MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC – 27001 – 2005 Certified)

SUMMER – 14 EXAMINATION

<u>Model Answer</u>

<u>Important Instructions to examiners:</u>

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

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

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

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

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

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

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

1. A) Attempt any six   (12Marks)

 a) List the dynamic characteristics of an instrument.

Ans : (Any two)   (2M)

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

b) List the parameters that can be measured by analog multimeter.

Ans : (Any two)   (2M)

1. Current
2. Voltage
3. Resistance

c) State the applications of digital voltmeter.

Ans : (Any two)   (2M)

Applications :-

1. It is used to convert Analog Voltage Signals into digital form.
2. It is used to measure analog dc voltage.
3. It is used to measure DC & AC current, ohms, temperature, pressure, etc.

d) List any four applications of CRO

Ans : (Any Four)   (2M)

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 components.
6. It is used to check signals at radio and TV receiver.
7. It is used in medical equipment such as ECG, patient monitor.
8. It is used to check B-H curve of different ferromagnetic material.
9. It is used to check modulation percentage of modulated wave.

e) What is the role of Schmitt trigger in the block diagram of pulse generator?

Ans : (2M)

- In pulse generator the upper constant current source charges the capacitor. When the capacitor voltage reaches upper limit the Schmitt trigger changes its states from positive to negative and switching circuit also changes its states.

- The lower constant current source discharges the capacitor upto lower limit then Schmitt trigger changes its states from negative to positive and switching circuit also changes its states.

f) State any four applications of wave analyzer.

Ans : Applications :- (2M)

1. To measure relative amplitude of single frequency component in complex waveform.
2. To measure amplitude in presence of interfacing and noise signal.
3. It is used for measurement of sound and vibration generated by rotation of electric machine.
4. To measure harmonic distortion of an Amplifier.
5. To measure the signal energy with well-defined bandwidth.

g) State the function of delay line.

Ans : (2M)

- 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 horizontal section consists of trigger circuit, sweep generator and amplifier.

- 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.

h) What is role of mirror in analog type instrument.

Ans : (2M)

Role of Mirror is to remove parallax error in Analog instrument.

B) Attempt any two: **(8 Marks)**

a) Compare absolute instruments and standard instruments.

Ans : **(4M)**

Sr. No.	Absolute Instruments	Standard (Secondary) Instruments
1	These instruments read the quantity under measurement indirectly i.e. in terms of deflection, degrees and meter constant.	These instruments read the quantity under measurement directly i.e. if it is ammeter, it reads directly in ampere.
2	Example of these instruments 1) Tangent galvanometer 2) Current balance meter.	Example, the meters commonly used in lab such as ammeter voltmeters, watt meter and energy meter.

b) Draw the constructional diagram of PMMC meter and explain its working principle.

Ans : Working : **(2M)**

- 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.
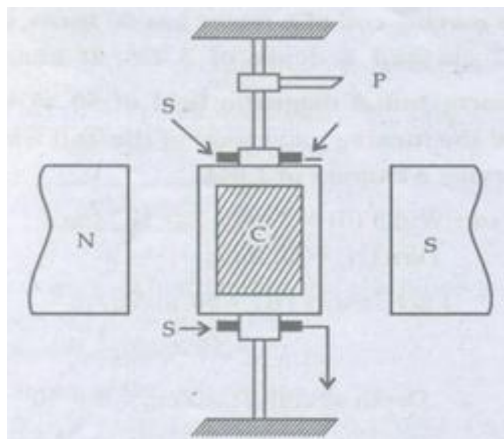
(2M)

Fig. constructional diagram of PMMC

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c) Differentiate digital instruments over with analog instruments.

Ans : (Any Four Points) (4M)

Sr. No.	Parameter	Analog Instrument	Digital Instrument
1	Principle	The instrument that displays analog signals is called as on analog instrument.	The instrument that displays digital signals is called as a digital instrument.
2	Accuracy	The accuracy is less.	The accuracy is more.
3	Resolution	The resolution is less	The resolution is more.
4	Power	Requires more power.	Requires less power.
5	Cost	Analog instruments are cheap.	Digital instruments are expensive.
6	Observational errors	Analog instruments have considerable observational errors.	Digital instruments are absolutely free from the observational errors.
7	Examples	PMMC instrument, Potentiometer, DC ammeter, DC voltmeter, etc.	Logical analyzer, signature analyzer, computers, microprocessor based instruments, etc.

2) Attempt any four : (16 Marks)

a) Draw the circuit of basic Q-meter. Explain its working.

Ans : Working: (2M)

- Q- Meter consist of a self-contained variable frequency RF oscillator. This oscillator delivers current to a low value shunt resistance R_{sh}. Through this resistance a small value of voltage E is applied to the resonant circuit, with a small resistance. This voltage is measured by a thermocouple voltmeter.

- A calibrated standard variable capacitor C is used for tuning the circuit. An electronic voltmeter is connected across the capacitor whose scale is calibrated directly in Q values.

- It has characteristics that the voltage across the coil or capacitor is equal to the applied voltage times, the Q factor of the circuit. (2M)
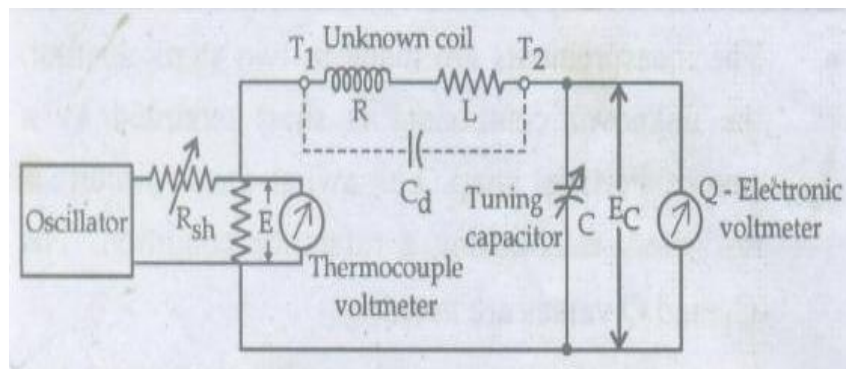

Fig. Series Resonance circuit of Q meter

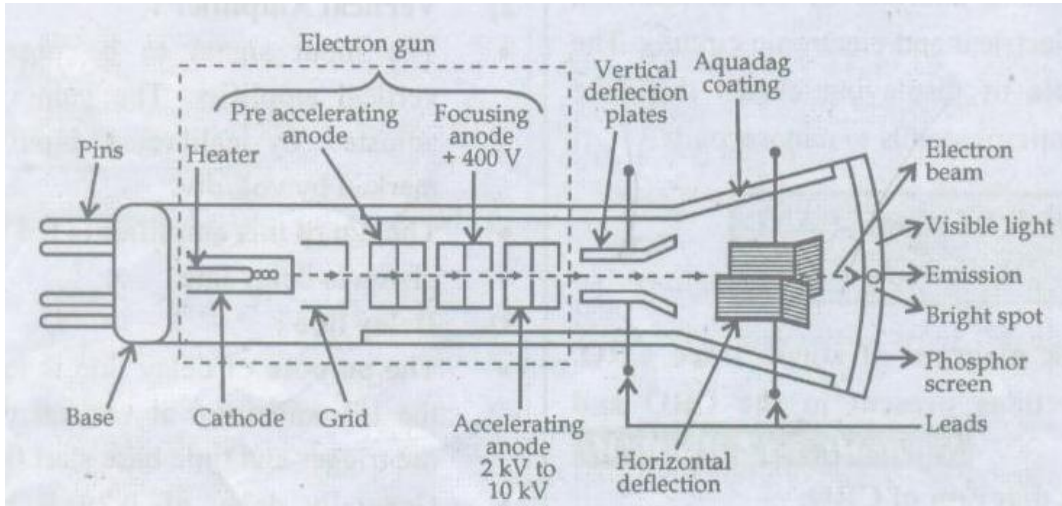**b) Draw a neat and labeled diagram of CRT.**

Ans : (4M)

Fig. diagram of CRT.

c) Draw the block diagram of spectrum analyzer and explain its operation.
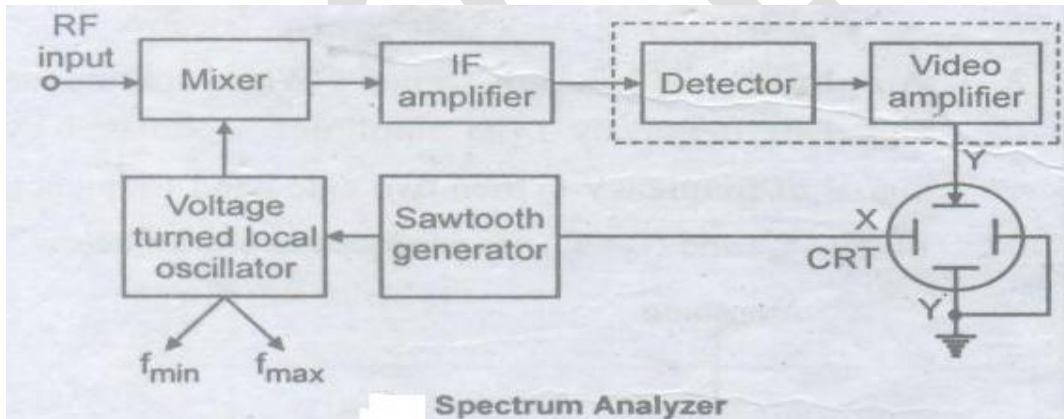
Ans : (2M)

Fig. block diagram of spectrum analyzer

(2M)

- 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.

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- 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.

d) Calculate the frequency of vertical input for an oscilloscope which displays the following Lissajous figures (Assume Horizontal input frequency in 10 KHz)

a.   b.
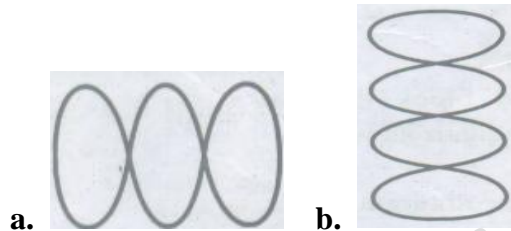
Ans : We know that

$$\frac{fy}{fx} = \frac{\text{number of loops touches to horizontal tangents}}{\text{number of loop touches to vertical tangents}}$$

$f_x = 10$ kHz

i) In Fig. (a) number of horizontal tangency is = 3

No. of vertical tangency is = 1

$fy = (3/1) \times f_x$

    = 3 x 10 kHz

Therefore, **f_y = 30 kHz.**   (2M)

ii) In Fig. (b) number of horizontal tangency is = 1

No. of vertical tangency is = 4

$fy = (1/4) \times f_x$

    = (1/4) x 10 kHz

Therefore, **f_y = 2.5 kHz.**   (2M)

e) Draw the circuit of multirange A.C. voltmeter and explain its working.

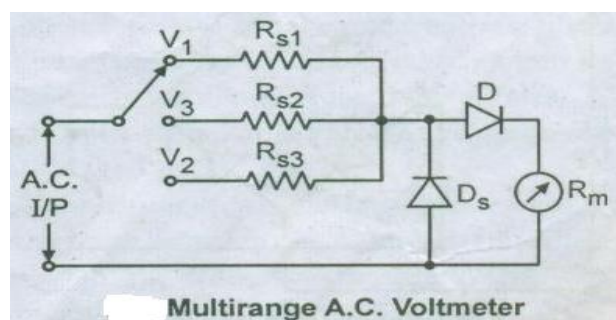   **Ans :**   (2M)

Fig. circuit of multirange A.C voltmeter

- The A.C. voltmeter with half wave rectifier is shown in fig. Here R_{S1}, R_{S2} & R_{S3} resistance are connected in parallel to each other.
- The construction of multirange a.c. voltmeter is similar to multirange d.c. –voltmeter.
- The a.c. input is given to the circuit which is rectified by diode D.
- Here, R_{S1}, R_{S2} & R_{S3} are series resistance used in ranges V_1, V_2 & V_3 respectively.
- The selector switch S is used to select respective range.
- The equation for series resistor may be written as :

$R_{S1} = V_{dc1} / I_{fsd} - R_m$

$R_{S2} = V_{dc2} / I_{fsd} - R_m$

$R_{S3} = V_{dc3} / I_{fsd} - R_m$

Where, $V_{dc1} = V_1 /\pi_{= 0.45}$ V_{rms1}

$V_{dc2} = V_2 /\pi_{= 0.45}$ V_{rms2}

$V_{dc3} = V3 /\pi_{= 0.45}$ V_{rms3}

- Since the voltages are expressed in terms of rms value, the meter scale is calibrated in terms of rms value.
- If we used full wave bridge rectifier the efficiency is increased upto 90.3%

f) State any two types of systematic error. How does they occur? What are the remedies to avoid them?

Ans : Systematic Errors : $\qquad\qquad$ **(1M)**

- Instrumental
- Environmental
- Observational

$\qquad\qquad$ **(3M)**

Instrumental Errors : The errors which arise due to inherent shortcoming of instrument, misuse of instrument, loading effect of instrument are called as instrumental errors.

These errors can be removed by :

- Selecting suitable instrument for particular application.
- Selection of correct setting on the instrument.
- Calibrating the instrument against standar.
- Applying correction factor after the determination of instrumental error.

Environmental Error : These errors occur due to external condition to the measuring instrument, such as temperature, pressure, humidity, dust and external magnetic field.

These errors can be avoided by :

- Keeping surrounding condition constant with the help of air conditioning, temperature control, enclosures, etc.
- Using proper magnetic shielding.

Observational Error : Observational Error are introduced by the observer. The most common error is the parallax error introduced in reading a meter scale.

These errors can be removed by :

- Taking reading carefully.
- Using mirror scale and having the pointer and scale in the same plane.
- Using digital instrument.

3) Attempt any four : **(16 Marks)**

a) A D.C. voltmeter used 50 μA and having an internal resistance of 400 Ω. Calculate the value of multiplier on ranges :

   i.   **10 V**   **iii.**   **20 V**

   ii.   **15 V**   **iv.**   **25 V**

Ans : Given $I_{fsd} = I_m = 50\ \mu A = 50 \times 10^{-6}$ A $R_m = 400\ \Omega$

(a) for $V_1 = 10$ V

    $R_{S1} = V_1 / I_{fsd} - R_m$

    $= 10 / 50 \times 10^{-6} - 400$

    $= 199.6 \times 10^3\ \Omega$

    Ans. $R_{S1} = 199.6\ k\Omega$ **(1M)**

(b) for $V_2 = 15$ V

    $R_{S2} = V_2 / I_{fsd} - R_m = 15 / 50 \times 10^{-6} - 400$

    Ans. $R_{S2} = 299.6\ k\Omega$ **(1M)**

(c) for $V_3 = 20$ V

    $R_{S3} = V_3 / I_{fsd} - R_m = 20 / 50 \times 10^{-6} - 400$

    Ans. $R_{S3} = 399.6\ k\Omega$ **(1M)**

(d) for $V_4 = 25$ V

    $R_{S4} = V_4 / I_{fsd} - R_m = 25 / 50 \times 10^{-6} - 400$

    Ans. $R_{S4} = 499.6\ k\Omega$ **(1M)**

b) Draw the block diagram of dual beam oscilloscope. What are the different methods used to generate two different beams ?
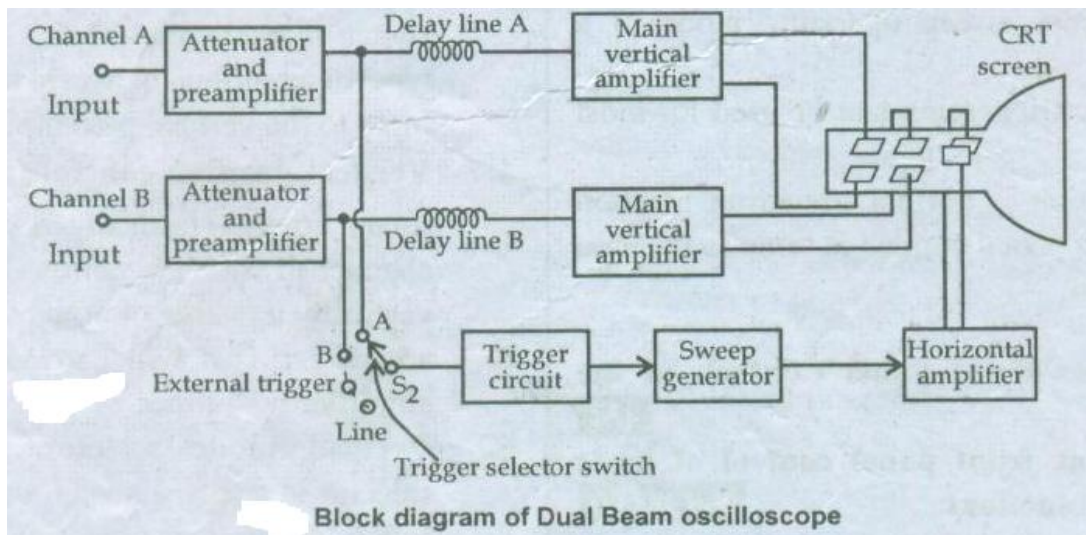
Ans : (3M)

Fig. block diagram of dual beam oscilloscope

There are two different methods used to generate two different beams: **(1M)**

1. The first method uses two different gun tubes. In this method different controls are used for each gun.

2. In second method, single beam is used. The beam can be split into two parts by horizontal splitter placed between last anode and vertical deflecting plates. In this method brightness and focus is affected.

c) Draw the block diagram of pulse generator. Give two applications of it.
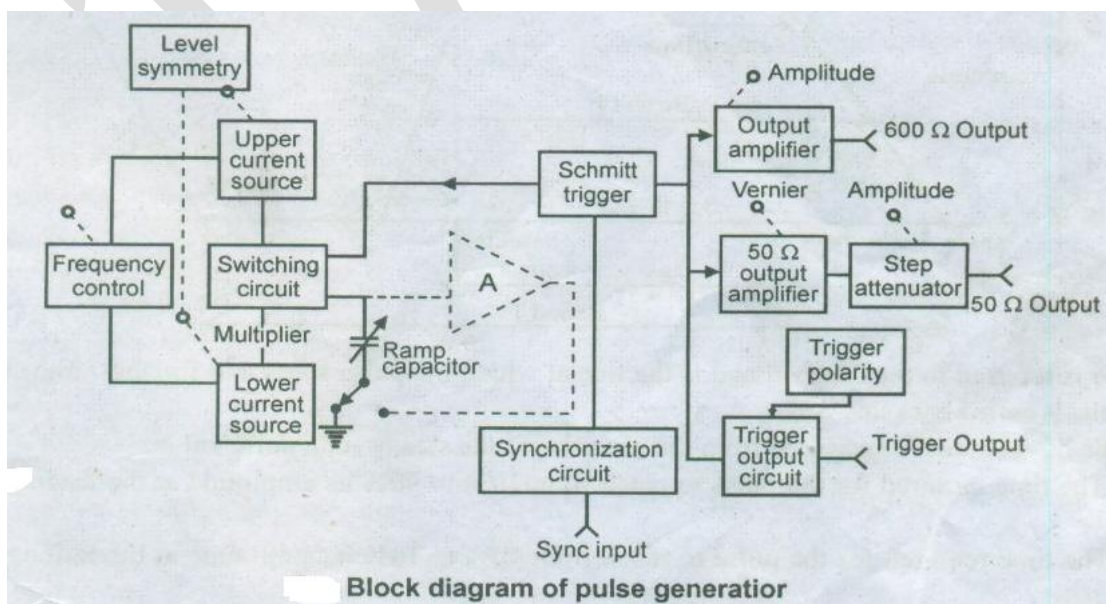
Ans : (3M)

Fig. block diagram of pulse generator

Applications : (1M)

1. Pulse generators are used to drive devices such as switches, lasers and optical components, modulators, intensifiers as well as resistive loads.

2. The output of a pulse generator may also be used as the modulation signal for a signal generator.

d) Draw the block diagram of digital multimeter. List its four applications.
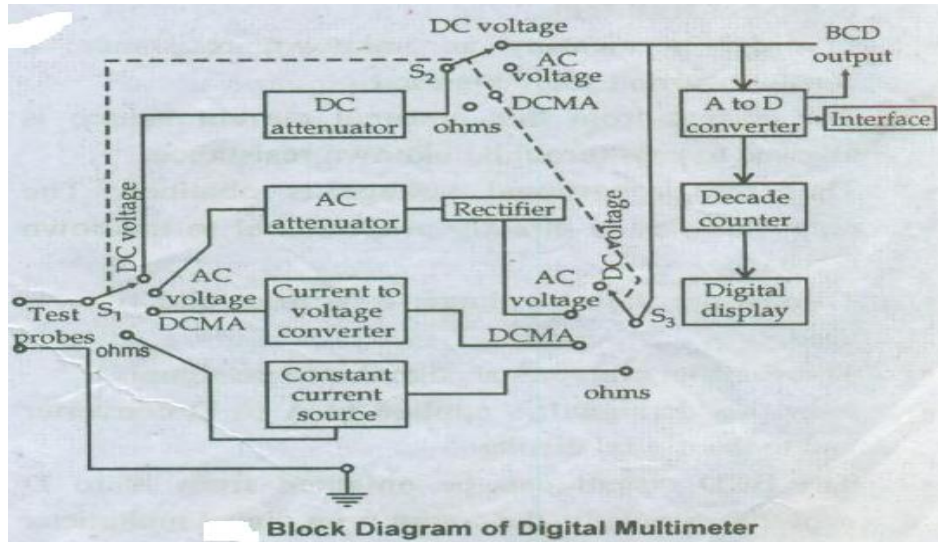
Ans : (2M)

Fig. block diagram of digital multimeter

Applications : (2M)

1. It is used continuity test.
2. It is used to check diode
3. It is used to check transistor
4. It is used to measure voltage, current & resistance.

e) What is meant by calibration of an instrument? State its concept and need in detail.

Ans :

Calibration: (2M)

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

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

Need of Calibration: (2M)

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

f) Draw the block diagram of dual slope type digital voltmeter. Draw the waveform of voltage verses time.
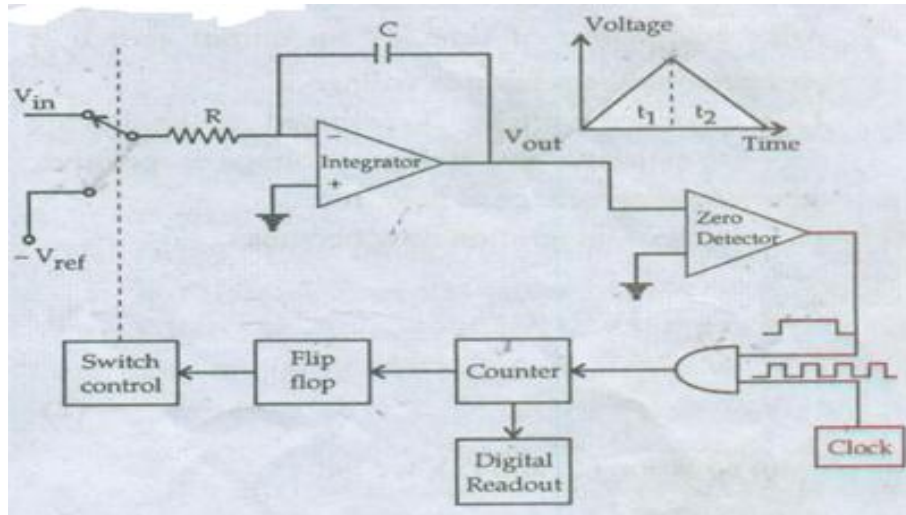
Ans : (2M)

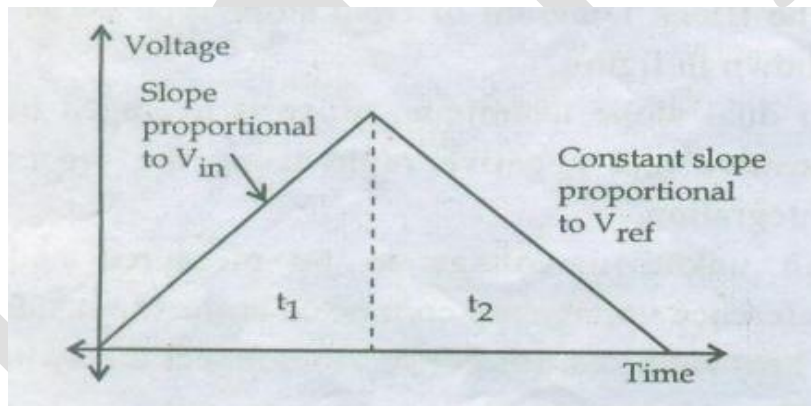Fig. Block diagram of dual slope type digital voltmeter

(2M)

Fig. waveform of voltage verses time.

4. Attempt any four (16 Marks)

a) What is use of Q-meter ? Draw circuit diagram of Q-meter.

Ans :

Q-meter : (2M)

- The Q factor is widely used in the laboratory for the testing of inductors and capacitors.

- The Q factor is equal to

    Q = ωL / R

    Where ω = Angular frequency at resonance.

    L = inductance.

R = Effective resistance of coil.

- The effective resistance R is never determined directly as its value depends on the frequency. The Q meter is an instrument which is designed to measure the value of Q directly and is useful for measuring the characteristics of coils and capacitors.
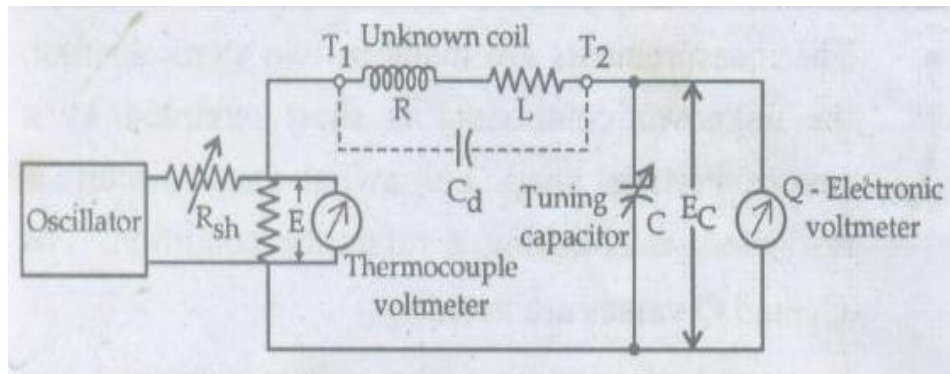
(2M)

Fig. Series Resonance circuit of Q meter

b) Draw the basic block diagram of CRO. State which material is used for coating for a Fluorescent screen.
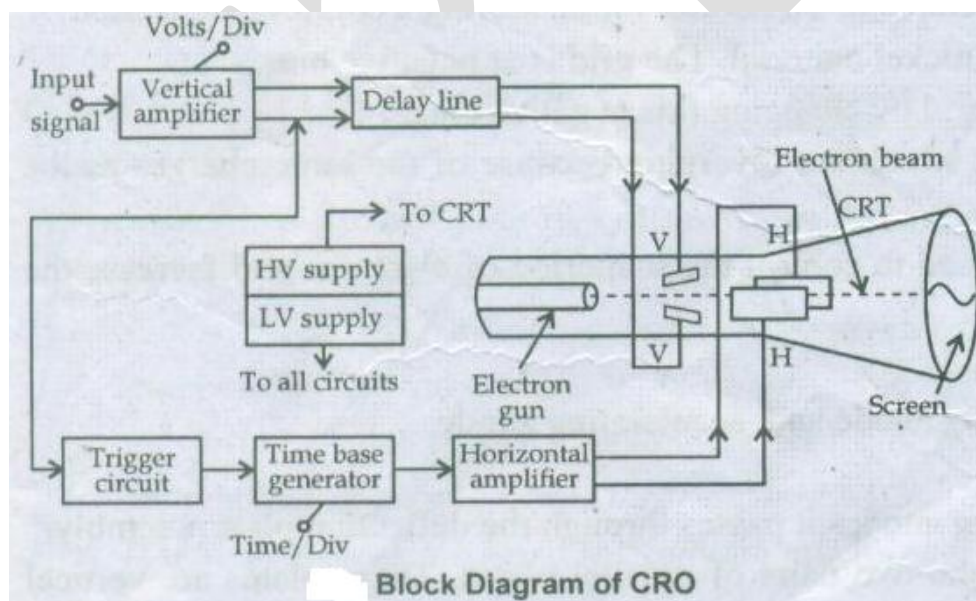
Ans : **(3M)**

Fig. block diagram of CRO

Fluorescent screen : **(1M)**

The screen is coated with fluorescent material called phosphor. This consists of pure crystals of phosphor.

c) Draw the circuit of basic D.C. ammeter. Derive equation for shunt resistance.

Ans :   **(2M)**
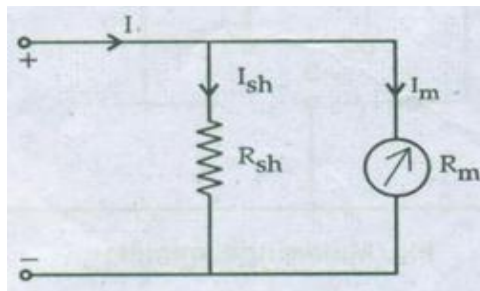

Fig. basic D.C. ammeter

(2M)

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.

Let, I $\rightarrow$ Total current to be measured.

R_{sh} $\rightarrow$ hunt resistor

I_{sh} $\rightarrow$ Current passing through shunt resistor.

R_m $\rightarrow$ Internal resistance of coil

I_m $\rightarrow$ Maximum or fullscale current of ammeter.

As shown in circuit, the R_{sh} are connected in parallel with R_m therefore the voltage drop across them is same.

Therefore, $I_{sh} \times R_{sh} = I_m \times R_m$

Therefore, $R_{sh} = I_m / I_{sh} \times R_m$ ------------------(1)

We know, $I = I_{sh} + I_m$

Therefore, $I_{sh} = I - I_m$

Put this value in equation (1)

Therefore, $R_{sh} = I_m / I - I_m \times R_m$

Therefore, $R_{sh} = 1 / I / I_m - 1 \times R_m$

Therefore, $R_{sh} = 1/m-1 \times R_m$

Where, $m = I / I_m$ $\rightarrow$ Multiplying power of shunt.

$R_{sh} = 1/m-1 \times R_m$

$m R_{sh} - R_{sh} = R_m$

$m R_{sh} = R_m + R_{sh}$

$m = R_m / R_{sh} + 1$

d) Define the term : i) Sensitivity of voltmeter ii) Loading effect of voltmeter.

Ans :

i) Sensitivity of voltmeter :   **(2M)**

- The sensitivity of voltmeter means the response given by a voltmeter to input signal.

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It is the ratio of total rsitance (R_T) to the voltage range

$$S = R_T / V$$

Where, R_T – Total resistance…… $R_T = R_S + R_m$

   V= Voltage range.

<div align="center">**OR**</div>

- It is also defined as the reciprocal of full scale deflection current of the basic movement.

    $$S = 1 / I_{fsd}$$

    I_{fsd} $\rightarrow$ full scale deflection current.

Loading effect of voltmeter :   **(2M)**

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

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

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

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

e) How we can classify the electronic instruments ? List the static characteristics of instrument.

Ans :

Electronic Instruments are classified as: **(1M)**

1. **Absolute instrument** :

2. **Secondary Instrument** :

List of static characteristics: **(Any six)**   **(3M)**

1. Accuracy

2. Precision

3. Reproducibility

4. Repeatability

5. Sensitivity

6. Drift

7. Resolution

8. Dead Time

9. Dead Zone

10. Hysteresis

f) How distortion factor meter works ?   Explain with neat sketch.

Ans :   **(2M)**

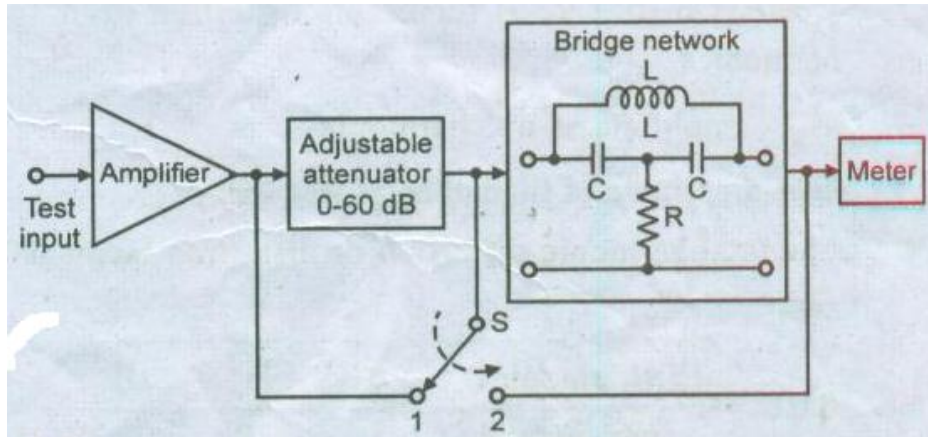Fig. Distortion factor meter

Working :   **(2M)**

- Initially the switch S is kept at position 1.
- The attenuator gets excluded and the bridge T network is adjusted for full suppression of fundamental frequency and hence we get minimum output condition.
- This condition indicated that the bridge T network is tuned to the fundamental frequency with full suppression of it.
- Then switch is moved at position 2, then the bridge T network is excluded.
- The attenuator is adjusted such that same reading as previous is obtained on the meter.
- Thus the total rms distortion is indicated by the reading of attenuator.

Q.5 Attempt any four   **(16 Marks)**

a) Draw the block diagram of Digital Frequency Meter. State the function of Schmitt Trigger in DFM.

Ans.   **(2M)**

Fig. Block diagram of Digital Frequency Meter

Function of Schmitt Trigger   **(2M)**

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

- The Schmitt trigger converts the signal into square wave having fast rise and fall times. The square wave is then differentiated and clipped. Each pulse is proportional to each cycle of unknown signal.

- The output from Schmitt trigger is applied to start and stop gate.

b) Describe the working of Frequency Selective Wave Analyzer.

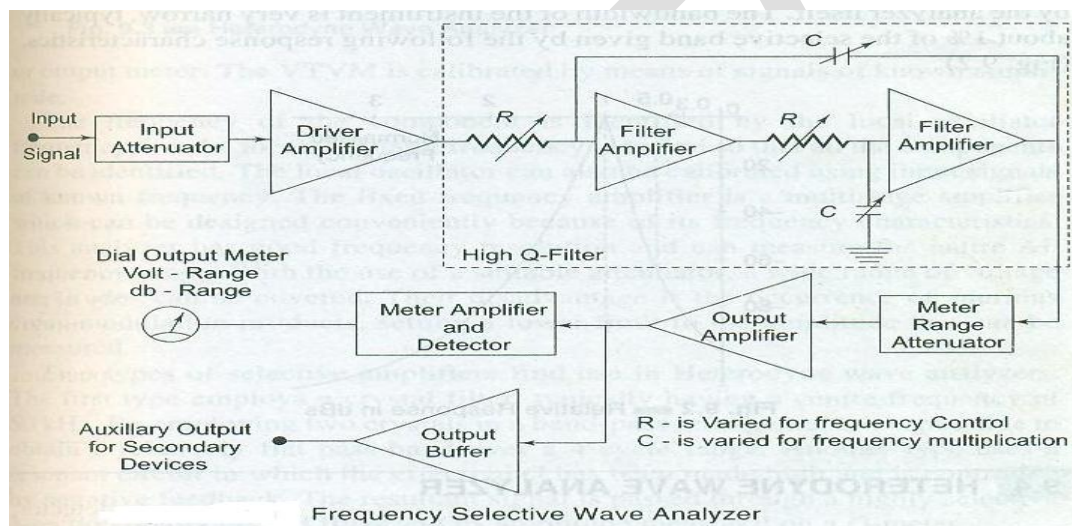Ans.   **(2M)**

Fig. Block diagram of Frequency Selective Wave Analyzer

Working of Frequency Selective Wave Analyzer   **(2M)**

- The wave analyzer consists of a very narrow pass-band filter section which can be tuned to a particular frequency within the audible frequency range.

- The complex wave to be analyzed is passed through an adjustable attenuator which serves as a range multiplier and permits a large range of signal amplitudes to be analyzed without loading the amplifier.

- The output of 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 active filter is a low pass filter which allows the frequency which is selected to pass and reject all other frequencies.

- The magnitude of this selected frequency is indicated by the meter and the filter section identifies the frequency of the component.

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- The selected signal output from the final amplifier stage is applied to the meter circuit and to an untuned buffer amplifier.
- The main function of the buffer amplifier is to drive output devices such as recorders or electronic counters.

c) Draw the block diagram of video pattern generator. State the uses of various patterns generated by pattern generator.
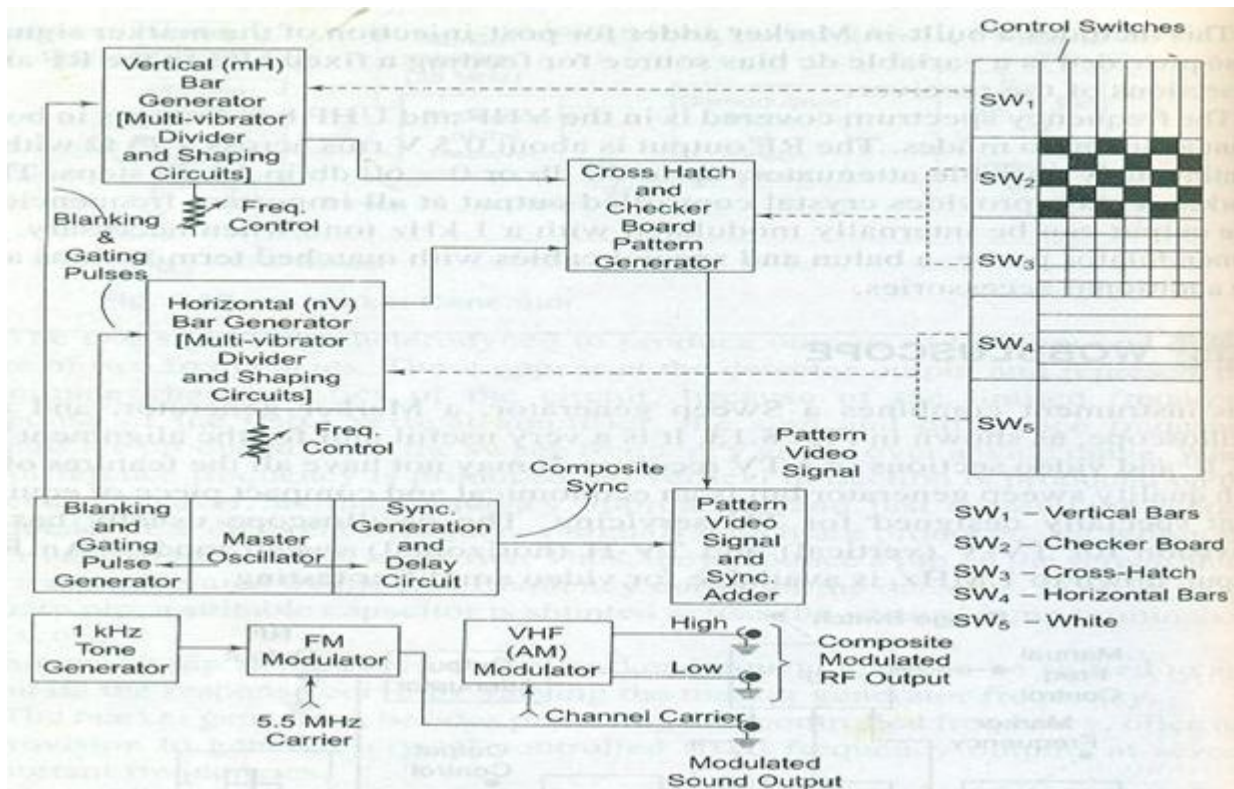
Ans. **(2M)**

Fig. Block diagram of video pattern generator

Uses of generated patterns **(2M)**

- A pattern generator is a device which can generate video signals that can be fed to a TV or Video monitor.
- The pattern consists of geometrical figures such as circles, ellipses, checker boards, horizontal /vertical lines, dots etc.
- These patterns enable us to adjust, test and service the TV monitors. It is essential to generate different pattern to differentiate between video and audio signals for alignment, testing and servicing of Television receivers.

d) Draw the block diagram of Digital Storage Oscilloscope. Give its applications.
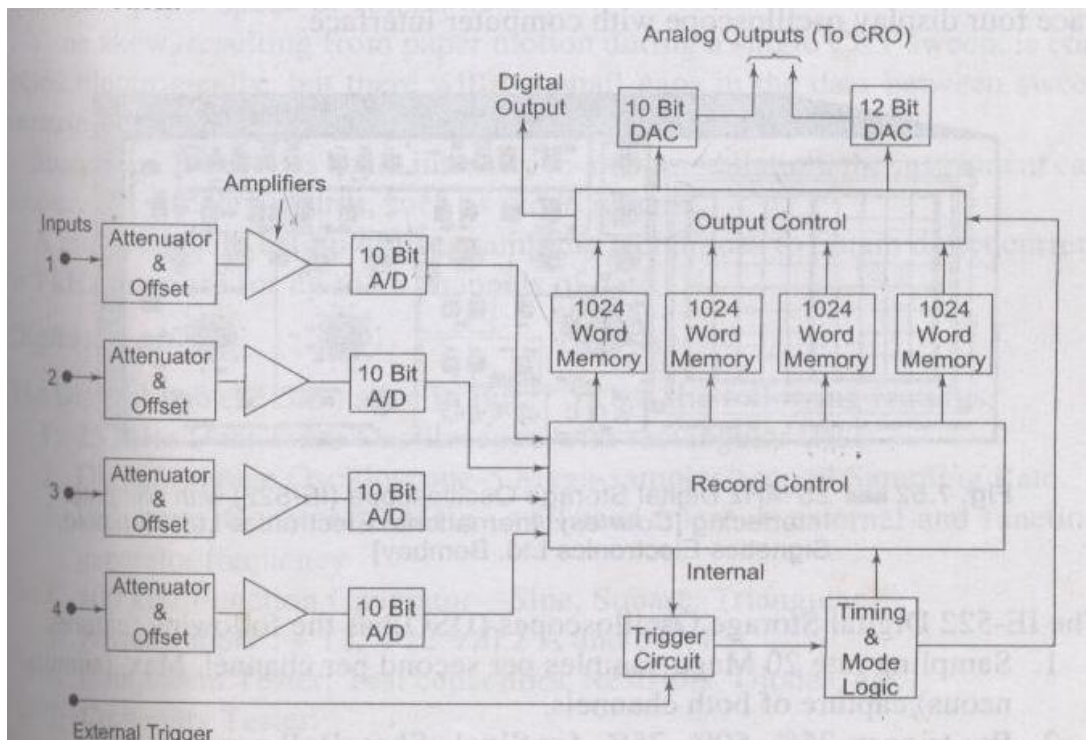
Ans. (3M)

Fig. Block diagram of Digital Storage Oscilloscope

Applications of DSO (Any two) (1M)

- 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.
- It can be used to measure frequency, time period, time interval between two signals.
- It can be used to measure inductance and capacitance.
- It is used to observe the V-I characteristics of diodes and transistors.
- It is used to observe radiation pattern generated by the transmitting antenna.
- It can be used to determine the modulation characteristics and detect the standing waves of transmission lines.

e) Draw the circuit diagram of basic D.C voltmeter. Explain how it can be converted into multirange D.C voltmeter.
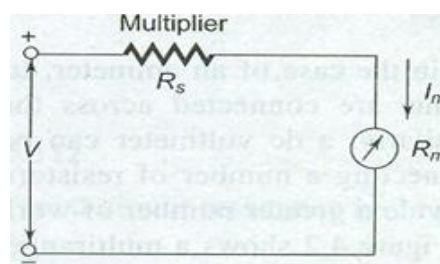
Ans. (2M)

Fig. Circuit diagram of basic D.C voltmeter

Where I_m - Deflection Current of the movement

R_m - Internal Resistance of movement

R_s - Multiplier Resistance

V - Full Range voltage of the instrument

<u>Explanation for conversion of D.C voltmeter into Multirange D.C voltmeter</u> **(2M)**

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

f) Differentiate between single beam dual trace and dual beam dual trace CRO.

Ans. (Any four points)   **(4M)**

Sr. No	Single Beam Dual Trace CRO	Dual Beam Dual Trace CRO
1	A single electron beam is used to display two traces.	Two electron beams are used for displaying two traces/signals.
2	A single vertical amplifier is used.	Two vertical amplifiers are used for two beams.
3	The two signals may or may not have same frequency.	Two signals must have the same frequency or they must be harmonically related.
4	Single Beam oscilloscope is not able to capture two fast transient events.	Dual Beam oscilloscope captures two fast transient events easily.
5	Simultaneous display of two traces is very difficult in Single Beam oscilloscope.	Simultaneous display of two traces is very simple in Dual Beam oscilloscope.
6	Cost is Less.	Cost is High.

Q.6   Attempt any four   **(16 Marks)**

**a) Explain how phase can be measured on CRO using Lissajous Pattern.**

Ans.   Phase measurement by Lissajous Figures: **(4M)**

- The phase measurement can be done by using Lissajous figures.

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

- Depending on the phase shift between the two signals, the shape of the Lissajous pattern will go on changing.
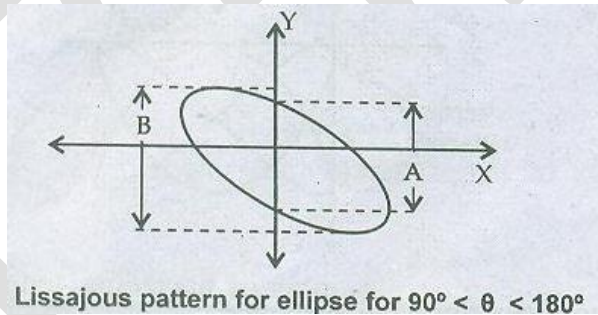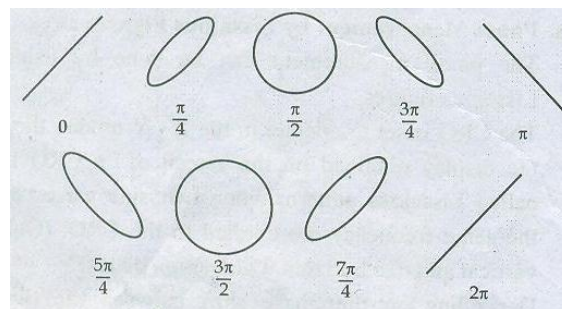
- The phase shift is given by :

$$\theta = \sin^{-1}\left(\frac{A}{B}\right)$$
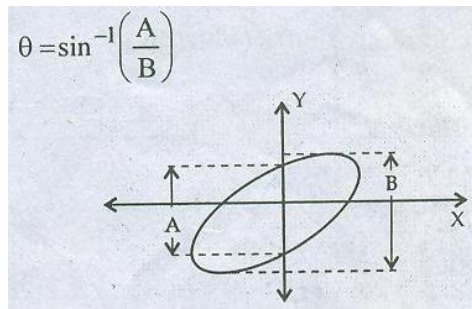
A. The Lissajous pattern will be an ellilpse if the sine waves of equal frequency but phase shift between 0° and 90° are applied to the two channels of CRO. The Lissajous pattern will be as shown below :

Lissajous pattern for ellipse for $0^o < \theta < 90^o$
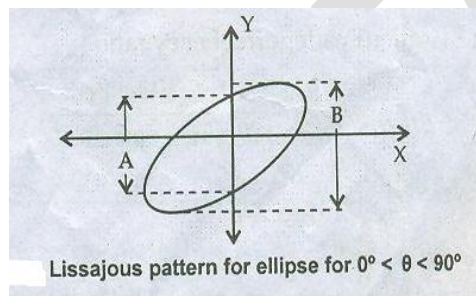
B. For the phase difference above 90° and less than 180°, the ellipse appears as shown

Lissajous pattern for ellipse for $90^o < \theta < 180^o$

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

(OR)

The phase difference is also calculated using the expression

$$\emptyset = sin^{-1}\frac{Y_1}{Y_2} = sin^{-1}\frac{X_1}{X_2}$$

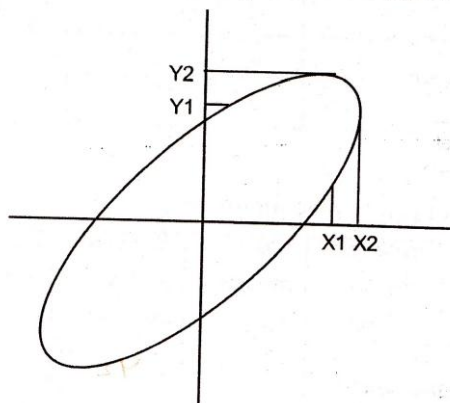Hence their Lissajous Pattern will be as shown below.

Fig. 7.1

Calculate phase difference by using formula

$\emptyset = sin^{-1}(Y1/Y2) \quad = \quad sin^{-1}(X1/X2)$

b) Draw the block diagram of horizontal deflection system. State the role of trigger circuit and time base generator in oscilloscope.
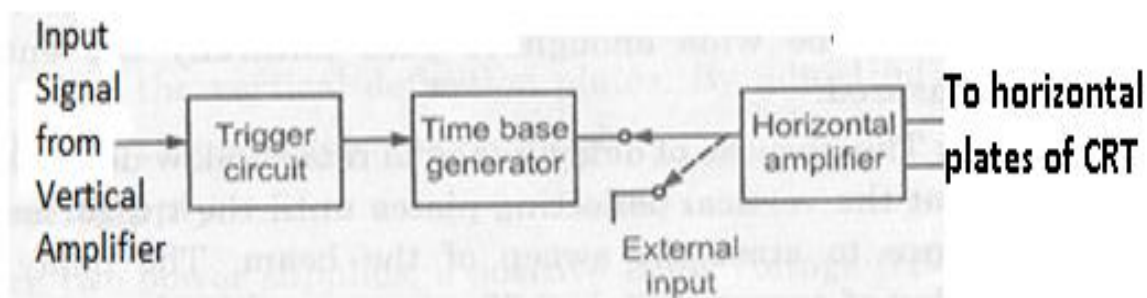
Ans. **(2M)**

Fig. Block diagram of horizontal deflection system

Trigger circuit: **(1M)**

- 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.

Time base Generator: **(1M)**

- 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.

c) Why ammeter is never connected across a source of e.m.f ? Justify your answer.

Ans.   **(4M)**

- Ammeter has very low resistance.
- If we connect it across source of e.m.f directly, then high current starts flowing through ammeter as shown in circuit below.
- This high current damage or destroy the delicate movement of ammeter.
- Hence a series resistance should be connected after the source to limit the current flow through the meter.
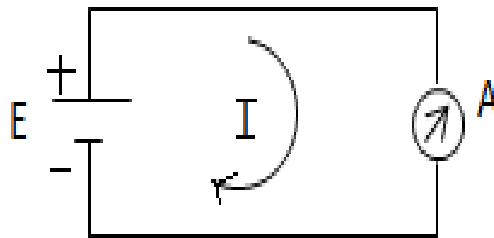
d) Design multirange D.C ammeter for R_m = 100Ω and I_m = 1mA and required current ranges are   0-20mA, 0-100mA, 0-200mA.

Ans.

Given : R_m = 100Ω, I_m = 1mA

    I_1 = 20 mA I_2 = 100Ma

    I_3 = 200Ma

    To find : 1) R_{sh1} 2) R_{sh2} 3) R_{sh3}

    Soln. m_1 = I_1 / I_m = 20mA / 1 mA = 20

Therefore, R_{sh1} = R_m / m_1 $^{-1}$ = 100 / 20 – 1 = 5.26 Ω

Therefore, R_{sh1} = 5.26 Ω   **(1M)**

 m_2 = I_2 / I_m = 100mA / 1 mA = 100

Therefore R_{sh2} = R_m / m_2 $^{-1}$ = 100 / 100 – 1 = 1.01 Ω

Therefore R_{sh2} = 1.01 Ω   **(1M)**

M_3 = I_3 / I_m = 200mA / 1 mA = 200

Therefore R_{sh3} = R_m / m_3 $^{-1}$ = 100 / 200 – 1 = 0.502 Ω

Therefore R_{sh3} = 0.50 Ω   **(1M)**

<u>Design</u> **(1M)**
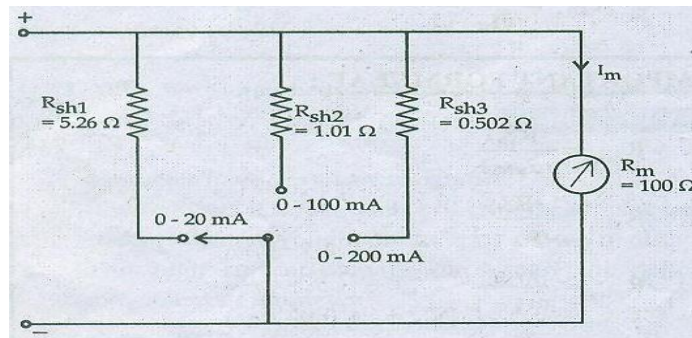
e) Compare analog and digital multimeter on the basis of

   i) Display   **iii) Function Available**
   ii) Resolution   **iv) Power Consumption**

Ans. **(4M)**

Sr. No	Parameter	Analog Multimeter	Digital Multimeter
1	Display	Analog Pointer is used	LCD display is used.
2	Resolution	Low Resolution	High Resolution
3	Function Available	Current, Resistance, Voltage measurement possible.	Current, Resistance, Voltage, Continuity in PCB conductor lines, Transistor Identification and hfe measurement possible.
4	Power Consumption	More Power Required	Less Power Required.

f) Draw the block diagram of function generator. State the function of diode wave shaping circuit.

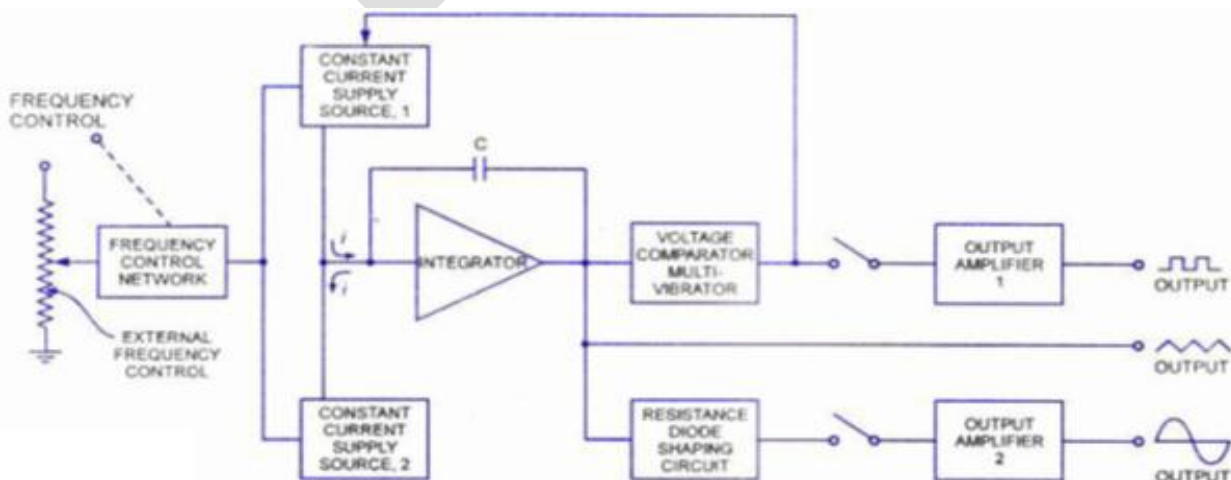**Ans.** **(2M)**

Fig. Block diagram of function generator

<u>Wave shaping circuit explanation</u>   **(2M)**

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.