SUMMER– 19 EXAMINATION

Subject Name :Electronic instruments & Measurements **Model Answer Subject Coc 17317**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.	Answers	Marking Scheme
1	**(A)**	**Attempt any SIX of the following:**	**12- Total Marks**
	(a)	**Define: (i) Accuracy** **(ii) Sensitivity**	**2M**
	Ans:	(i) **Accuracy:** It is the degree of closeness with which an instrument reading approaches the true value of the quantity being measured. (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 each**
	(b)	**List two advantages of PMMC instrument.**	**2M**
	Ans:	**Advantages of PMMC instrument.**	

		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.	**(1 Mark each for any two)**
	(c)	**State any four specifications of digital voltmeter.**	**2M**
	Ans:	DC Voltage – 1 Five voltage ranges from ±200 to ±1000 2 Accuracy is about ±0.03% 3 Resolution is about 10µV AC Voltage- 1. Five voltage range available for 200mV to 750V 2. Accuracy is dependent on frequency. Best accuracy obtained is 0.5%	**(1 Mark each for any two)**
	(d)	**List four applications of digital multimeter.**	**2M**
	Ans:	**Applications :** 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.	**1M each (any relevant answer can be considered**
	(e)	**List four applications 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 aero plane, 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)**
	(f)	**List four controls on front panel of dual trace CRO.**	**2M**
	Ans:	**(i)X-shift on CRO**: Controls the horizontal position of the display i.e moves the spot across the screen left and right. **ii) CT MODE Button on CRO**: To test different components **iii) Symmetry knob on function generator**: Select either positive pulse/ramp or negative pulse/ramp **iv) Level knob on function generator**: Determines where on the edge the trigger point occurs i.e. it's a Variable control, selects the trigger point on the displayed waveform. **v) V/div on CRO**: To control the gain/attenuation of vertical amplifier **vi) Mono/Dual Button on CRO**: In DUAL, operates as a DUAL trace scope in ALT or CHOP mode as selected.	**1M each (any relevant answer can be considered)**
	(g)	**List four specifications of function generator.**	**2M**
	Ans:	**Specifications:** 1. Output- Square wave , sine wave, Triangular, TTL pulse 2. Frequency Ranges- 0.1 Hz to 11 MHz, up/down range switchable in eight decade steps 3. Dial Range-1 to 11 calibrated 0.1 to 1 uncalibrated	**1 Mark each**

		4. Pulse and Ramp Aspect Ratio-95:5	
	(h)	**State any four applications of spectrum analyzer.**	**2M**
	Ans:	**Applications:** 1. Spectrum analyzer is a very important item of test equipment for someone designing or repairing electronic equipment that uses radio frequency signals. 2. Its key factor is that it is able to look at signals in the frequency domain 3. Spectrum analyzer generally is used to measure spectral purity of multiplex signals. 4. It also measure percentage of modulation of AM signals, and modulation characteristics of fm and pulse-modulated signals. 5. The spectrum analyzer is also used to interpret the displayed spectra of pulsed RF emitted from a radar transmitter. 6. Use for accurate total power measurements 7. Used to provide very accurate measurements of the dominant frequency within a signal 8. Used to measure the properties of RF devices	**(2 M for any four point)**
	(B)	**Attempt any TWO of the following:**	**08- Total Marks**
	(a)	**List the different types of errors and list out their sources.**	**4M**
	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. 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. • **Instrumental error**: the errors which arise due to inherent shortcoming of instrument, misuse of instrument, loading effect of instrument are called as	**1M-List 3M explanat**

		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. • **Observation error**: these are introduced by the observer. the most common error is the parallex error introduced in reading a meter scale. **iii. Random error**: these errors are due to unknown causes, these error remain since the systematic and gross error are removed, **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.	**ion**
	(b)	**Define the term standards ,state the type of standard.**	**4M**
	Ans:	**Standards**:-Standard is a physical representation of a unit of measurement. A known accurate measure of physical quantity is termed as standard. These standards are used to determine the values of other physical quantities by comparison method. 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.	**(Definition-1M, State-1M, Explanation-2M)**

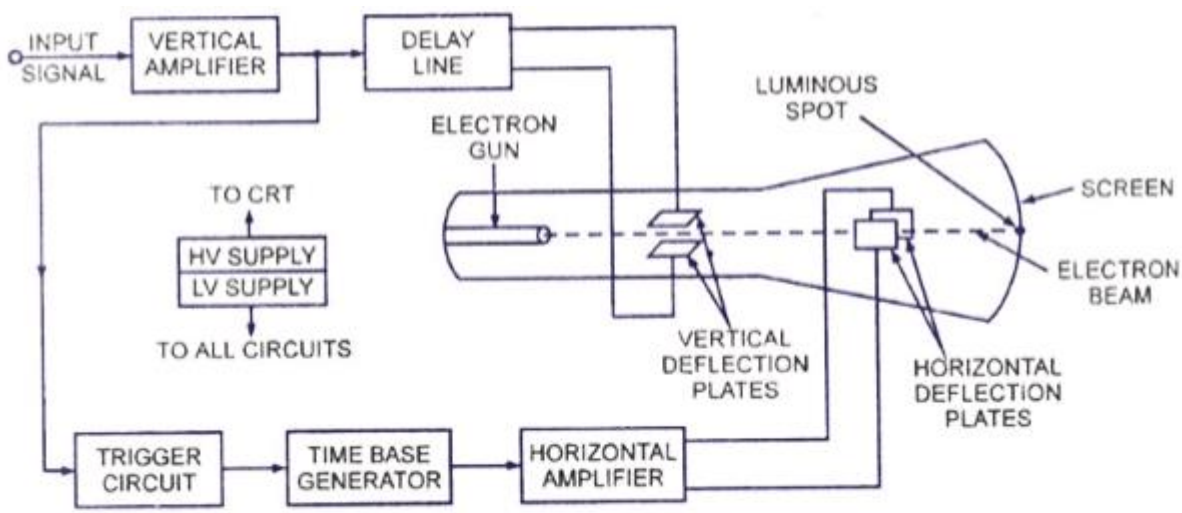
		3) Secondary standards These standards are also called as basic standards. These standards are used by industries and calibration laboratories. Each industry has its own laboratory. **4) Working standards** These standards are used in general laboratories. These standards are used to check components and calibrating laboratory instruments to achieve good accuracy and better performance.	
	(c)	**State any four precautions to be taken while using an Ammeter and Voltmeter.**	**4M**
	Ans:	**Precautions to be taken while using Ammeters**: Ammeters are to be connected in series of circuits. 1. While connecting ammeters across emf source always a series resistance should be used. This is necessary to limit the current passing through meter. 2. The polarity of the meter should be first observed & then it should be connected accordingly. The reverse polarity may damage the pointer of meter. 3. While using the multi range ammeter, first use highest current range & then go on decreasing range until good upscale reading obtained. **Precautions to be taken while using Voltmeters:** 1. The resistance of Voltmeter is very high & so while connecting Voltmeter, care should be taken that the Voltmeter is connected across (parallel) the circuit or component. 2. Polarity should be observed & connections should be accordingly made. 3. While using Voltmeter highest range should be used first &then range should be decreased.	**2M** **2M**

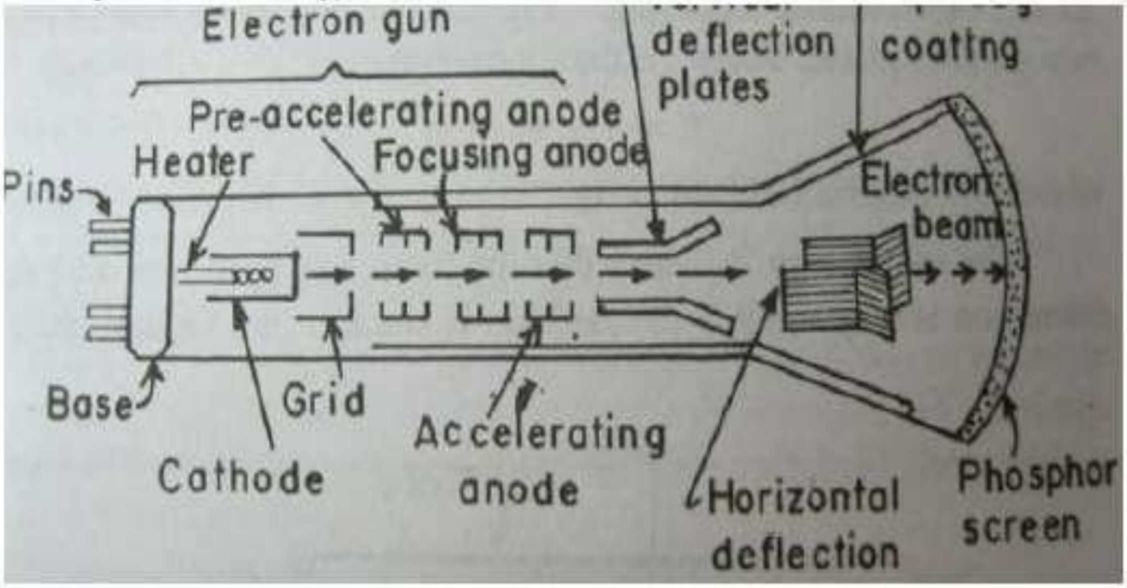
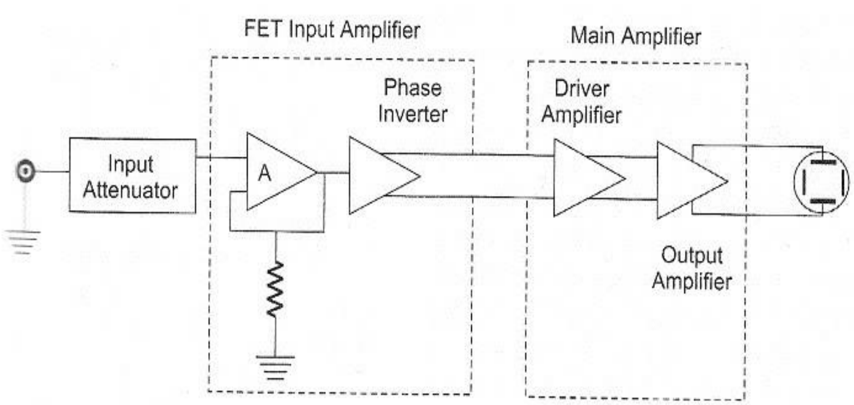
		4. Loading effect can be minimized by using high sensitivity	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any FOUR of the following::**	**16- Total Marks**
	(a)	**Define calibration of instruments. Explain why calibration is needed for measuring instruments.**	**4M**
	Ans:	**Calibration -** It is a process of estimating the value of a quantity by comparing that quantity with a standard quantity. **Need of calibration: -** Calibration defines the accuracy and quality of measurement recorded using a piece of equipment. Over time there is a tendency for result and accuracy to drift particularly using measuring particular parameters such as temperature and humidity. To be better result being measured there is an ongoing need to service and maintain the calibration of equipment throughout its lifetime for reliable, accurate and repeatable measurement. The aim of calibration is to minimize any measurement uncertainty by ensuring the accuracy of test equipment.	**02Marks For Definition** **02Marks for need**
	(b)	**Give any four points of comparison between dual trace CRO & dual beam CRO.**	**4M**
	Ans:	(see table below)	1 M for Each correct comparison any 4

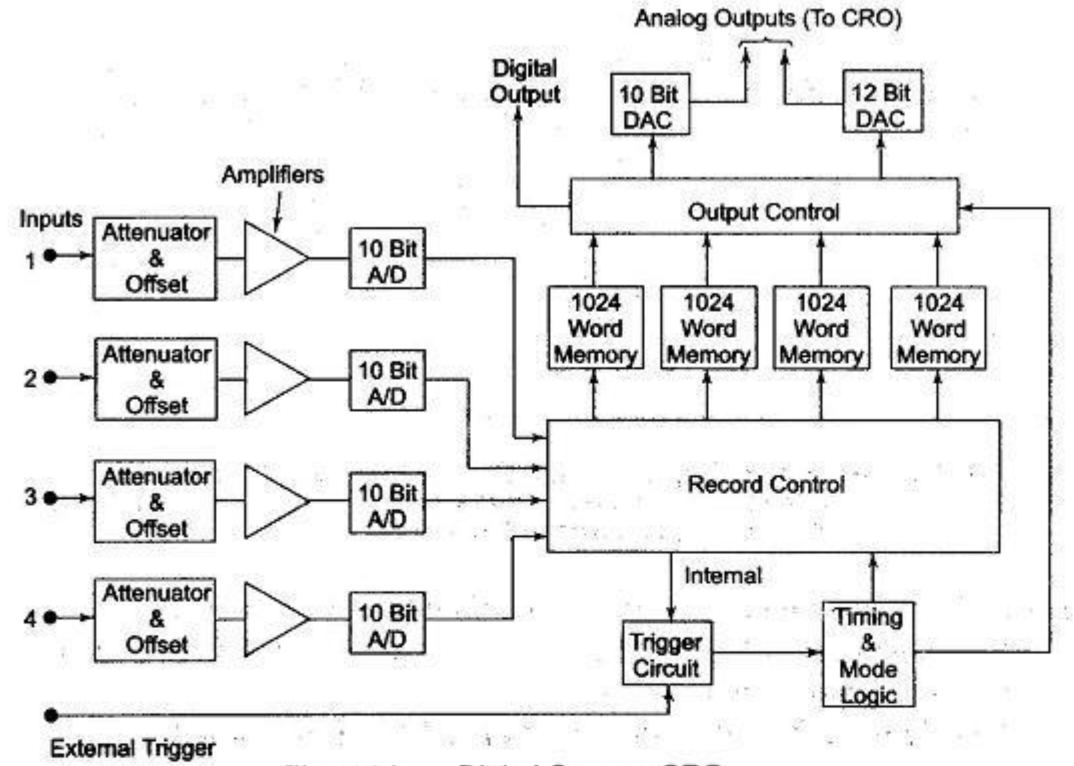
Sr.No	Single Beam Dual Trace CRO	Dual Beam Dual Trace CRO
1	A single electron beam is used to display two traces.	Two electron beams are used for displaying two traces/signals.
2	A single vertical amplifier is used.	Two vertical amplifiers are used for two beams.
3	The two signals may or may not have 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

(c)	**Sketch block diagram of single trace CRO. State function of delay line.**		4M
Ans:	 **Function of Delay line:** This block is used to delay the signal for a period of time in the vertical section of CRT. The input signal is not applied directly to the vertical plates because the part of the signal gets lost, when the delay time is not used. Therefore, the input signal is delayed by a period of time.		**(Block Diagram 3M function 1M)**
(d)	**Draw labelled diagram of CRT.**		**4M**
Ans:	**labelled diagram of CRT:**		**4M**

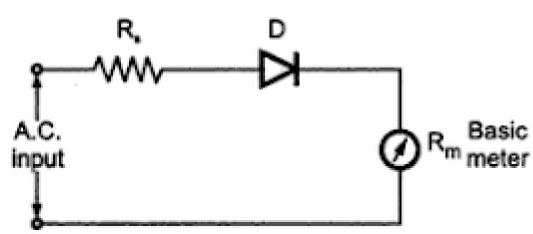
			
	(e)	**Explain vertical deflection subsystem with neat diagram.**	**4M**
	Ans:	 **vertical deflection subsystem** The main function of the vertical deflection system is to provide an amplified signal of prope r level toderive the vertical deflection plates without any distortion. For amplification of the signal to appropriate level, it uses the vertical amplifier. Figure shows the block diagram of th e vertical amplifier.	**Daigram -2M Explaina tion 2M**

		The vertical amplifier consists of a number of stages having fixed overall sensitivity or gain which is expressed in volts / division. Because of fixed gain the amplifier can designed in a manner such that it meets the requirements of stability and bandwidth. The input stage of the preamplifier consists of an FET source follower. The FET source follower has high input impedance. This impedance is isolated the FET amplifier from the attenuator. The FET source follower input stage is followed by a BJT emitter follower .this is done in Order to match the medium impedance of the FET amplifier with low input impedance of the phase inverter. Two antiphase output signals are provided by the FET amplifier, in order to derive the push-pull amplifier output. The push pull out put stage delivers equal signal voltage of opposite polarities to the vertical deflecting plates of the CRT. The advantages of using push-pull stage at the output are better hum cancellation, even harmonic suppression, reduced nonlinear effects because none of the plates are at ground potential.	
	(f)	**Draw block diagram of digital storage oscilloscope.**	**4M**
	Ans:	**block diagram of digital storage oscilloscope.**	**4M**

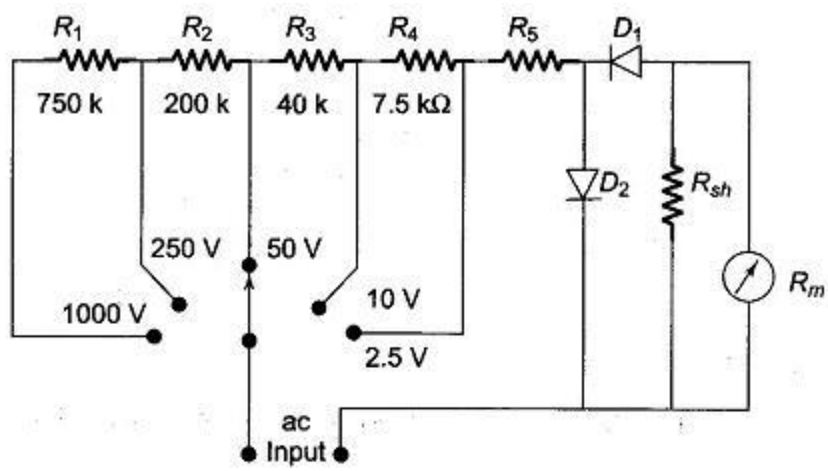


block diagram of digital storage oscilloscope.

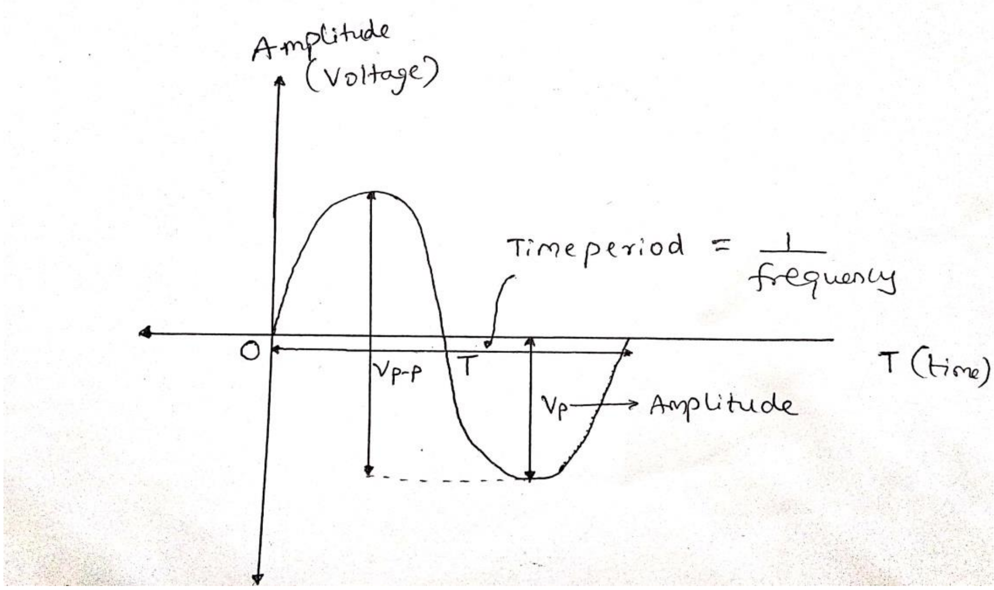
Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any FOUR of the following:**	**16- Total Marks**
	(a)	**List four dynamic characteristics of instruments. Define any two of them.**	**4M**
	Ans:	Dynamic characteristics of instruments are: 1. Speed of response 2. Fidelity 3. Lag 4. Dynamic error.	**(list any four 2M, definition any two 1 M**

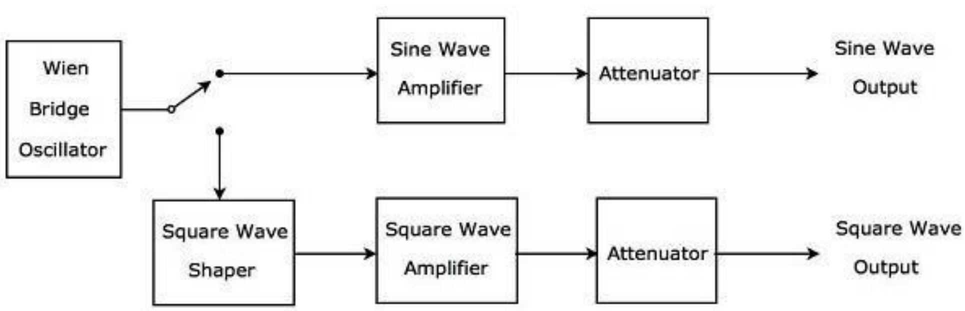
		Definition: **1. Speed of response:** The rapidity with which instrument responds to make changes in the measured quantity is called as speed of response. **2. Fidelity:** The degree to which instrument indicates the change in measured variable without dynamic error is called as fidelity. **3. Lag:** The retardation on delay in the response of an instrument to make the change in measure quantity is known as lag. **4. Dynamic error:** The difference between the true value of a quantity changing with time and the value indicated by the instrument if no static error is assumed is called as dynamic error.	**each)**
	(b)	**Describe working of A.C. voltmeter using half wave rectifier with neat circuit diagram.**	**4M**
	Ans:	**AC Voltmeter using Half Wave Rectifier :** The a.c. voltmeter using half wave rectifier is achieved by introducing a diode in a basic d.c. voltmeter. This is shown in the Fig. 1.  **Fig. 1 A.C. voltmeter using half wave rectifier** The diode D conducts only during positive half cycle. Let us compare the sensitivities of d.c.	**1M for Circuit dgm**

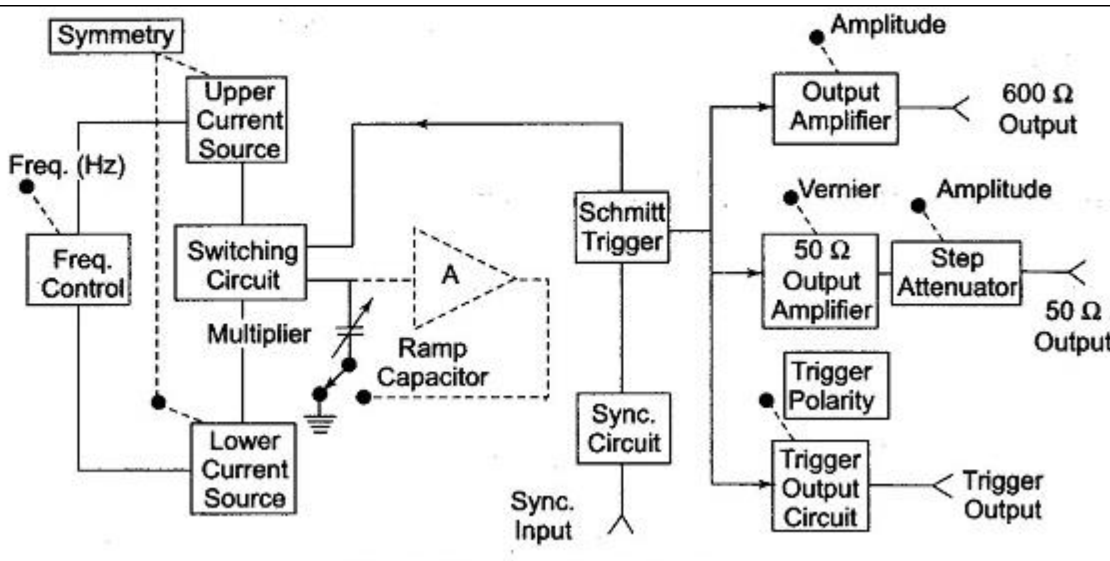
		and a.c. voltmeters. The sensitivity of d.c. voltmeter is, $S_{d.c.} = \frac{1}{I_{fsd}}$ Let I_{fsd} be 1 mA, hence the sensitivity becomes 1 kΩ /volt. The series resistance R_s is 10 kΩ hence the 10 V d.c.input would cause exactly the full scale deflection, when connected with prpoper polarity. Let purely sinusoidal input of 10 V r.m.s is applied. $\therefore \quad E_{rms} = 10 \text{ V}$ $\therefore \quad E_p = \text{Peak value} = \sqrt{2}\, E_{rms}$ $= 14.14 \text{ V}$ Now the rectified d.c. is pulsating d.c. hence meter will deflect proportional to the average value. . $\therefore \quad E_{av} = 0.636\, E_p = 8.99 \text{ V}$ But the diode conducts only for half cycle and meter movement is bypassed for another cycle. Hence it responds to half the average value of the a.c. input. $\therefore \quad E_{av} = \frac{8.99}{2} \approx 4.5 \text{ V}$ Thus pointer will deflect for full scale if 10 V d.c. is applied and 4.5 V when 10 V r.m.s. sinusoidal input is applied. **Note**: Thus the a.c. voltmeter is less sensitive than d.c. voltmeter.	**3M for working**

		$\therefore \quad \boxed{E_{dc} = 0.45\ E_{rms}}$ Thus the value of series multiplier can be obtained for a.c. voltmeter as, $R_s = \frac{E_{dc}}{I_{dc}} - R_m$ $\therefore \quad \boxed{R_s = \frac{0.45E_{rms}}{I_{dc}} - R_m}$ Where I_{dc} is the full scale deflection current..	
	(c)	**Draw the circuit diagram of multi range AC voltmeter and describe its working**	**4M**
	Ans:	Fig. 4.22 Multirange ac Voltmeter The above circuit looks like a multi range AC voltmeter. We know that, we will get AC voltmeter just by placing rectifier in series (cascade) with DC voltmeter. The above circuit was created just by placing the diodes combination and resistor, R6in between resistor, R5 and PMMC galvanometer.	**2M for Circuit diagram)** **(2M for working)**

		We can measure the AC voltage across any two points of an electric circuit, by connecting the switch, S to the desired voltage range.	
	(d)	**Explain how CRO is used for measurement of frequency & amplitude with suitable diagram**	**4M**
	Ans:	**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. $Period=Number\ of\ divisions\ \times po\ sition\ of\frac{time}{div}knob$ The frequency is inversely proportional to the period. $Frequency=\frac{1}{period}$	**(3M for explanation & 1M for diagram)**



	(e)	**Draw block diagram of AF sine and square wave generator and explain its working**	**4M**
	Ans:	The AF signal generator, which generates either sine wave or square wave in the range of audio frequencies based on the requirement is called AF Sine and Square wave generator. Its block diagramis shown in below figure.  The above block diagram consists of mainly **two paths**. Those are upper path and lower path. Upper path is used to produce AF sine wave and the lower path is used to produce AF square wave. **Wien bridge oscillator** will produce a sine wave in the range of audio frequencies. Based on	**(2M for diagram)**

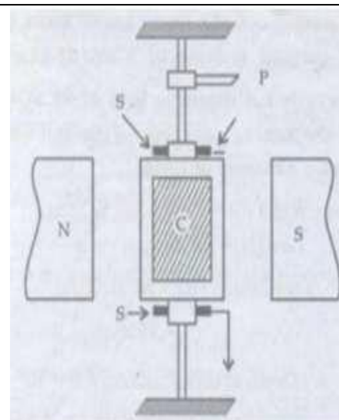
		the requirement, we can connect the output of Wien bridge oscillator to either upper path or lower path by a switch. The upper path consists of the blocks like sine wave amplifier and attenuator. If the switch is used to connect the output of Wien bridge oscillator to upper path, it will produce a desired **AF sine wave** at the output of upper path. The lower path consists of the following blocks: square wave shaper, square wave amplifier, and attenuator. The square wave shaper converts the sine wave into a square wave. If the switch is used to connect the output of Wien bridge oscillator to lower path, then it will produce a desired **AF square wave** at the output of lower path. In this way, the block diagram that we considered can be used to produce either AF sine wave or AF square wave based on the requirement.	**(2M for working)**
	(f)	**Describe working of pulse generator with proper block diagram**	**4M**
	Ans:	 Block Diagram of a Pulse Generator **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	**(2M for block diagram)** **(2M for working)**

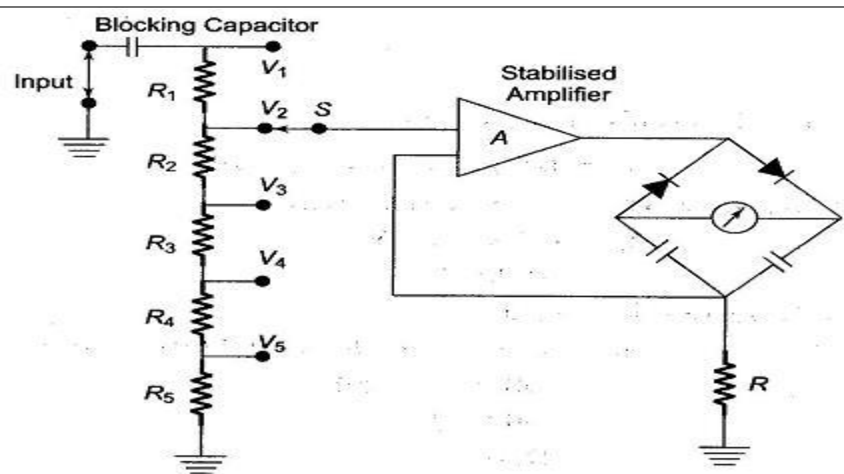
switching circuit. The two current sources provide a constant current to a ramp capacitor, so that the capacitor can be charged and discharged.

- 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.

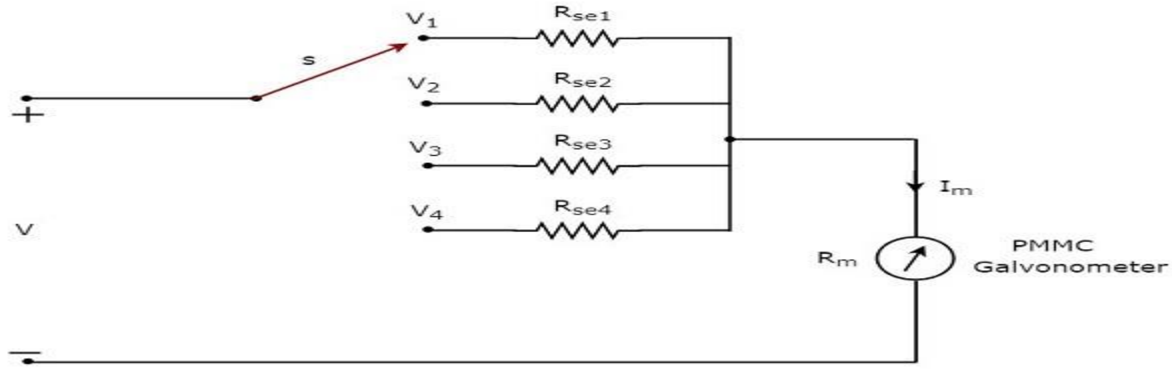
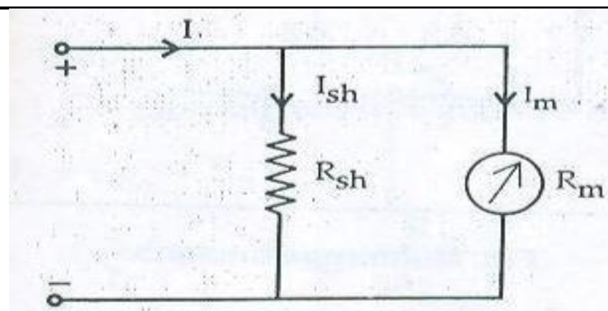
SUMMER– 19 EXAMINATION

Subject Name :Electronic instruments & Measurements **Model Answer Subject Co[illegible]** 17317

Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any FOUR of the following::**	**16- Total Marks**
	(a)	**Draw the diagram of PMMC instrument and state the deflection torque equation**	**4M**
	Ans:	 Fig: PMMC Instrument **Equation** Ţ= B*A*I*N Where r= torque Newton. Meter B = flux density in the air gap. Wb/m2 A = effective coil area (m) N= number of turns of wire of the coil	**2M** **2M**
	(b)	**Describe following terms w.r.t. Analog voltmeter :** **(i) Sensitivity** **(ii) Loading effect**	**4M**
	Ans:	**Sensitivity:** The sensitivity of a voltmeter is just its capability to detect voltage, usually meaning smaller and smaller voltages. When selecting a meter for a certain voltage measurement, it is important to consider the sensitivity of a dc voltmeter, A low sensitivity meter may give a correct reading when measuring voltage in a low resistance circuit. but it is certain to produce unreliable readings in a high resistance circuit.	**2M**

		Loading Effect: The voltmeter is always connected across the two points between which the potential difference is to be measured. If it is connected across a low resistance then as voltmeter resistance is high, most of the current will pass through a low resistance and will produce the voltage drop which will be nothing but the true reading. But if the voltmeter is connected across the high resistance then due to two high resistances in parallel, the current will divide almost equally through the two paths. Thus the meter will record the voltage drop across the high resistance which will be much lower then the true reading. Thus the low sensitivity instrument when used in high resistance circuit gives a lower reading then the true reading. This is called loading effect of the voltmeters. It is mainly caused due to low sensitivity instruments.	**2M**
	(c)	**Draw and explain construction diagram of average responding voltmeter.**	**4M**
	Ans:	 **Fig. 4.23** Block Diagram of Average Responding Voltmeter **Explain:** The basic construction of average responding voltmeter is shown in above fig. at the input side of an unknown voltage to be measured is applied. The blocking capacitor is used to block dc signals entering into the amplifier. A high stabilized amplifier is used to provide the amplification action. One terminal of high stabilized amplifier is connected to the	**2M for construction diagram** **2M for explaination**

		attenuator network. This attenuator network is constructed by using five resistors R1 to R5. The other terminal of high stabilized amplifier is connected to the feedback path. The DC millimeter is used as indicating meter. This meter is calibrated in terms of rms value. This meter is connected in the bridge circuit. The bridge circuit consists of two diodes and two capacitors.	
	(d)	**Design multi range DC ammeter with R_m = 50 Ω , I_m= 1 mA for current ranges (i) 0-20 mA (iii)0-100 mA**	**4M**
	Ans:	given: → $R_m = 50\Omega$, $I_m = 1mA$, Range (i) 0 − 20 mA (ii) 0 − 100 mA. consider, $I_1 = 20mA$, $I_2 = 100mA$. $R_{SH_1} = ?$, $R_{SH_2} = ?$ $m_1 = \frac{I_1}{I_m} = \frac{20mA}{1mA} = 20$. $R_{SH_1} = \frac{R_m}{(m_1 - 1)} = \frac{50}{(20-1)} = 2.63\Omega$ $m_2 = \frac{I_2}{I_m} = \frac{100mA}{1mA} = 100$. $R_{SH_2} = \frac{R_m}{(m_2 - 1)} = \frac{50}{(100-1)} = 0.505\Omega$	**1M** **1M** **1M** **1M**
	(e)	**Explain range extension for analog DC voltmeter.**	**4M**
	Ans:	**Explanation**	**2M** **2M**

		 A DC voltmeter can be converted into a multirange voltmeter by connecting a number of resistors (multipliers) in series with the meter movement	
	f)	**Sketch the circuit of basic DC ammeter , derive equation for shunt resistance.**	4M
	Ans:	 **Derivation** **The basic movement of dc ammeter circuit consists of D' Arsonval galvanometer.** • **When large current is to be measured then some extra modification is required.** • **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 coil winding of basic movement is small and light therefore it carries very small current.**	2M 2M

		The voltage across the shunt and movement must be same. $V_{sh} = V_m$ $I_{sh}R_{sh} = I_mR_m$ $R_{sh} = I_mR_m/I_{sh}$ $R_{sh} = I_mR_m/(I-I_m)$	
Q. No.	**Sub Q. N.**	**Answers**	**Marking Scheme**
5.		**Attempt any FOUR of the following:**	**16- Total Marks**
	a)	**Define Lissajous pattern. Explain how Lissajous pattern is useful for frequency and phase measurement.**	**4M**
	Ans:	**Lissajous Pattern :** The CRO is set to operate in the X- Y mode, when two sine waves of the same frequency are applied to the CRO (One vertical and one horizontal deflection plates) then the display obtained on the screen of a CRO is called Lissajous pattern. **Phase measurement :** The phase shift is given by, Ɵ = 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	**(1M for def)** **(3M for any one eg.offreq& phase measurement)**

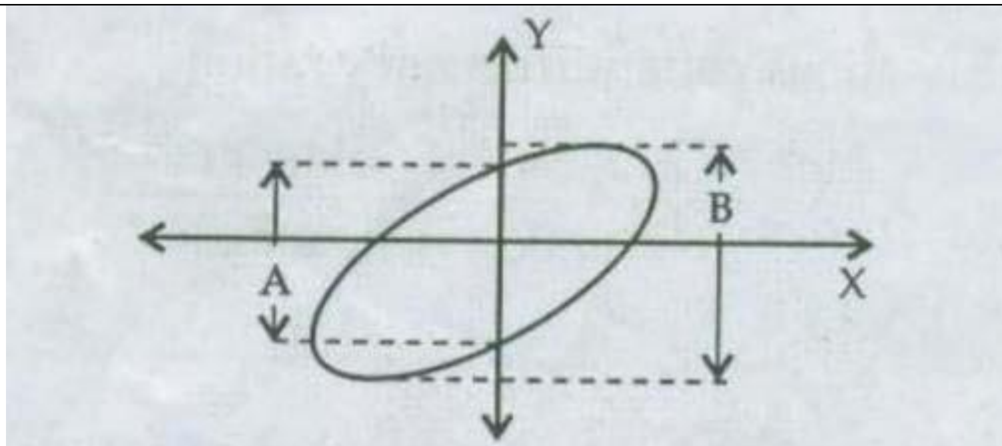
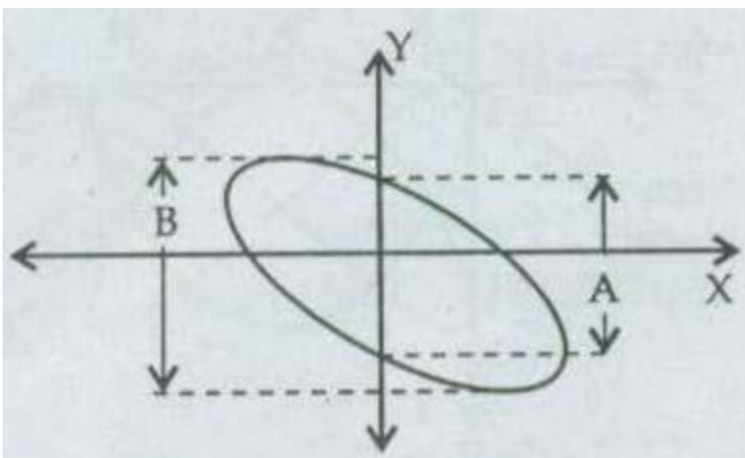
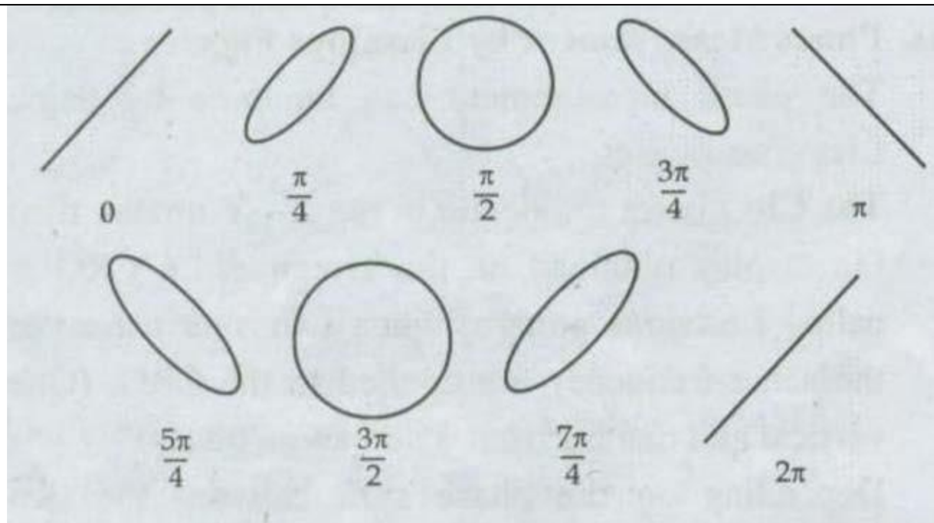


Fig. Lissajous pattern for ellipse for $0° < \theta < 90°$

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



Frequency measurement :

Lissajous pattern can be used for measurement of unknown frequency.

Initially switch ON the CRO on X-Y mode. The unknown frequency signal is applied to the vertical deflection plates of the CRO (Channel Y) and standard known variable frequency signal is applied to the horizontal deflection plates (channel X).

The frequency of the standard source is adjusted now, until a circular or elliptical pattern appears on the CRT screen. When such a pattern is observed on the screen, it indicates that the two frequencies are equal.

Practically, it is not possible to adjust the standard frequency exactly equal to unknown frequency. Hence the standard frequency is adjusted to be a multiple or sub- multiple of the unknown frequency. The Lissajous pattern appears stationary

Consider two sine waves are applied to Y plate and X plate of the CRO.

The frequency applied to Y plate is twice that applied to the X plates. The Lissajous pattern obtains is shown in figure.

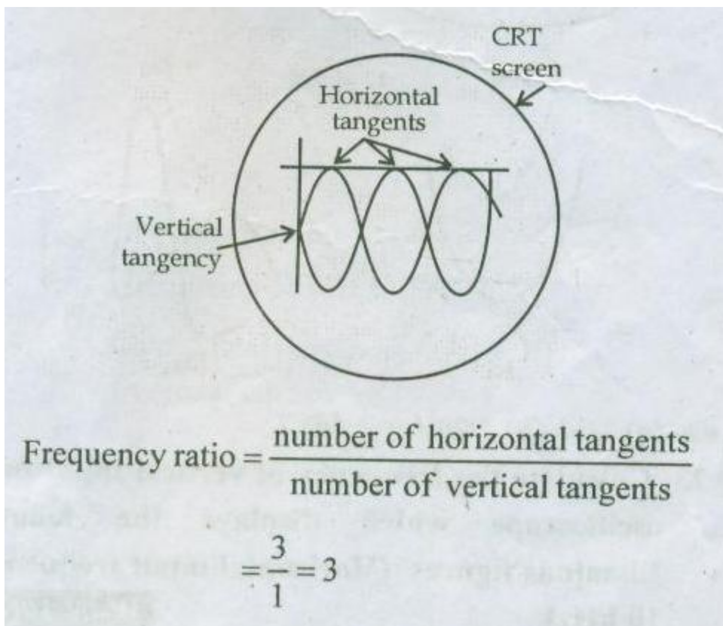
The figure ratio is given by,

fy = number of horizontal tangents

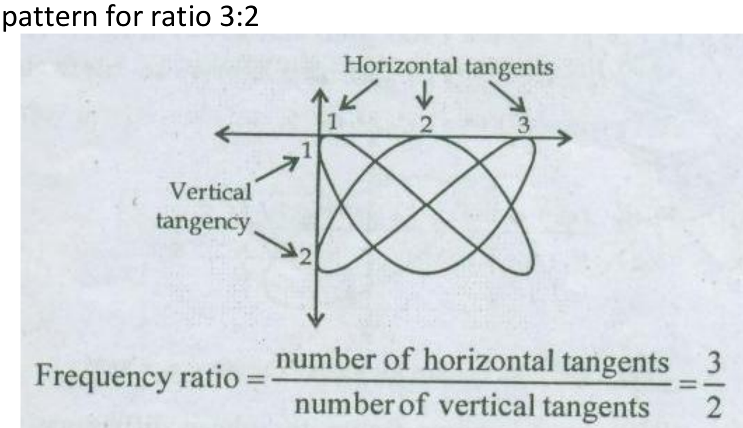
fx number of vertical tangents

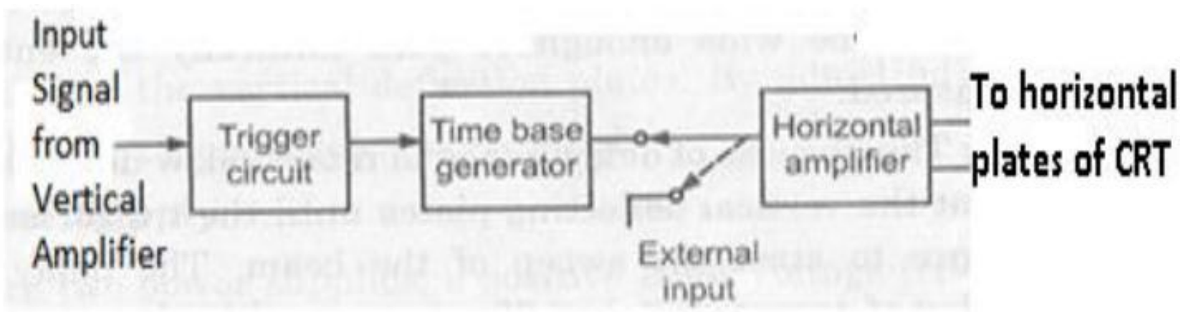
Some examples are given below,

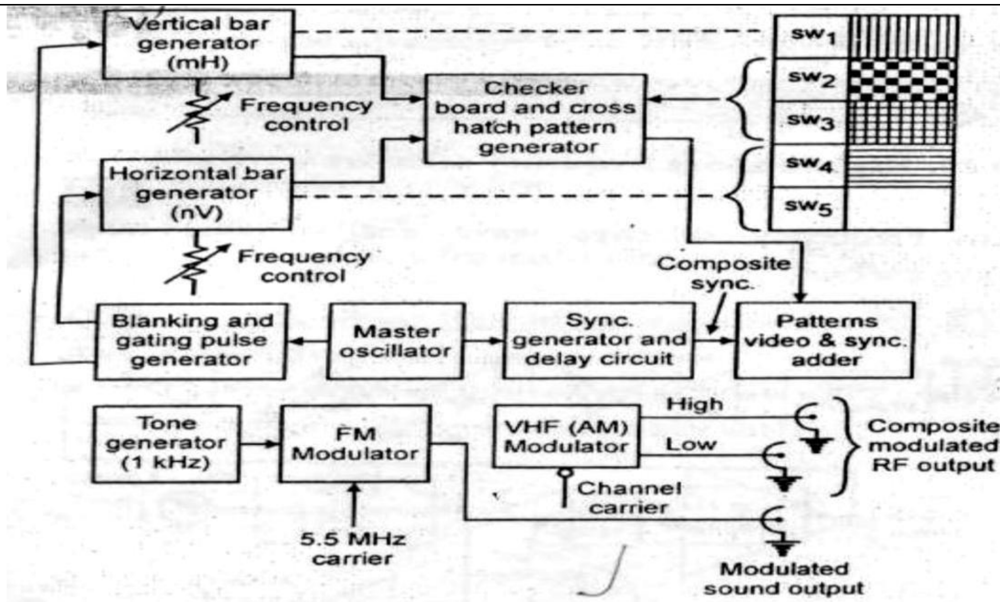
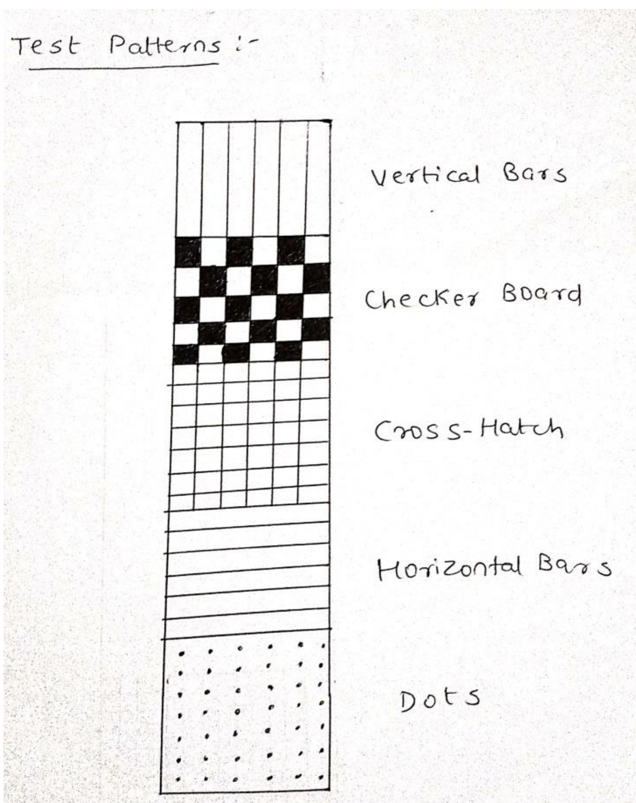
1. Lissajous pattern for ratio 3:1

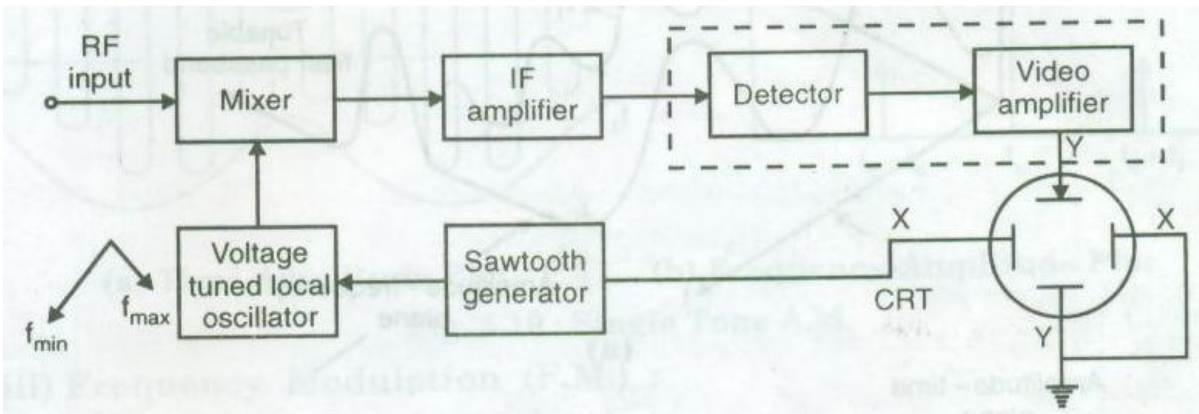


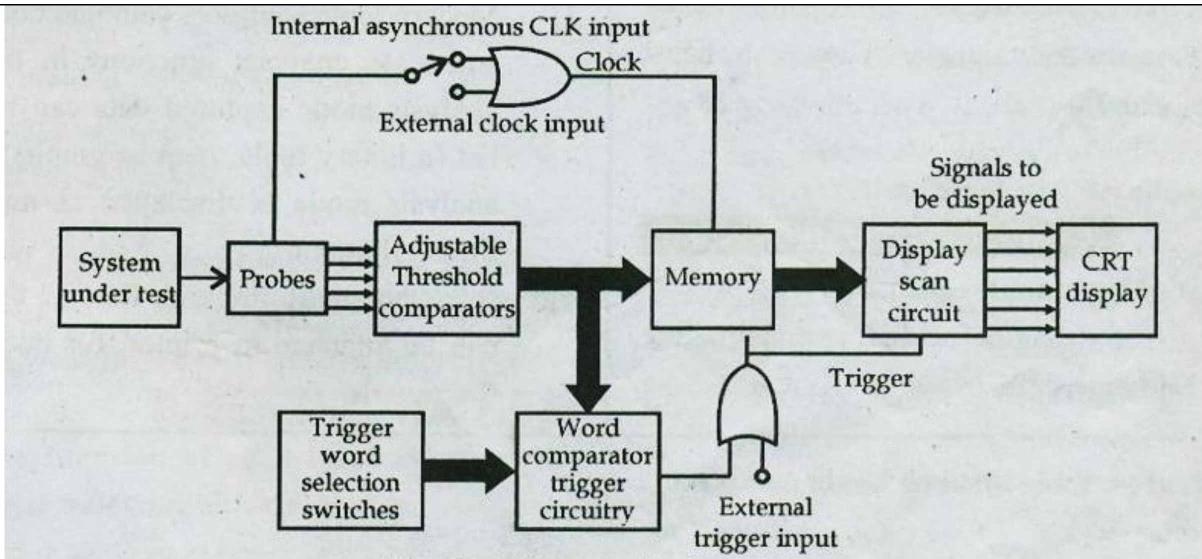
2. Lissajous pattern for ratio 3:2

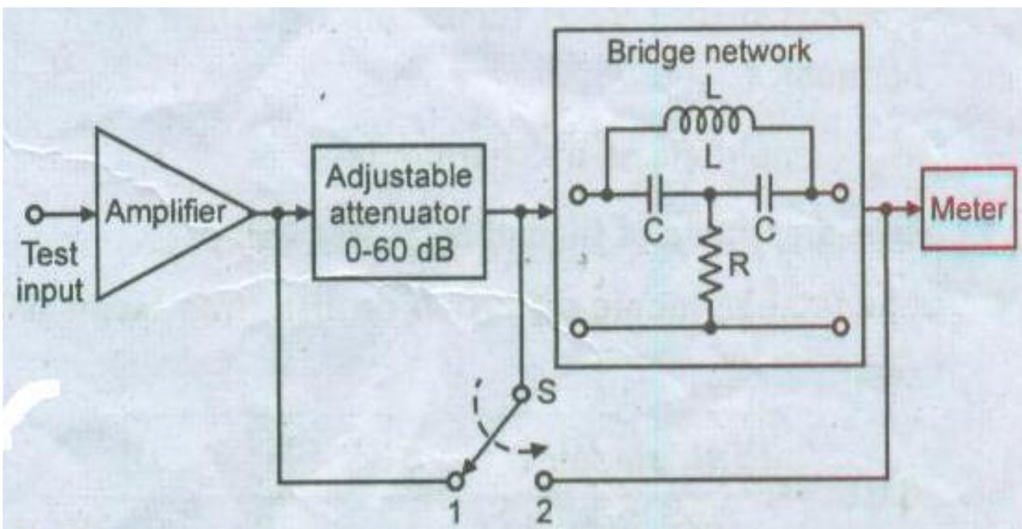


	b)	**Draw and describe horizontal deflection system in CRO**	**4M**
	Ans:	**Block Diagram:**  **Explanation:** Input from vertical amplifier is given to Horizontal system. **Trigger circuit:** a. A trigger circuit is used to convert the incoming signal into trigger pulses, so that the input signal and the sweep frequency can be synchronized. b. 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. 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.	**(Block dgm-2M)** **(2M for explanation)**
	c)	**Sketch block diagram of pattern generator and draw any four test patterns**	**4M**
	Ans:	**Block Diagram of Pattern Generator:**	

			(2M for Block diagram)
		Test patterns of Pattern Generator: (any four) 	(2M for test patterns)

	d)	**Describe block diagram of spectrum analyzer and explain its working**	**4M**
	Ans:	 **Fig: Block Diagram of Spectrum analyzer.** 1. Spectrum analyzer consists of voltage tune oscillator, mixer, IF amplifier, detector, video amplifier, sweep generator and CRT. 2. The input signal applied to the circuit is used with oscillator signal, produces two different frequencies called intermediate frequency. 3. 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. 4. The IF signal is then amplified by IF amplifier for further processing. 5. The information is signal is detected by detector and further amplified by video amplifiers. Then these signals are fed to the vertical deflecting plate of CRT. 6. The sawtooth waveform also supply signal to horizontal deflecting plates after the amplification. 7. The CRT produces amplitude versus frequency waveform on the screen. 8. In this type the signal are broken down into their individual frequency component.	**(2M for block diagram)** **(2M for explanation)**

	e)	**Explain function of each block of logic analyzer with proper block diagram**	**4M**
	Ans:	 **Fig. Block diagram of logic Analyser** **Explanation:** • 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 receiving 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.	**(2M for block diagram)** **(2M for explanation)**

		• 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.	
	f)	**Explain block diagram of distortion factor meter and explain how it operates**	**4M**
	Ans:	 Fig. Distortion factor meter **Working** : • 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.	**(2M for diagram)** **(2M for working)**

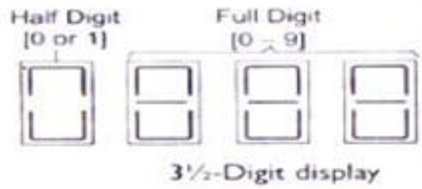
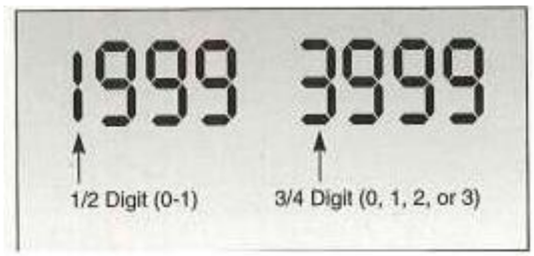
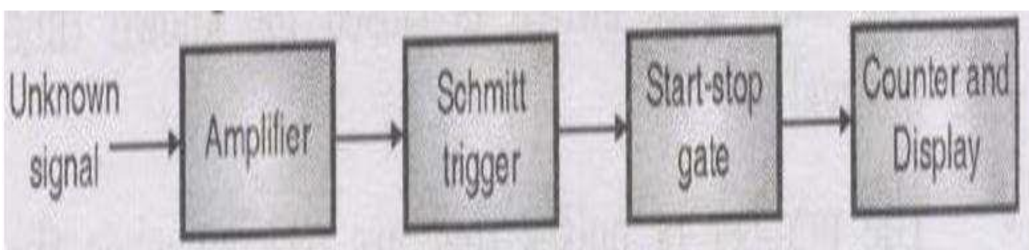
Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any FOUR of the following::**	**16- Total Marks**
	a)	**Compare analog instruments with digital instruments.(Any four points)**	**4M**
	Ans:	(table below)	**1M each**

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.

Q. No.	Sub Q. N.	Answers	Marking Scheme
	b)	**State significance of ½ digit with an example**	**4M**
	Ans:	The number of digit position in a digital meter determine the resolution. ½ digit has a maximum value of 1 and has 2 possible conditions (0 or 1). Hence 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 m V. Normally, a fourth digit capable of indicating 0 or I (Hence called a half digit) is placed to the left. This permits the digit meter to read values above 999 up to 1999, to give overlap between ranges for convenience, a process called over ranging.	2 M for explanation 2M example (Diag.)

SUMMER– 19 EXAMINATION

Subject Name :Electronic instruments & Measurements Model Answer Subject Code: 17317

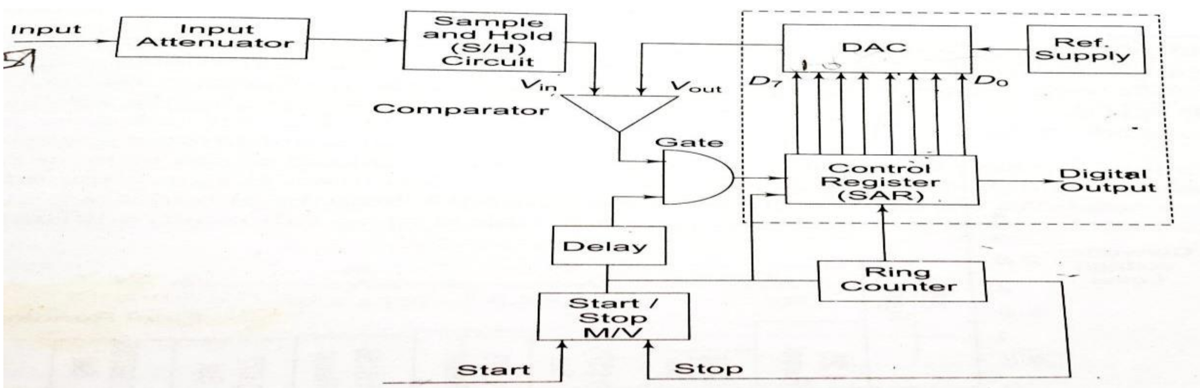
		 OR 	
	c)	**Draw block diagram of frequency meter and state it's principle of operation**	**4M**
	Ans:	**Block diagram**  **Principle** The signal may be amplified before being applied to the Schmitt trigger. The Schmitt trigger converts the input signal into a square wave with fast rise and fall times, 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	**2M** **2 M**

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,

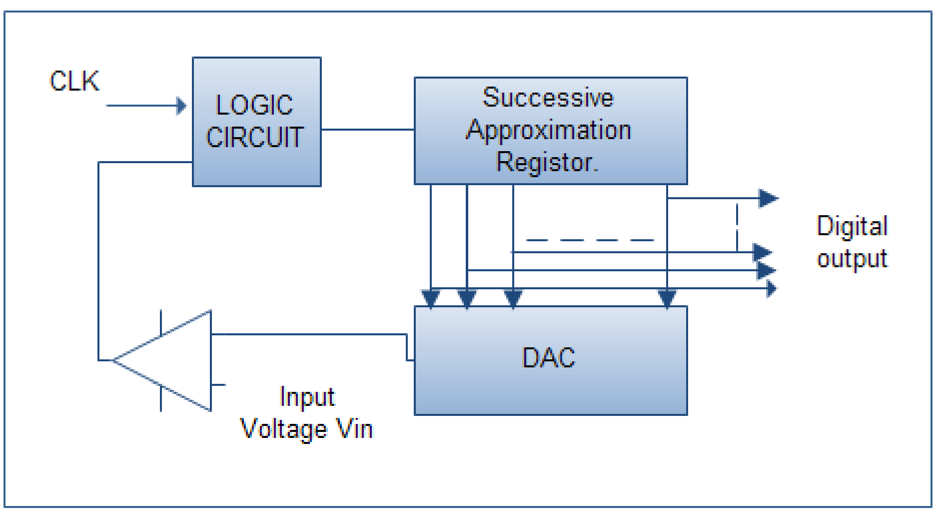
f = N / t

d) **Draw block diagram of successive approximation digital voltmeter. State its two advantages and two disadvantages** **4M**

Ans: **Block diagram** **2M**



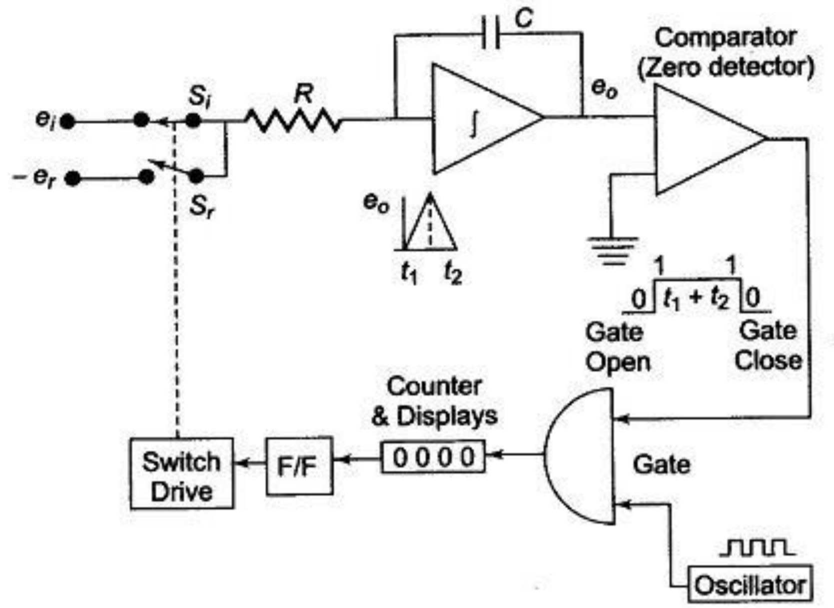
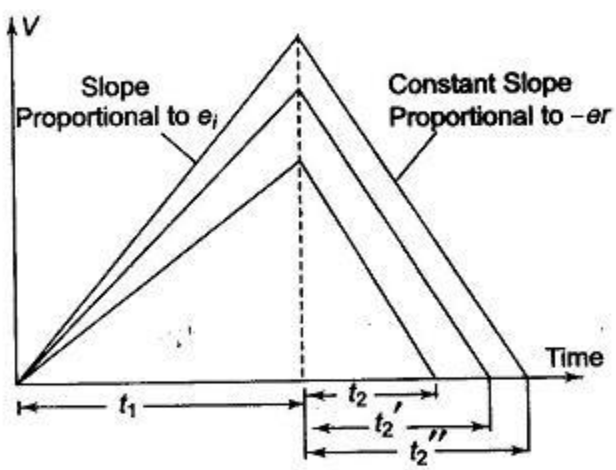
Or

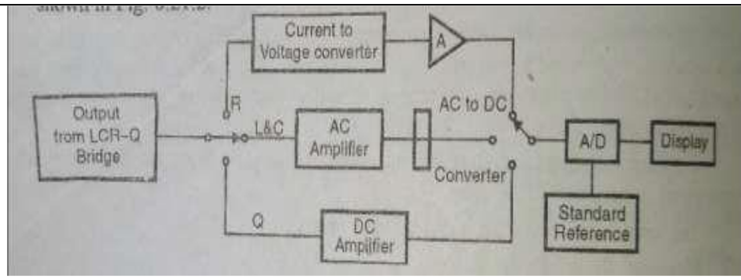


Advantages:

- It is economical method of analog to digital conversion.

		○ The resolution is up to 5 important digits are obtained. **Disadvantages:** ○ Incorrect reading is obtained when the noise signal is occurred. ○ The filter is used to reduce the noise signal which also reduces the total speed of operation. ○ The accuracy of the whole system is depends on accuracy of digital to analog converter and accuracy of internal reference supply. ○ The speed of operation is restricted. The speed is depends on which type of switches are used. ○ The conversion time required for digital to analog converter.	**1M** **1M**
	e)	**Draw block diagram of Dual slope integrating voltmeter and also draw waveform for voltage V/s time.**	**4M**
	Ans:	**Block diagram**	**2M**

		 **Fig. 5.4** Block Diagram of a Dual Slope Type DVM **Waveform**  **Fig. 5.3** Basic Principle of Dual Slope Type DVM	**2M**
	f)	**Draw block diagram of digital LCR –Q meter and explain its working.**	**4M**
	Ans:	**Block diagram**	**2M**

		 **Working** **The output of LCR-Q meter is given to current to voltage converter, AC amplifier or DC amplifer depending upon position of switch** **Current to voltage converter converts current into voltage , the output is given to amplifer .** **Ac amplifier amplifies analog input and then it is given to ac to dc converter .** **The ouput of dc amplifier is given to A/D converter.** **A/D converter converts analog signal into digital output andfinaaly displayed on display.**	**2M**