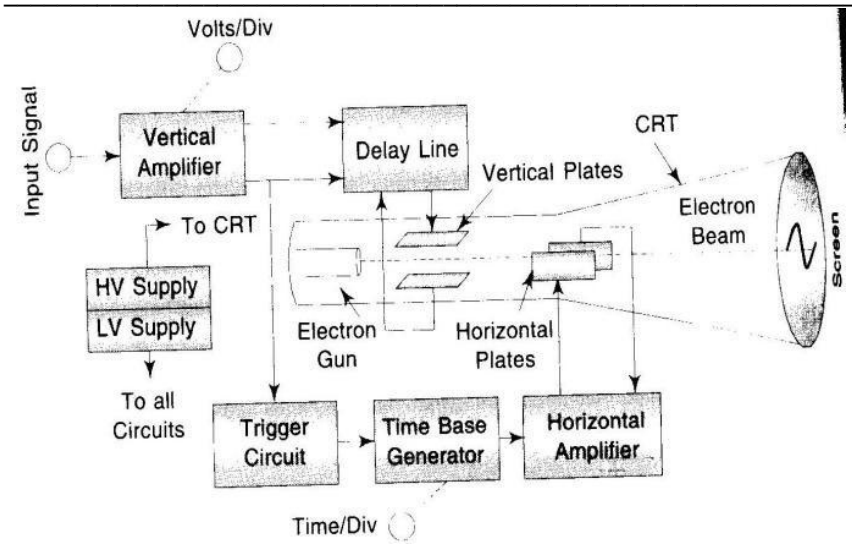
The signal may be amplified before being applied to the Schmitt trigger. The Schmitt trigger converts the input signal into a square wave with fast rise and fall times, which is then differentiated and clipped. As a result the output from the Schmitt trigger is a train of pulses, one pulse for each cycle of the signal. The output pulses from the Schmitt trigger are fed to a START / STOP gate. When this gate is enabled, the input pulses pass through this gate and are fed directly to the counter which counts the number of pulses. When gate is disabled the counter stops counting the incoming pulses. The counter displays the number of pulses that have passed through it in the time interval between start and stop. If this interval is known the pulse rate and hence the frequency of the input signal cab be known. If f is the frequency of unknown signal, N is the number of counts displayed by counter and t is the time interval between start and stop gate then, frequency of unknown signalis,

$$f = N / t$$

c) Draw block diagram of CRO. Explain function of each block

Ans: (Block Diagram 2M, Function of blocks 2M)

Block Diagram:



Function of blocks:

Fig shows a block diagram of general purpose CRO. It consists of the following main components.

1 **Cathode ray tube** – The CRT is the heart of oscilloscope, which generates sharply focused electrons beam, accelerates the beam to a very high velocity, deflects the beam to create the image and contains the phosphor screen where the electron beam eventually becomes visible. To make these tasks, various electrical signals and voltages are required as shown infigure.

2. **Power Supply** – It provides the voltages required by the CRT to generate and accelerate the electron beam as well as to supply the required operating voltages for the other circuits of the oscilloscope. High voltages are required by the CRT for acceleration and low voltage is for the heater of the electron gun of the CRT, which emitselectron.

3. **Vertical Amplifier** – The input signal to be viewed on CRT screen is applied to the vertical amplifier, the push pull output of which is fed to the vertical deflection plates of CRT via delayline with sufficient power to drive the CRT spot in the vertical direction.

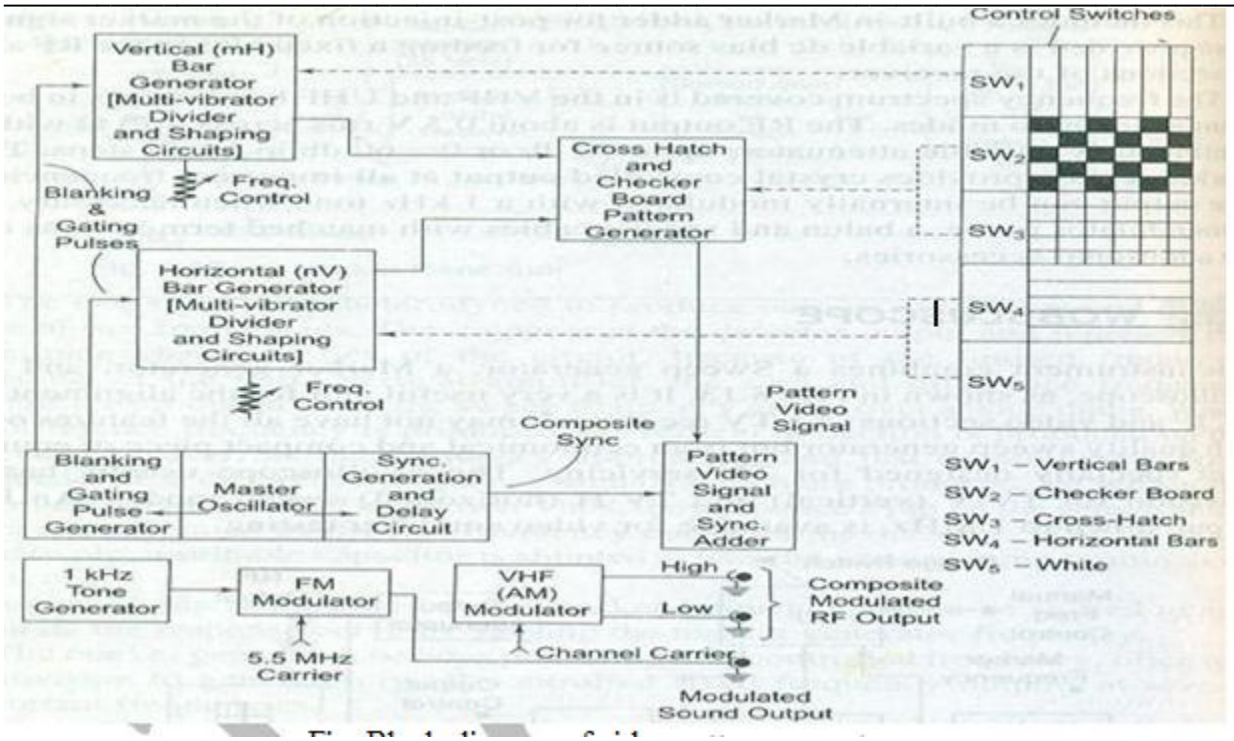
4. **Time base generator** – It develops a saw tooth waveform that is used as the horizontal deflection voltage of theCRT.

5. **Horizontal Amplifier** – The saw tooth voltage is fed to the horizontal amplifier which includes a phase inverter and produces two simultaneous output waveform. The positive going saw tooth is applied to the right hand horizontal deflection plate of CRT and the negative going saw tooth to the left hand horizontal deflection plate. These voltages cause the electron beam to be swept across the CRT screen, from left toright.

6. **Trigger Circuit** – The trigger circuit is used to convert the incoming signal into trigger pulses so that the input signal and the sweep frequency can besynchronized.

d) Draw a neat diagram of pattern generator.

Ans: (Block Diagram 4M)



e) State advantages of CRO over multimeter.

Ans: (Any 2 points 4M)

Multimeter is very versatile tool it can measure voltages, currents, resistances, and some can even check if diodes and transistors work. In contrast, an oscilloscope only measures voltage but with a lot more detail. Following are advantages of CRO over multimeter

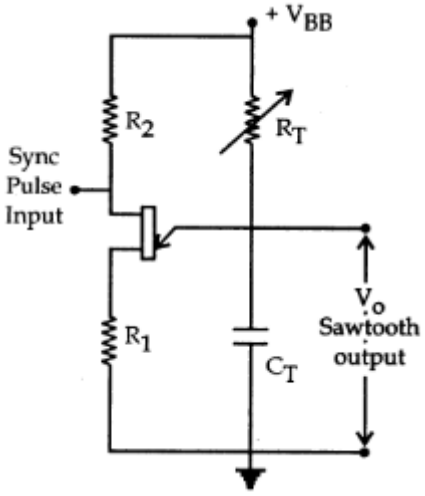
CRO is an extremely useful and versatile laboratory instrument used for the measurement and analysis of waveform.
By seeing the waveform, we can analyze some properties like amplitude, frequency, rise time, distortion, time interval and etc.
We can measure phase shift between two waveforms by using CRO.

f) Draw and explain circuit diagram of time base generator in CRO.

Ans:(Circuit Diagram 2M, Explanation 2M)

The motion of spot on CRT screen from left to right is called sweep.
The generator which generates signals to move beam spot on screen horizontally is called time base or sweep generator.

Circuit Diagram:



Explanation:

The time base convert given signal into sawtooth waveform. As shown in figure which deflect the beam in the horizontal direction.

The waveform is divided into two parts i.e. sweep time and retrace time.

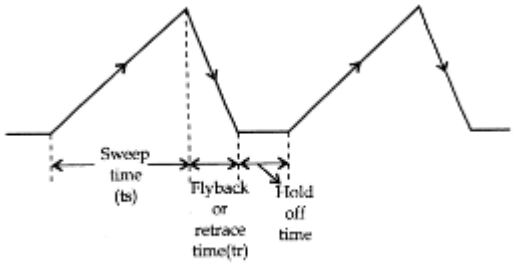
During sweep time ts the beam moves left to right horizontally.

The beam is deflected towards right by increasing amplitude of ramp voltage and the fact that positive voltage attracts the negative electrons.

During retrace time or flyback time Tr the beam returns quickly to the left side of screen.

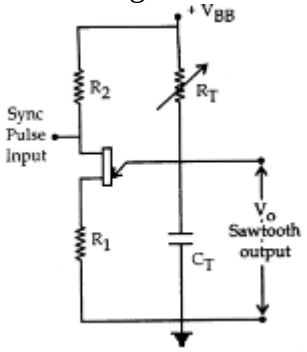
The control grid is generally "gated OFF" which back out the beam during retrace time and prevent an undesirable retrace pattern from appearing on the screen.

The base generator performs the task of producing such repetitive and synchronized voltage signal.



OR

The time base generator is shown in figure.



Explanation:

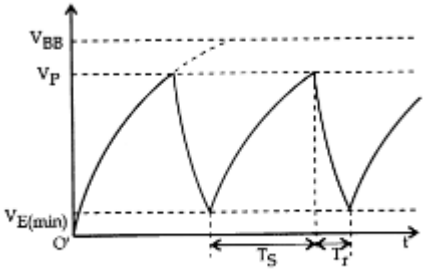
UJT relaxation oscillator is main part of time base generator. It is used to produce sweep.

When power is applied to UJT, initially it is off and the capacitor charge through RT.

When voltage across capacitor reaches VP (peak voltage), then UJT turn ON.

Then capacitor discharge rapidly through R1 and turn OFF UJT.

The cycle of charging and discharging repeats and sawtooth waveform produced as shown in figure.



Q. 6 Attempt any Four of the following **16M**

a)How phase shift can be measured using Lissajous pattern.

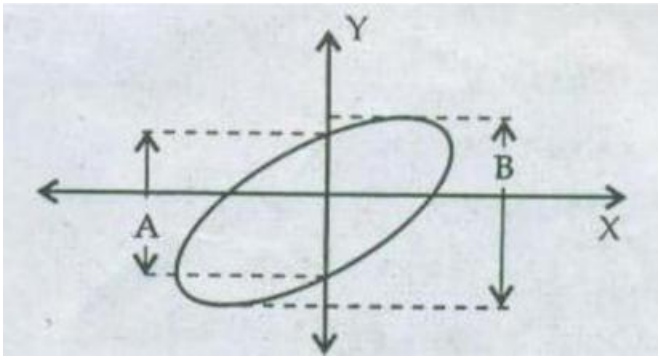
Ans:(Explanation with formula 3M, different patterns 1M)

Phase measurement of Lissajous pattern:

- The phase measurement can be done by using Lissajous figures.
- The CRO is set to operate in the X- Y mode, then the display obtained on the screen of a CRO is called Lissajous pattern, when two sine waves of the same frequency are applied to the CRO. (One vertical and one horizontal deflection plates).
- Depending on the phase shift between the two signals, the shape of the Lissajous pattern will go on changing.

The phase shift is given by,

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



A. The Lissajous pattern will be an ellipse if the sine waves of equal frequency but phase shift between 0^0 and 90^0 are applied to the two channels of CRO. The Lissajous pattern will be as shown below-

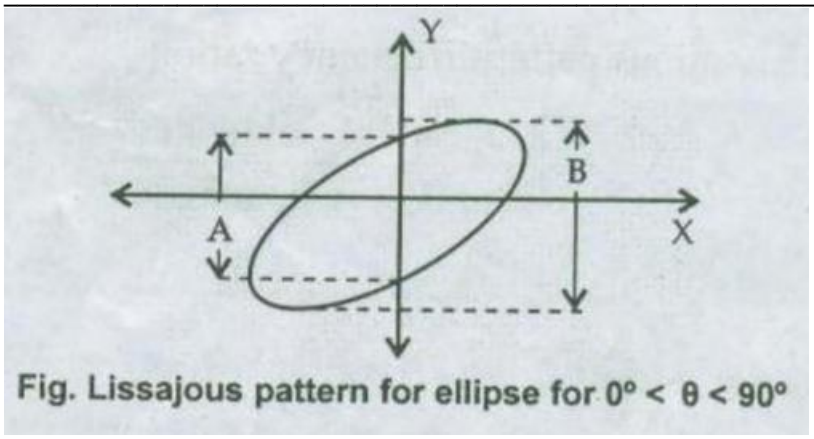
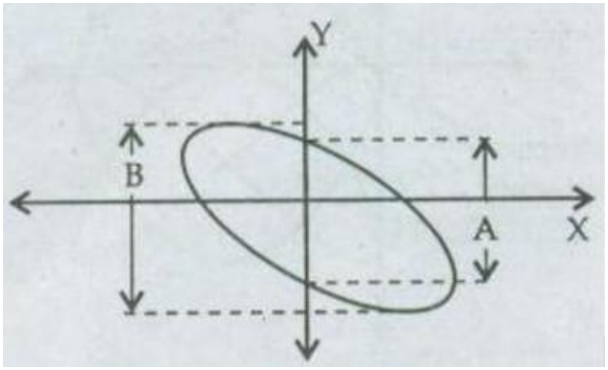
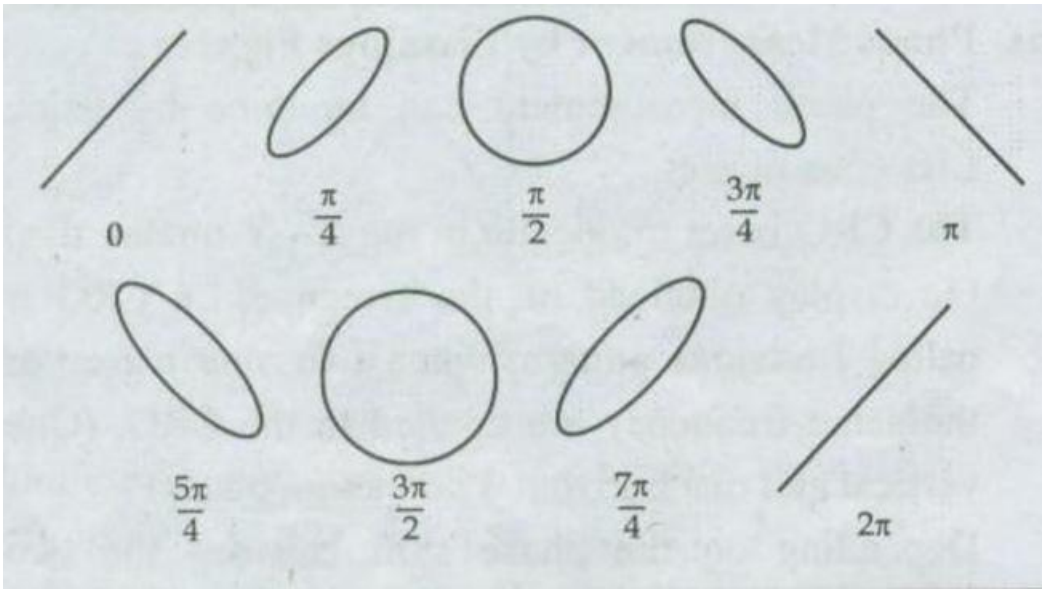


Fig. Lissajous pattern for ellipse for $0° < \theta < 90°$

B. For the phase difference above 90^0 and less than 180^0, the ellipse appears as shown



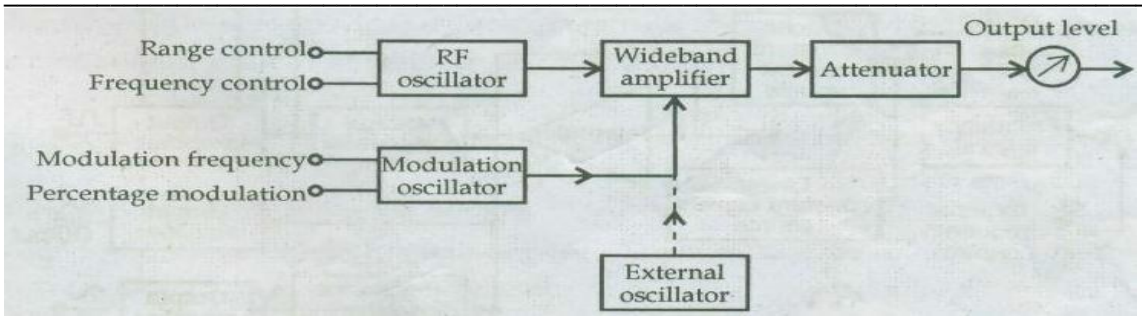
C. Different Lissajous figure for phase difference 0^0, 45^0, 90^0, 135^0, 180^0, 225^0, 270^0, 315^0, 360^0 are shown below respectively



b) **Explain block diagram of radio frequency type signal generator.**

Ans: (Block Diagram 2M, Explanation 2M)

Block Diagram:



Explanation:

A block diagram of a RF type signal generator is shown in figure .

1. The function of the RF oscillator stage is to produce a signal that can be accurately set in frequency at any point within the range of the generator. The type of oscillator circuit used depends on the range of frequencies for which the generator is designed
2. The function of the modulator is to produce an audio (or video) modulating signal that can be superimposed on the RF signal produced by the oscillator. The modulating signal may be provided by an audio oscillator within the generator. This is termed INTERNAL MODULATION. It may also be derived from an external source. This is termed EXTERNAL MODULATION. In some signal generators, either of these two methods of modulation can be employed. In addition, a means of disabling the modulator section is available so that the pure, unmodulated signal from the oscillator can be used when desired.
3. The output from the oscillator will need amplifying. This will be achieved using a special amplifier module. This will amplify the signal, typically to a fixed level. It would have a loop around it to maintain the output level accurately at all frequencies and temperatures.
4. An attenuator is placed on the output of the signal generator. This serves to ensure accurate source impedance is maintained as well as allowing the generator level to be adjusted very accurately. In particular the relative power levels i.e. when changing from one level to another are very accurate and represent the accuracy of the attenuator. It is worth noting that the output impedance is less accurately defined for the highest signal levels where the attenuation is less

c) Describe loading effect of voltmeter , How to avoid it ?

Ans: (Loading effect 3M, Method to aviod 1M)

A low resistance voltmeter may give correct reading when measuring voltage in low resistance circuit but the Voltmeter produces unreliable and erroneous reading when connected in high resistance circuit. This is because, as the resistance of voltmeter is less when compared to the circuit resistance, this will act as a shunt path for the current and therefore the voltage drop across the resistor where we want to measure the voltage will be less. Because of this the reading of voltmeter will not be the actual voltage drop rather it will be lower than actually existed before the connection of the voltmeter. This effect is known as **Loading Effect.**

OR

A low sensitivity meter gives accurate reading when it is used for the measurement of voltage in low resistance circuit, but it may give inaccurate reading during the measurement of voltage in high resistance circuit.

If voltmeter connects across low resistance, then most of the current will pass through low resistance and very less current flow through voltmeter because of its high resistance. The voltage drop is a measure of true value.

If the voltmeter is connected across high resistance then the current may be divided into two paths and voltage drop recorded by meter is lower than true value. This effect is known as loading effect.

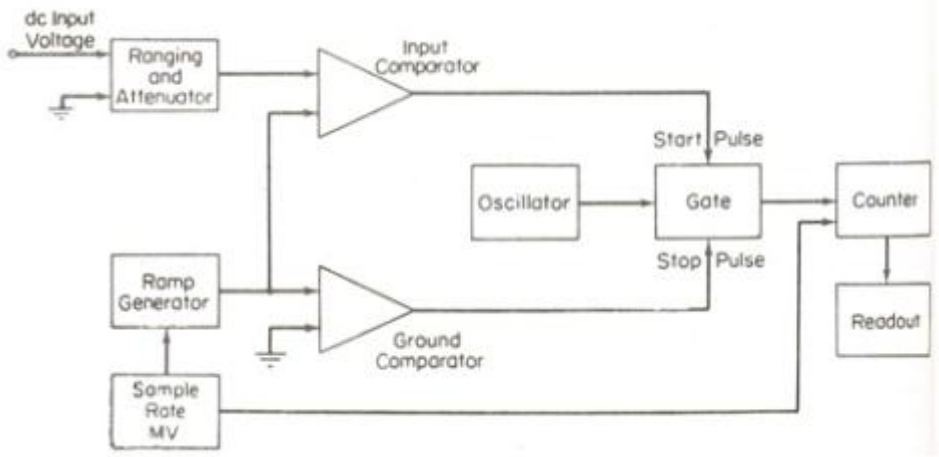
Loading effect can be minimize/ avoided by keeping the voltmeter resistance is much higher than the circuit resistance.

d) Draw and explain block diagram of ramp type digital voltmeter

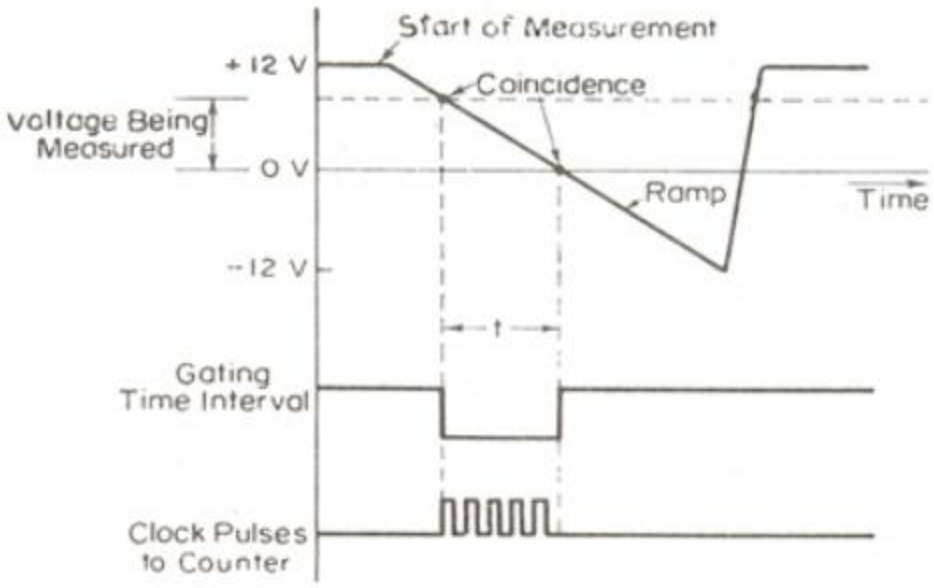
Ans: (Block diagram 2M, Explanation 2M)

Note: Any relevant diagram can be consider

Block Diagram:



Waveforms:



Operation:

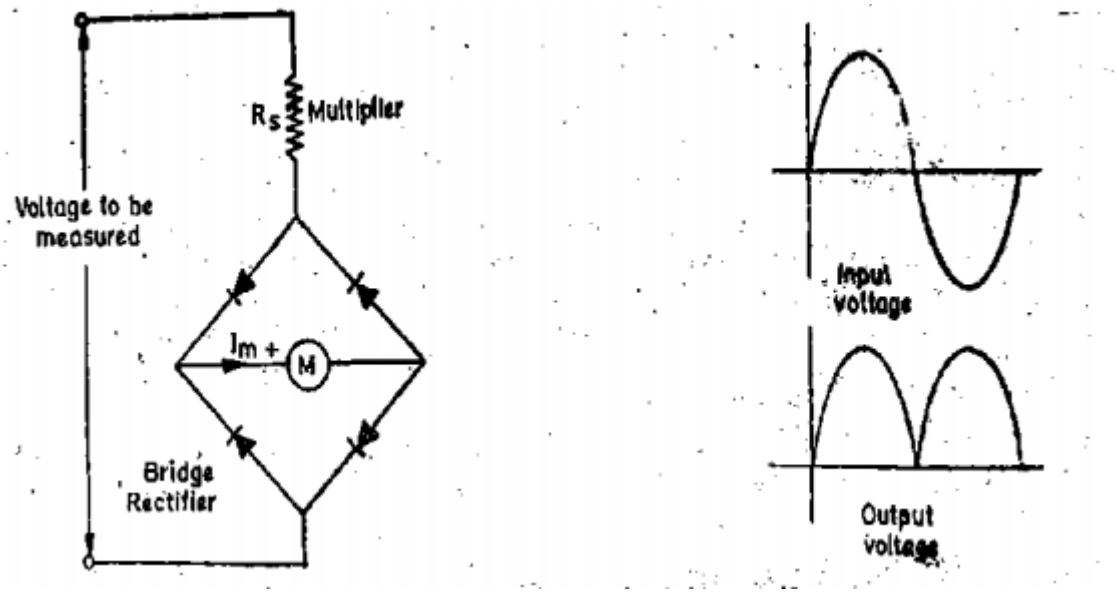
At the start of the measurement cycle, a ramp voltage is initiated; this voltage can be positive-going or negative-going. The negative-going ramp, shown in waveforms , is continuously compared with the unknown input voltage. At the instant that the ramp voltage equals the unknown voltage, a coincidence circuit, or comparator, generates a pulse which opens a gate. This gate is shown in the block diagram of below figure. The ramp voltage continues to decrease with time until it finally reaches 0 V (or ground potential) and a second comparator generates an output pulse which closes the gate.An oscillator generates clock pulses which are allowed to pass through the gate to a number of decade counting units (DC Us) which totalize the number of pulses passed through the gate. The decimal number, displayed by the indicator tubes associated with the DCUs, is a measure of the magnitude of the input voltage. The sample-rate multivibrator determines the rate at which the measurement cycles are initiated.

e) Draw and explain fullwave rectifying type AC voltmeter

Ans: (Circuit Diagram 2M, Explanation 2M)

Note: Any relevant diagram can be consider

Circuit Diagram:



Explanation

A rectifier element is used to convert the alternating current to direct current or unidirectional current before it flows through the meter. Rectifier type instrument use copper oxide, selenium ,doped germanium and silicon crystal diode rectifiers. The bridge circuit is fullwave rectifier producing a pulsating unidirectional output voltage over the complete cycle of input voltage. Because of the inertia of moving coil the meter will indicate a steady deflection proportional to the average value of current. For practical purpose since currents and voltages are expressed in rms values, the meter scale is calibrated in rms value of alternating sine wave input.

f) Compare between single trace CRO and dual trace CRO.

Ans: (Any four points 4M)

Sr. No	Single Trace CRO	Dual Trace CRO
1	It displays only one waveform	It displays two waveforms simultaneously.
2	Only one channel is present	Two channels are present
3	Signals can be displayed continuously.	Signals can be displayed alternatively on two channels
4	Comparison of signals is not possible	Comparison of two signals are possible.
5	No need of electronic switch	It requires electronic switch to toggle.