WINTER– 16 EXAMINATION (Subject Code: 17317)

Model Answer

Important Instructions to examiners:

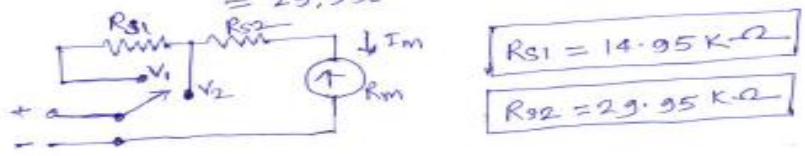
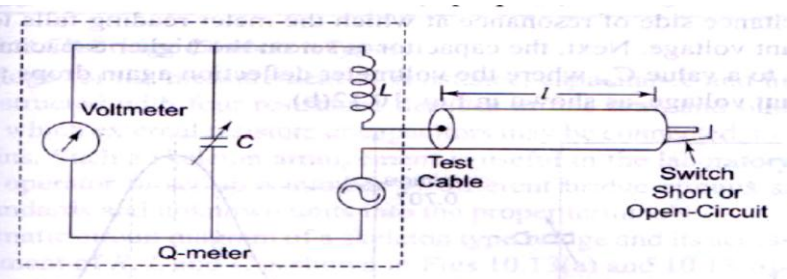
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

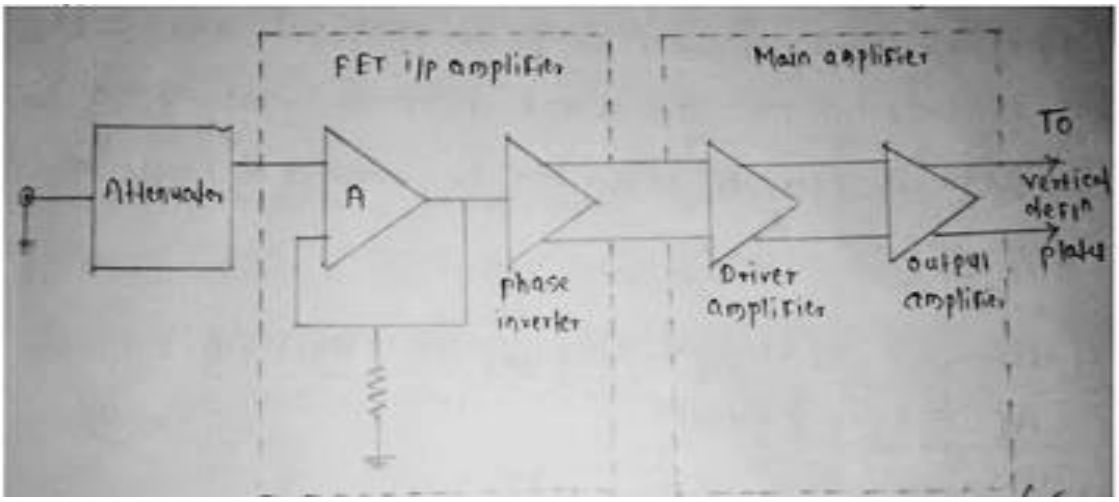
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		**Attempt any six of the following.**	**12-Total M**
1	**I)**	**Define the term** **i)Resolution ii) Sensitivity**	**2 M**
	Ans:	**i) Resolution:** The smallest change in input to which instrument can respond is known as resolution. ii) **Sensitivity:** The ratio of change in output of an instrument to the change in input is known as sensitivity. Sensitivity = Change in output/ Change in input	**(1 Mark for Each Define)**
	II)	**State two advantages and two disadvantages of PMMC instrument.**	**2 M**
	Ans:	**Advantages of PMMC meter:** 1. It has uniform scale. 2. Power consumption is low 3. It can be obtained in wide ranges. 4. High sensitivity & accuracy 5. It is unaffected by external magnetic field. 6. Additional damping device not required. 7. Hysteresis problem is not there. **Disadvantages of PMMC meter:** 1. It is suitable for d.c. measurement only. 2. Comparatively high cost than moving iron type instrument. 3. Ageing of permanent magnet & spring introduce errors. 4. Friction due to jewel- pivot suspension.	**(1 Mark each for any two)** **(1 M each for any two)**

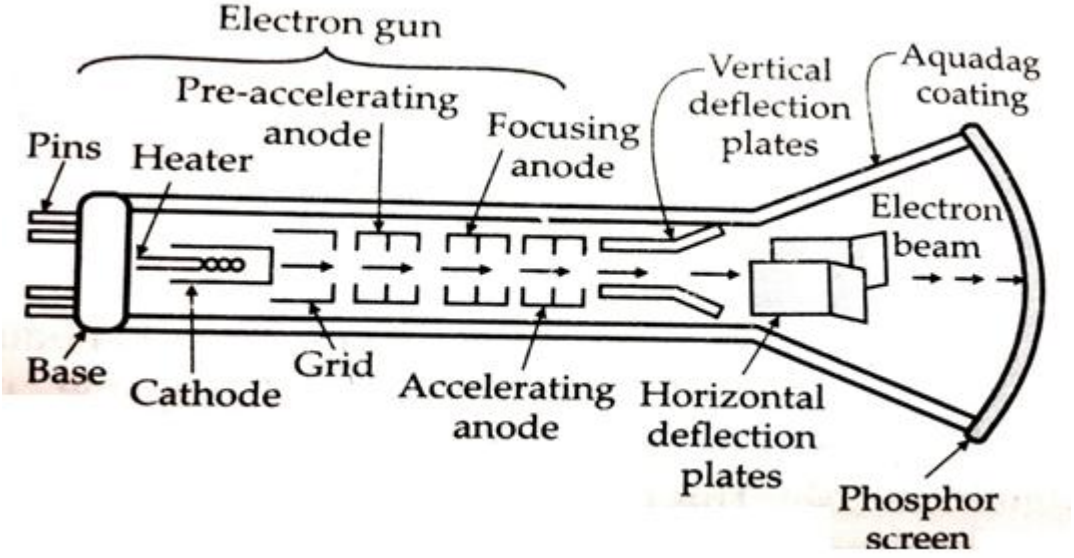
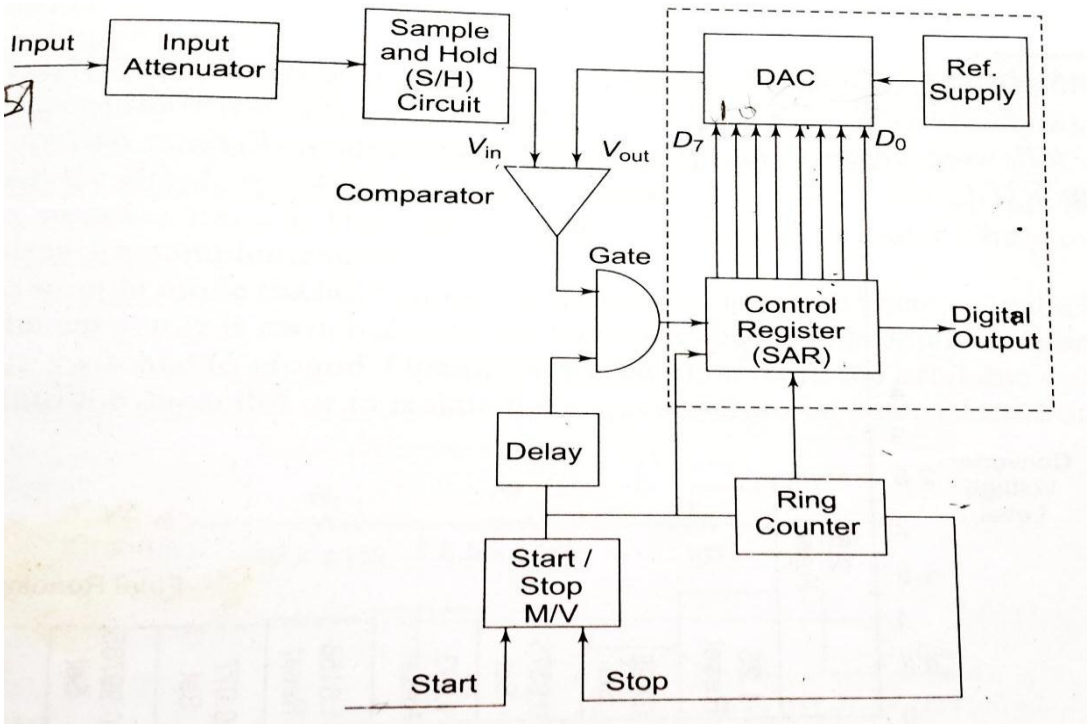
III)	**List four application of CRO.**	**2M**
Ans:	**Applications of CRO:** 1. It is used in laboratory for measurement of AC/DC voltage, current, frequency, phase and study nature of waveform. 2. It is used in TV receiver for creation of images. 3. It is used in radar receiver for giving visual indication 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.	**(2 M for any four point)**
IV)	**State four applications of digital storage oscilloscope.**	**2 M**
Ans:	**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.	**(2 M for any four point)**
V)	**State the need of wave analyzer.**	**2M**
Ans:	**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 analyzers 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**.**	**2M**

VI)	**State two applications of Logic Analyzer.**	**2M**
Ans:	**Applications of logic analyzer are:** 1. Testing the IC's to detect defect before constructed. 2. To find out hardware defect. 3. VLSI chip design industries. 4. IN various software industries. 5. To find fault in Bio- medical instruments.	**(2 M for any two)**
VII)	**State any two disadvantages of digital instruments.**	**2M**
Ans:	i. They are costly. ii. They are complex in nature. iii. Speed of operation is limited due to digitizing circuits.	**(Any two disadvantages: 2M)**
VIII)	**Which section of DMM decides its resolution?**	**2M**
Ans:	A/D converter & BCD counter will decide the resolution of DMM depends upon current flowing through it.	**2M**
B)	**Attempt any two of the following:**	**8M**
I)	**Differentiate between absolute instrument and secondary instrument.**	
Ans:		**Each Point:2M**

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.

	II)	**A basic D' Arsonval movement with an internal resistance of 5Of! and a full scale deflection current of 1 mA is to be used as a multirange voltmeter. Design a series of string of multipliers to obtain the voltage ranges of 0 - 15 V and 0 - 30 V.**	**4M**
	Ans:	II) Given : Internal Resistance (R_m) = 50 Ω $I_{FSD} = I_m = 1mA = 1\times10^{-3} A$ To Find i) R_{S1} ii) R_{S2} **Case I :-** For 0 – 15 V i.e. $V_1 = 15 V$. $R_{S1} = \frac{V_1}{I_m} - R_m$ $= \frac{15}{1\times10^{-3}} - 50$ $R_{S1} = 14,950 \Omega$ or 14·95 KΩ **Case II :-** For 0 – 30 V i.e. $V_2 = 30 V$. $R_{S2} = \frac{V_2}{I_m} - R_m$ $= \frac{30}{1\times10^{-3}} - 50$ $= 29,950 \Omega$ or 29·95 KΩ  $R_{S1} = 14·95 K\Omega$ $R_{S2} = 29·95 K\Omega$	**Rs_1=2M** **R_{s2}=2M**
	III)	**Draw a Q-meter circuit of series connection and explain it.**	**4M**
	Ans:	**Explanation:** The series connection is used to measure low impedance, components, small resistances, small coils and large capacitance. The component to be measured is a test cable and it is connected in series with the working coil conncected across the testing terminals. The reactance /unit length of the line is the total reactance divided by the length l. Series resonanc occurs when the line is short circuited and the line length is an even multiple of λ/4 and when open circuited it is an odd multiple of λ/4. **Diagram:**  	**2M** **2M**

Q 2		Attempt any four of the following	16M
	a)	**Describe the different standards**	4M
	Ans:	**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.	(1M for each type)
	b)	**Draw the block diagram of vertical deflection system and describe its operation.**	4M
	Ans:	**Block Diagram:**  	2M
		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	2M

		medium impedance of FET amplifier with low i/p impedance of phase inverter. Two antiphase 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.	
	c)	**Draw the labeled diagram of CRT.**	**4M**
	Ans:		**4M**
	d)	**Explain the working of successive approximation type DVM.**	**4M**
	Ans:	**Diagram:** 	**2M**

Explanation:

Successive approximation DVMs are capable of 1000 readings per second.

- These instruments make use of successive approximation converter for analog to digital conversion. A simplified block diagram of such a DVM.
- In the beginning of measurement cycle, a start pulse is applied to the (start/ stop) multivibrator. This sets a MSB of control register high and all other bits low.
- Assuming a 8 bit control register, its reading would then be 10000000. This initial setting of control register causes the output of DAC to be one half the reference supply (1/2V).
- The converter output is compared with unknown input by the comparator.
- It produces an output which causes the control register to retain 1 at its MSB and converter register to retain 1 at its MSB and converter continues to supply its reference voltage of ½ V.
- The ring counter next advances one count, shifting a 1 in the second digit. MSB of the control register and its reading becomes 11000000.
- This makes D/A converter to increase its reference by one increment to 1/2V +1/4 V and another comparison with unknown input voltage takes place.
- If accumulates reference exceeds the unknown voltage the comparator produces and output that causes the control register to reset its MBS to 0.
- Finally when the ring counter reaches its last count, the measurement cycle stops and the digital output of control register represents the final approximation of the unknown input voltage.

2M

e) How function generator differs from signal generator? **4M**

Ans:

Sr. No.	Signal Generator	Function generator
1	Signal generator generates only sine wave.	Function generator generates various waveforms such as sine, square, triangular, sawtooth.
2	Limited frequency stability.	High frequency stability.
3	No capability of phase locking with external source.	Capability of phase locking with external source.
4	Frequency can be controlled by varying the capacitor in LC or RC circuit.	Frequency can be controlled by varying the magnitude of current that drives the integrator.

Each point:1M (consider any other relevant point)

	f)	**Differentiate digital instruments with Analog instruments?**	**4M**
	Ans:		**Each point:1M**

Sr. No.	Parameter	Analog instrument	Digital instrument
1	Principle	The instrument that displays analog signals is called as an analog instrument.	The instrument that displays digital signals is called as an digital instrument.
2	Accuracy	Low	High
3	Resolution	Low	High
4	Power	draws more power	draws less power
5	Cost	Cheap	costly
6	Portability	Portable	Less
7	Observational error	Considerable Observational error	Free from Observational error
8	examples	PMMC instrument, analog ammeter, analog voltmeter.	DMM, DVM

Q. 3		**Attempt any four of the following:**	**16M**
	a)	**Derive the relation for deflection torque in PMMC instruments.**	**4M**
	Ans:	**Deflecting Torque Equation**:	**1M**

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 **1M**

F= BiL

The deflecting torque is given by

Td = Force x distance

Td = F x S **1M**

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

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

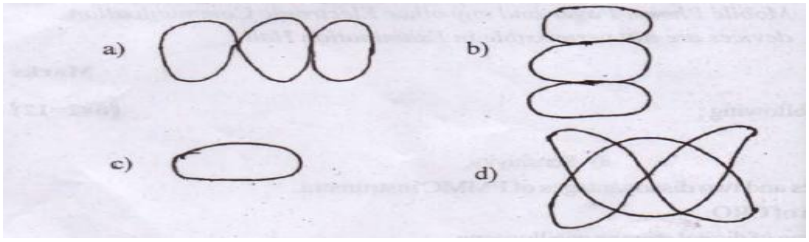
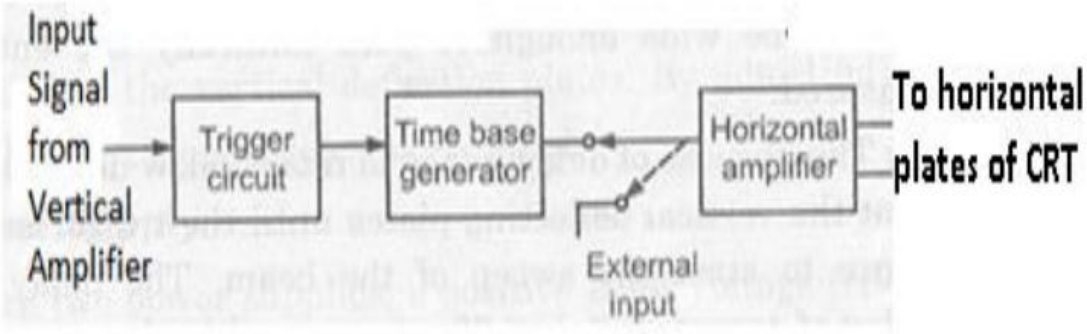
Where, A = l x d = Area of coil former.

N,B,A are constants for a galvanometer **1M**

Therefore deflecting torque = T_d = G i

G = NBA = NB (l*d)

G is called displacement constant of a galvanometer

b)	**Define calibration. Explain why calibration is needed for measuring instrument.**	**4M**
Ans:	**Calibration**: 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:** 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. 4. Calibration increases productivity, optimizes resources and assures consistency.	**2M** **Any two points: 2M**
c)	**Calculate the ratio of vertical to horizontal frequencies for an oscilloscope, which displays the following Lissajous patterns shown in Fig. 1** 	**4M**
Ans:	We know that $\frac{Fv}{Fh} = \frac{\text{No.of loops touches to horizontal tangents}}{\text{No.of loops touches to vertical tangents}}$ a) $\frac{Fv}{Fh} = \frac{3}{1}$ b) $\frac{Fv}{Fh} = \frac{1}{3}$ c) $\frac{Fv}{Fh} = \frac{1}{1}$ d) $\frac{Fv}{Fh} = \frac{3}{2}$	**1M** **1M** **1M** **1M**
d)	**Explain the function of each block of horizontal deflection system of CRO.**	**4M**
Ans:	**Block Diagram:** 	**2M**

Explanation:
Input from vertical amplifier is given to Horizontal system.
Trigger circuit:
• A trigger circuit is used to convert the incoming signal into trigger pulses, so that the input signal and the sweep frequency can be synchronized. • The trigger circuit is activated by signals of a variety of shapes and amplitudes, which are then converted to trigger pulses of uniform amplitude, for the precision sweep operation.
Time base Generator:
• A time base generator is used to generate the saw tooth voltage required to deflect beam in the horizontal section. The circuit used to generate the saw tooth is called the continuous sweep generator.
Horizontal amplifier:
Horizontal amplifier amplifies the signal & passes the signal to horizontal plates of CRT.

2M

e) **Draw the block diagram of Logic Analyzer and describe its operation.** **4M**

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

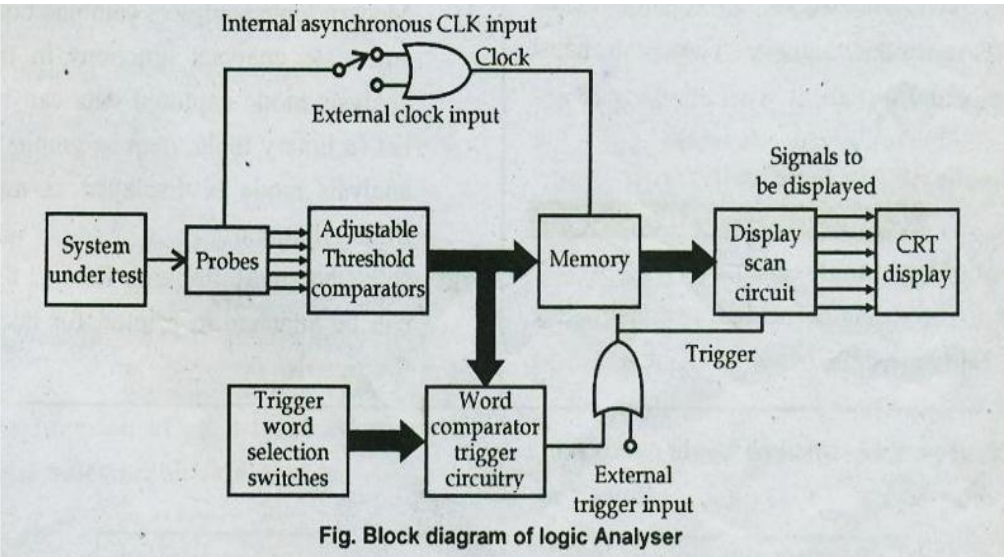


Fig. Block diagram of logic Analyser

Explanation: **2M**

- A logic analyser 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 analyser with frequency domain and logic analyser with digital domain.
- Logic analyser is basically a multichannel oscilloscope.
- The probes connect the logic analyser to the system under test.
- The logic analyser memory consists of a RAM. The clock signal i.e. internal or external clock input is connected to the memory on receivieng clock signal the logic analyser samples the data present on input signals
- These samples are stored in the memory for each input channel. The analyser

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 analyser
- 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.

f) **Describe the working of spectrum analyzer with the help of block diagram.** **4M**

Ans: **2M**

Diagram:

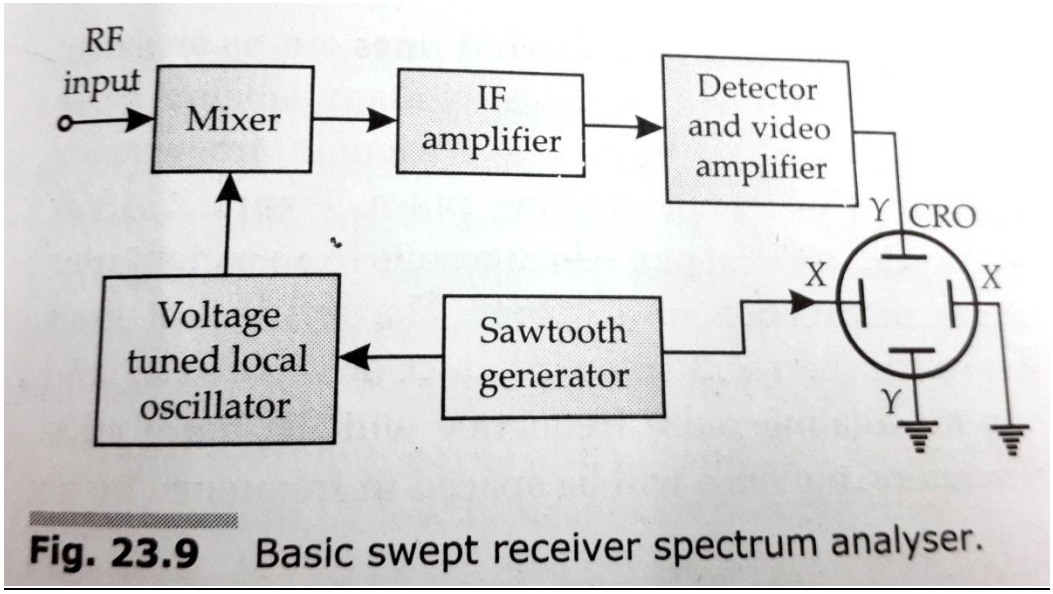
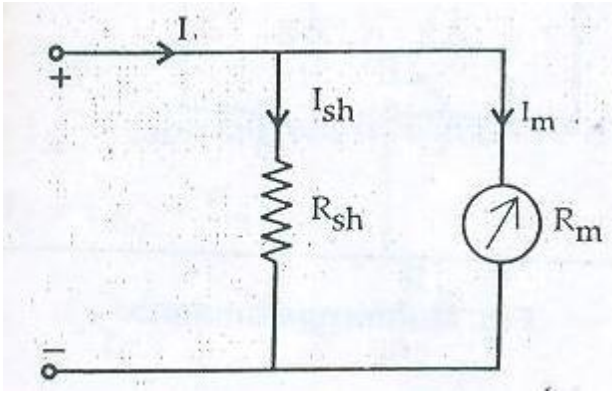
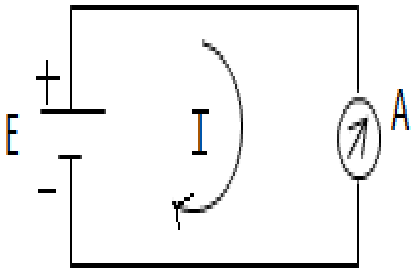
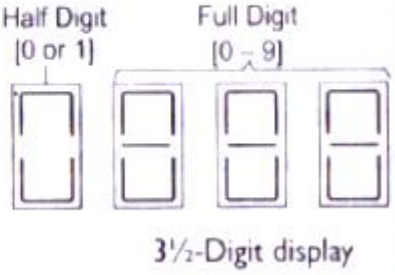
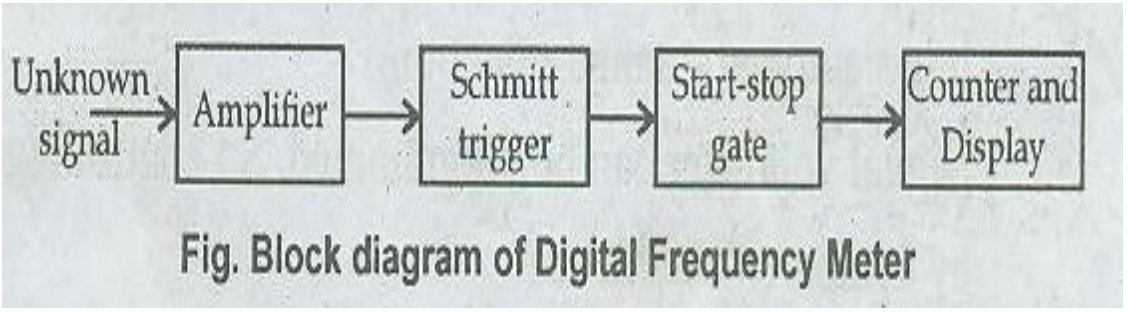


Fig. 23.9 Basic swept receiver spectrum analyser.

Explanation: **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. 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.	
Q. 4		**Attemptany four of the following:**	**16 M**
	a)	**Describe the working of Shunt Resistance Ammeter with diagram.**	**4 M**
	Ans:	**Diagram:**  **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. • • $V_{sh}=V_m$ • $I_{sh}R_{sh}=I_mR_m$ • $R_{sh}=I_mR_m/I_{sh}$ • $R_{sh}=I_mR_m/(I-I_m)$	**2M** **2M**
	b)	**Why ammeter never connected across source of emf ? Justify.**	**4 M**
	Ans:	The following precautions should be taken while using an ammeter: 1. While connecting an ammeter across the emf source always a series resistance should be used. This is necessary to limit the current passing through the meter movement may	**(Proper relevant answer- 4**

		be damaged. This is because the meter is having a small internal resistance. So it may draw very high current from the emf source. 2. The polarity of the meter should be first observed and then it should be connected accordingly. The reverse polarity may damage the pointer of meter. ***Diagram Optional***  	**M)**
	c)	**What do you mean by $3_{1/2}$ digit display in digital voltmeter?**	**4 M**
	Ans:	The number of digit positions used in a digital meter determines the resolution. Hence a 3 digit display on a DVM for a 0 – 1 V range will indicate values from 0 – 999 mV with a smallest increment of 1 mV. Normally, a fourth digit capable of indicating 0 or 1 (hence called a Half Digit) is placed to the left. This permits the digital meter to read values above 999 up to 1999, to give overlap between ranges for convenience, a process called over-ranging. This type of display is called a 3½ digit display, shown in Fig.  3½-Digit display	**4M**
	d)	**Explain how frequency is measured with the help of digital frequency meter.**	**4 M**
	Ans:	Diagram:  Fig. Block diagram of Digital Frequency Meter **OR**	**2M**

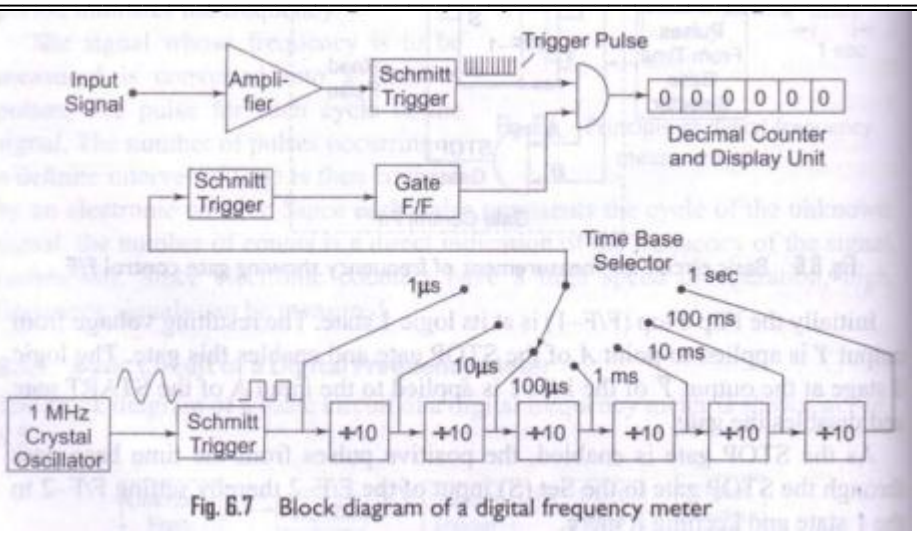


Fig. 6.7 Block diagram of a digital frequency meter

Explanation:

Digital frequency meter:

- Frequency is defined as number of cycles per unit time interval. The signal whose frequency is to be measured is used as an event.
- The unknown frequency is first converted to train of pulses. One pulse represents one cycle of unknown signal. These pulses are directly proportional to the frequency to be measured.

Amplifier:

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

Schmitt trigger:

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

Start- Stop gate:

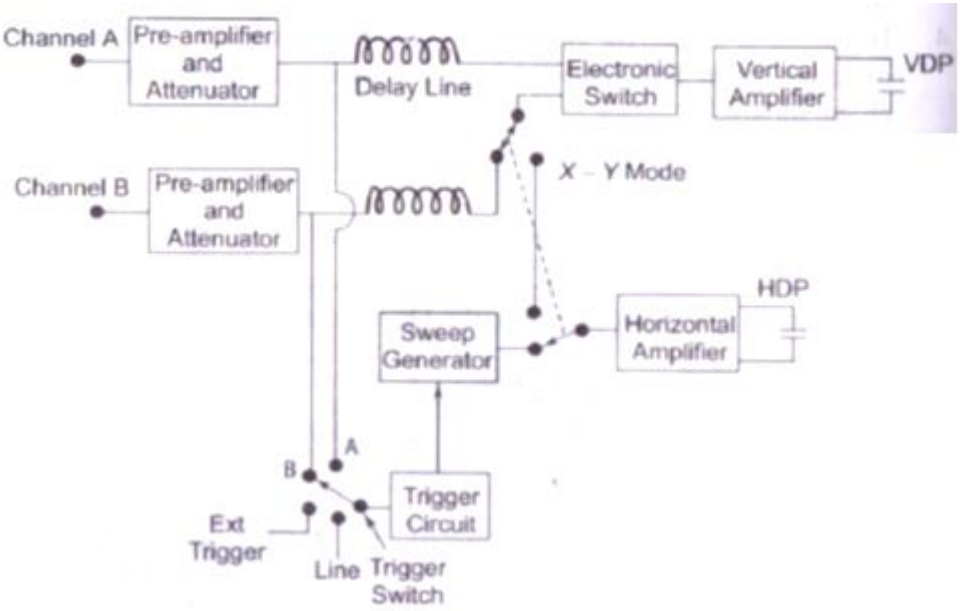
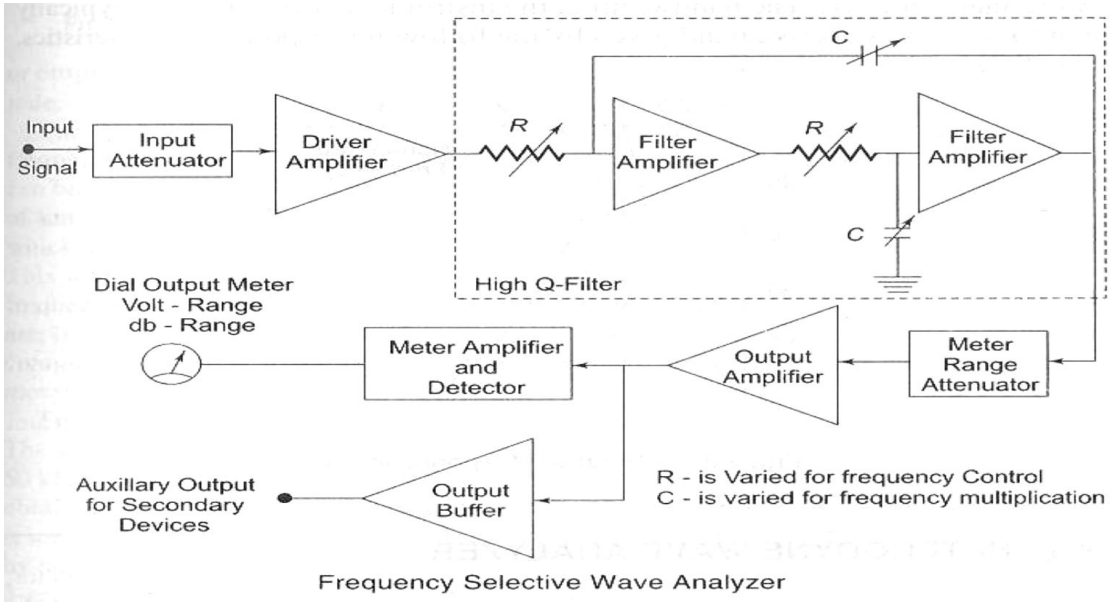
- The output from Schmitt trigger is applied to start and stop gate. These pulses are applied to the switch.
- This switch is controlled by a signal having definite time interval. The main gate switch is closed for known time interval.
- When the gate is open, input pulses are allowed to pass through it. A counter will now start to count these pulses.
- When the gate is closed, input pulses are not allowed to pass through the gate. The counter will now stop counting.

Counter and display:

- The number of pulses during the period gate is open are counted by the counter.
- If this interval between start and stop condition is known, the frequency of unknown signal is measured.

2M

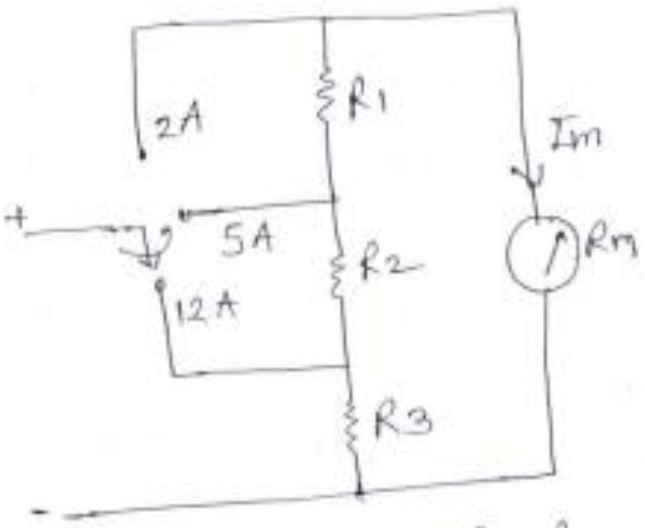
(Consider relevant explanation)

	F= N/t Where, F= Unknown frequency N= Number of counts displayed by the counter. t= Time interval between start and stop condition of the gate.	
e)	**Draw the block diagram of Dual trace CRO.**	**4 M**
Ans:	**Block diagram of Dual trace CRO** 	**4M**
f)	**Describe with neat block diagram the operation of frequency selective wave analyzer**	**4 M**
Ans:	**Diagram-**  Frequency Selective Wave Analyzer	**2M**

		Explanation: Working of Frequency Selective Wave Analyzer • 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. • 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.	**2M**
Q.5		**Attempt any four of the following.**	**16 M**
	a)	**Design a Ayrton shunt to provide an ammeter with current ranges of 2 A, 5 A and 12A.Abasic meter with an internal resistance of 50Q and a full scale deflection current of 1 mA is to be used.**	**4 M**

Ans:

Q 5 g) ①



To find value of R_1 R_2, R_3

i) For 2A

$$(I - I_m)(R_1+R_2+R_3) = I_m R_m$$

$$(2-0.001)(R_1+R_2+R_3) = 0.001 \times 50$$

$$R_1+R_2+R_3 = \frac{0.05}{1.999} = 0.025$$

$$R_1+R_2+R_3 = 0.025 \quad \text{---} (1)$$

ii) For 5A

$$4.999(R_2+R_3) = 0.001 \times 50 + 0.001 R_1$$

$$-0.001 R_1 + 4.999 R_2 + 4.999 R_3 = 0.05 \quad \text{---} (11)$$

iii) For 12A

$$11.999 \times R_3 = 0.001(50 + R_1 + R_2)$$

$$-0.001 R_1 - 0.001 R_2 + 11.999 R_3 = 0.05 \quad \text{---} (111)$$

Diagram:1 M & Each resistance :1M

$\therefore R_1 + R_2 + R_3 = 0.025$ ——— (I)

$-0.001R_1 + 4.999R_2 + 4.999R_3 = 0.05$ ——— (II)

$-0.001R_1 - 0.001R_2 + 11.999R_3 = 0.05$ ——— (III)

$\therefore$ Eq (I) $\times$ 0.001

$0.001R_1 + 0.001R_2 + 0.001R_3 = 2.5 \times 10^{-5}$ ——— (IV)

Eq (IV) + Eq^n (II)

$0.001R_1 + 0.001R_2 + 0.001R_3 = 2.5 \times 10^{-5}$

$-0.001R_1 + 4.999R_2 + 4.999R_3 = 0.05$

$5R_2 + 5R_3 = 0.050025$ ——— (V)

Eq (II) − Eq (III)

$-0.001R_1 + 4.999R_2 + 4.999R_3 = 0.05$

$-0.001R_1 - 0.001R_2 + 11.999R_3 = 0.05$

$+ \quad + \quad - \quad -$

$5R_2 - 7R_3 = 0$ ——— (VI)

Eq (V) − Eq (VI)

$5R_2 + 5R_3 = 0.050025$

$5R_2 - 7R_3 = 0$

$- \quad + \quad -$

$12R_3 = 0.050025$

$R_3 = 4.168 \times 10^{-3}\ \Omega$

Put R_3 in Eq (VI)

$5R_2 = 7 \times 4.168 \times 10^{-3}$

$R_2 = \frac{7 \times 4.168 \times 10^{-3}}{5}$

$R_2 = 5.836 \times 10^{-3}$

put in (1)

$R_1 = 0.025 - 4.1 \times 10^{-3} - 5.8 \times 10^{-3}$

$= 0.0151\ \Omega$

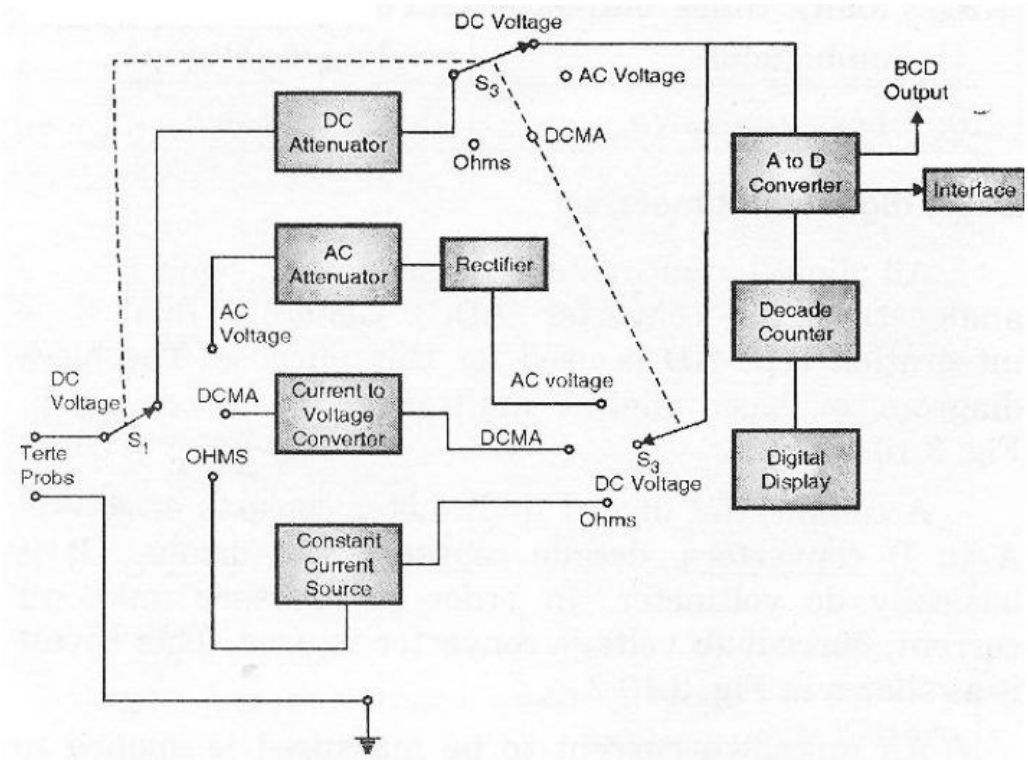
$R_1 = 0.0151$

$R_2 = 5.836 \times 10^{-3}\ \Omega$

$R_3 = 4.1 \times 10^{-3}\ \Omega$

b) **Describe the working of digital multimeter with block diagram.** **4M**

Ans:



Working:

Resistance:

- Generally six resistance ranges are available. The resistance range is from 200Ω to20MΩ.
- Accuracy is about ±0.1% of reading.

DC current:

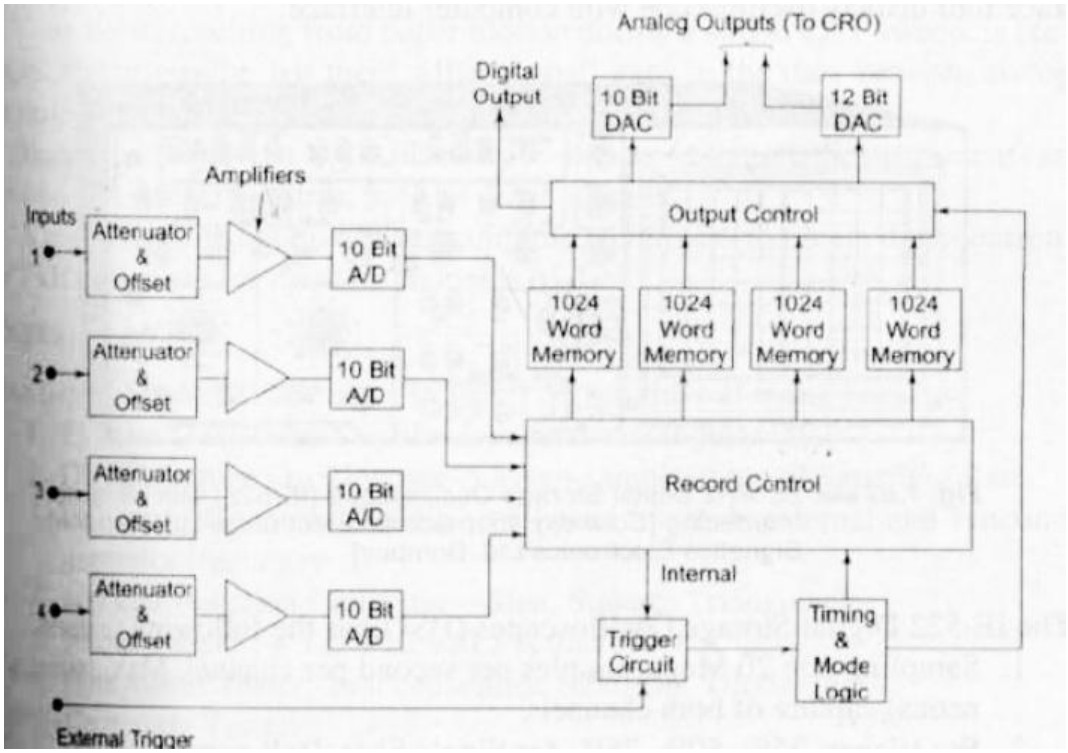
- Five ranges are available. This range is from ±200μA to 2Amp.
- Accuracy is about ±0.3% of reading.

- Resolution is about ±0.01μA.

AC current:

- Five current ranges are available. This range is from 200μ to 2 Amp.
- Accuracy is dependent on frequency. Best accuracy obtained is about ±1%.

c)	**Draw the block diagram of DSO and describe its working**	**4 M**
Ans:	**Diagram:**	**2M**



(consider other relevant diagram)

Block diagram of Digital Storage Oscilloscope **2M**

- The analog voltage input signal is digitized in a 10 bit A/D converter with a resolution of
- 0.1% (1 part in 1024) and frequency response of 25 kHz. The total digital memory storage capacity is 4096 for a single channel, 2048 for two channels each and 1024 for four channels each.
- The analog input voltage is sampled at adjustable rates (Upto 100, 000 samples per second) and data points are read onto the memory. A maximum of 4096 points are storable in this particular instrument. (Sampling rate and memory size are selected to suit the duration and waveform of the physical event being recorded.)
- Once the sample record of the vent is captured in memory, many useful manipulations are possible, since memory can be read out without being erased.
- If the memory is read out rapidly and repetitively, an input event which was a single shot
- transient becomes a repetitive or continuous waveform that can be observed

easily on an
- ordinary scope(without going through DAC) to say a computer where a stored program can manipulate the data in almost anyway desired.
- Pre triggering recording allows the input signal preceding the trigger points to be recorded.
- In ordinary triggering the recording process is started by the rise of the input (or some
- external triggering) above some preset threshold value.
- As in digital recorder, DSO can be set to record continuously(new data coming into the
- memory pushes out the old data, once memory is full), until the trigger signal is received;
- then the recording is stopped, thus freezing data received prior to the trigger signal in the
- memory.
- An adjustable trigger delay allows operator control of the stop point, so that the trigger may occur near the beginning, middle or end of the stored information.

d) **Differentiate between Dual trace CRO and Dual Beam CRO for two points.** **4M**

Ans: **Any 2 Points :2M**

Sr. No	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.

e) **State how frequency and amplitude can be measured on CRO.** **4M**

Ans: **Each State:2M**

Voltage measurement/Amplitude:
- The most direct voltage measurement that can be made with the help of oscilloscope is the peak to peak value.
- The RMS value can be calculated from peak to peak value.
- In order to measure the voltage from the CRT display, one must observe the

vertical

- attenuator expressed in volts/div and the number of division of the beam. The peak to peak value is then computed as,

$$Vp-p = \left(\frac{Volts}{Div}\right) \times \left(\frac{number\ of\ divisions}{1}\right)$$

$Vp = \frac{1}{2} Vpp$ *is the peak value.*

Frequency measurement:

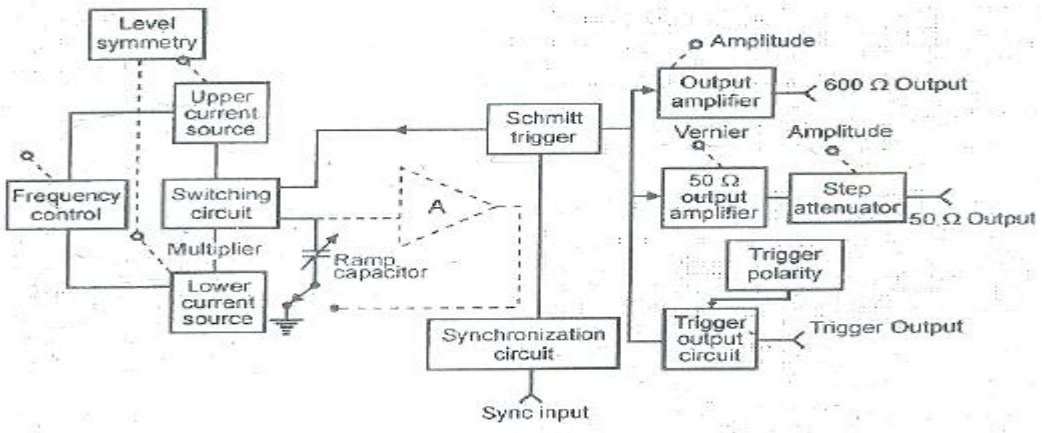
- The period and frequency of periodic signals are easily measured.
- The period is the time between two identical points of successive cycle of the waveform.

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

The frequency is inversely proportional to the period.

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

	f)	**Draw the block diagram of pulse generator. State its operation.**	**4M**
	Ans	**Diagram:**	**2M**



Explanation-

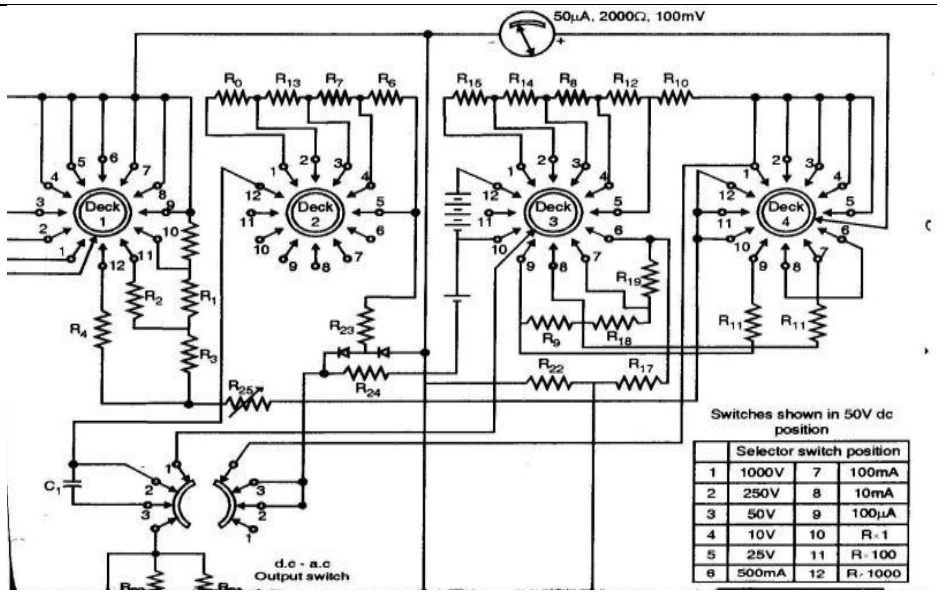
- Figure shows the block diagram of pulse generator. The circuit consists of two current sources, a ramp capacitor and schematic trigger circuit as well as current switching circuit. The two current sources provide a constant current to a ramp capacitor, so that the capacitor can be charged and discharged. **2M**
- The ratio of the charging current and discharging current is determined by setting the symmetry control i.e. the symmetry control determine the duty cycle of the output waveform. In the current source and appropriate control voltage is applied to control the current in transistors which control the frequency i.e. the sum of the two current. The multiplier switch provides decade swathing control output frequency and frequency dial provides continues vernier control of the output frequency. The upper current source provides a constant current to the ramp capacitor. This will charge the capacitor at a constant rate. The voltage across the

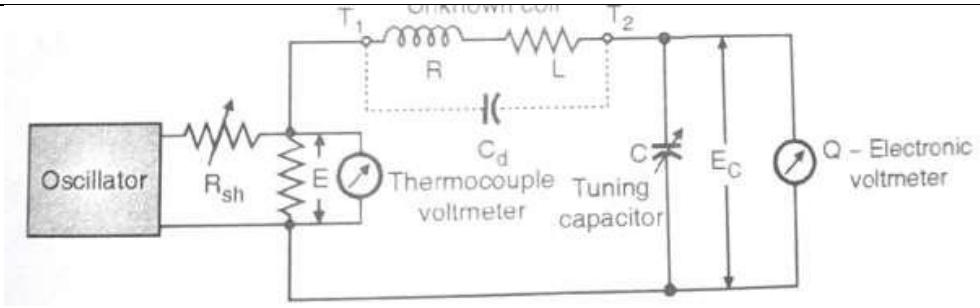
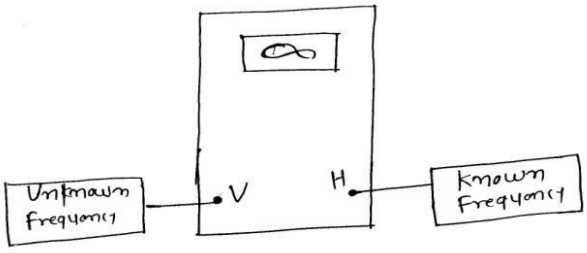
ramp capacitor linearly increases. When the positive ramp reaches maximum upper limit set by the circuit components, the Schmitt trigger changes its state.

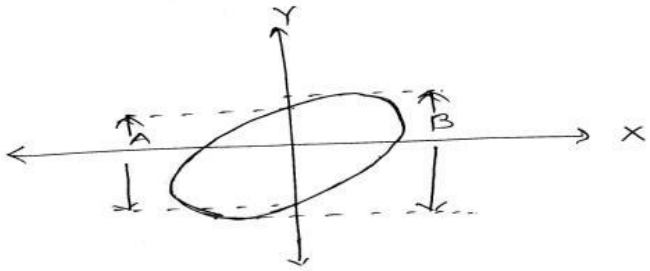
- The trigger circuit output become negative. The trigger circuit negative output changes the condition of the current control switch this make the capacitor to slowly discharge linearly. When the discharge ramp reaches the lower limit set by the circuit components the schematic trigger comes back to its original state. The trigger circuit output becomes positive and the condition of the current control switch again charges. This make the capacitor to charge by switching upper current source on.
- This process is a repetitive giving positive and negative pulses at a constant rate. The Schmitt trigger output is given to the trigger output circuit, 50 Ω and 600 Ω amplifiers. The trigger output circuit differentiates square wave output inverts the resulting pulse and provides positive trigger pulse. The generator can be synchronized to an external signal by triggering the circuit by an external synchronization pulse.

Q.6		**Attemptany four of the following**	**16 M**
	a)	**Define unit and give any two examples of base, supplementary and derived units.**	**4 M**
	Ans:	**Unit: -** The result of a measurement of a physical quantity must be defined both in kind and magnitude. The standard measure of each kind of physical quantity is called a Unit. (Any two relevant examples).	**Unit:1M & Each example:1 M**

Examples of Base units			
Sr. No	Unit	Name	Symbol
01	Length	Meter	M
02	Mass	Kilogram	Kg
03	Time	Second	S
04	Intensity of electric current	Ampere	A
Examples of Supplementary units			
01	Plane angle	radian	rad
02	Solid angle	steradian	sr
Examples of Derived units			
01	Area	Square meter	m^2
02	Volume	Cubic meter	m^3
03	Frequency	Hertz	Hz
04	Density	Kilogramme per cubic meter	Kg/m^3
05	Velocity	Meter per second	m/s^2

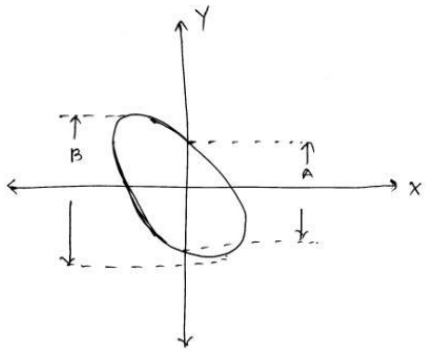
	b)	**State detailed classification of error**	**4 M**
	Ans:	1. **Static error** : The error which occurs in stationary condition is called as static error. These are classified as: i. **Gross errors**: the errors which occur due to human mistakes while taking reading, handling instrument incorrect setting 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 handing of instrument. ii. **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. a. **Instrumental error:** the errors which arise due to inherent shortcoming of instrument, misuse of instrument, loading effect of instrument are called as instrumental error. These errors can be removed by, selecting suitable instrument for particular application, selection of correct setting on the instrument, calibrating the instrument against standard, applying correction factor after the determination of instrumental error. b. **Environmental error**: these errors occur due to external condition to the measuring instrument, such as temperature, pressure, humidity, dust and external magnetic field. This error can be avoided by, keeping surrounding condition constant with the help of air conditioning, temperature control, enclosure, etc. and using proper magnetic shielding. c. **Observation error**: these are introduced by the observer. the most common error is the parallex error introduced in reading a meter scale. these error can be removed by taking reading carefully, using mirror scale and having the pointer and scale in same plane, and using digital 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.	**Each classification:1M**
	c)	**Draw neat electrical circuit diagram of Analog Multimeter.**	**4 M**
	Ans:		**Diagram:4 M**

	d)	**Describe the working of LCR meter with diagram.**	**4 M**
	Ans:	 **2. Measurement of inductance:** The value of f and c are known. So inductance can be found $f = \frac{1}{2\pi\sqrt{LC}}$ $\therefore L = \frac{1}{4\pi^2 f^2 C}$ f = Resonant frequency.	**Diagram:2 M & Explanation:2.M**
	e)	**Explain the process of phase measurement by Lissajous pattern.**	**4 M**
	Ans:	**Lissajous pattern for phase measurement:** When two signals are applied simultaneously to an oscilloscope without internal sweep, one to the horizontal channel and the other to the vertical channel, the resulting pattern is a Lissajous figure that shows a phase difference between the two signals. Such patterns result from the sweeping of one signal by the other. Figure shows the test setup for phase measurement by means of Lissajous figures.  Depending on the phase shift between the two signals, the shape of the Lissajous pattern will go on changing 1. The Lissajous pattern will be an ellipse if the sine waves of equal frequency but phase shift θ between 00 and 900 are applied to the two channels of CRO. The phase shift is given by, θ = sin-1 (A/B)	**Explanation:2M**

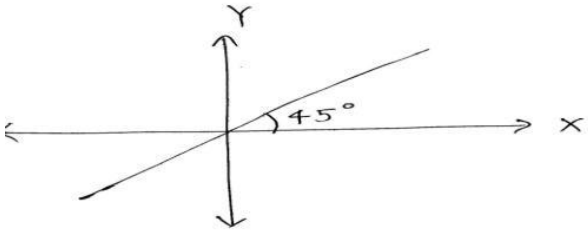


2. For phase difference above 900 and less than 1800, the ellipse appears. The phase shift is

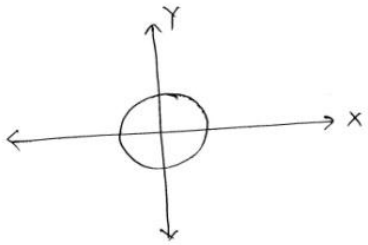
$\theta = 1800 - \sin^{-1}(A/B)$

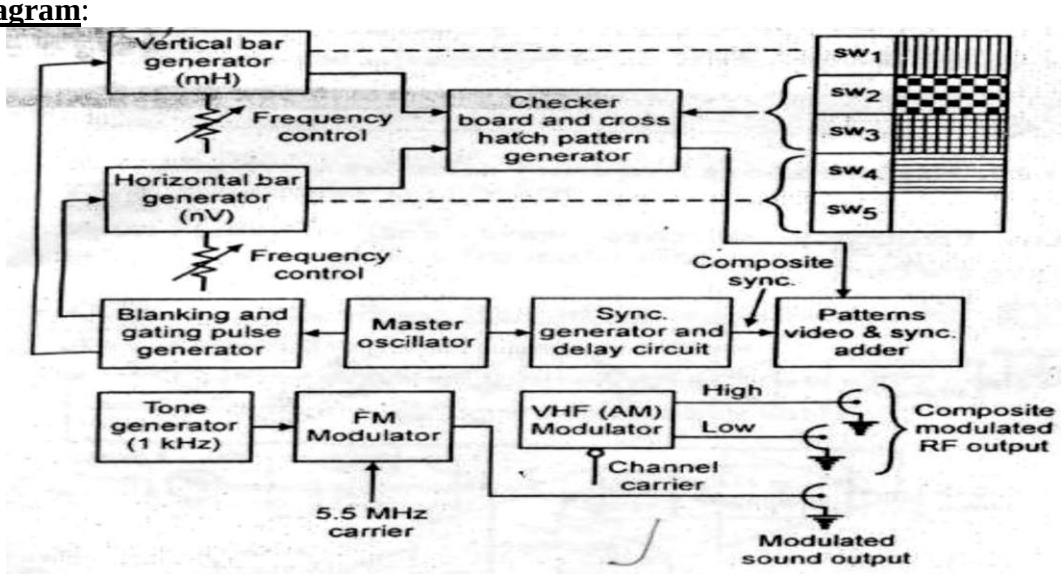


3. If the two sine waves are of same frequency are in phase, then Lissajous pattern will be a diagonal line making an angle of 450 with X- axis



4. If the phase angle $\theta = 900$, frequency is identical and amplitudes are equal of the two input sinusoidal signals, the Lissajous pattern will be a circle .



	f)	**Draw the block diagram of pattern generator. Explain generation of cross hatch pattern.**	**4M**
	Ans:	**Diagram**:  **Explanation:** There are two bar generators i.e. vertical and horizontal. • Each consists of stable chain of multivibrator, divider and pulse shaping circuits. • One if the chain, operates below the line frequency and produces series of horizontal bars. • Another chain works at frequency above 15.625 kHz and produces series of vertical bars. • These signals with long duration are converted to short pulses using appropriate circuitry. • These pulses in accordance with sync pulses produces fine line on TV screen. • A trigger signal generated by horizontal blanking pulse is given to multivibrator in vertical bar generator. • Then it produces square wave video signal which is m times horizontal frequency. • Hence it produces m vertical black and white bars. • Another multivibrator in horizontal bar generator is triggered by train of pulses derived from 50Hz main supply. • It generates square wave video signal which is n times vertical frequency and produces horizontal black and white bars. • The switches provided in between signal path of both multivibrator produces different patterns. • If both mH and nV switch are OFF a blank white raster is produced. • When only mH switch is ON, vertical bars are produced. • When only nV switch is ON, horizontal bars are produced. • When both mH & nV is ON, cross hatch pattern is generated.	**Diagram:2.5M & Explanation:1.5M**