Important Instructions to examiners:

1) The answers should be examined by keywords 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.	Question & its Answer	Rema-rk	Total Marks
Q.1A	**Attempt any six**		**12**
a)	**Define Resolution and Dead Zone.**		**02**
Ans.	**Resolution: -** Resolution is the least incremental value of input or output that can be detected, caused or otherwise discriminated by the measuring device **OR** It is the smallest change in the measured value to which the instrument will respond. **Dead Zone: -** The largest range of values of a measured variable to which the instrument does not respond.	**01 mark** **01 mark**	
b)	**What is loading effect of multirange voltmeter?**		**02**
Ans.	When selecting a meter for a certain voltage measurement, it is important to consider the sensitivity of a dc voltmeter. A low sensitivity meter gives a correct reading when measuring voltages in a low resistance circuit, but it is certain to produce unreliable readings in a high resistance circuit. A voltmeter when connected across two points in a highly resistive circuits, acts as a shunt for that portion of the circuit, reducing the total equivalent resistance of that portion. The	**02 marks**	

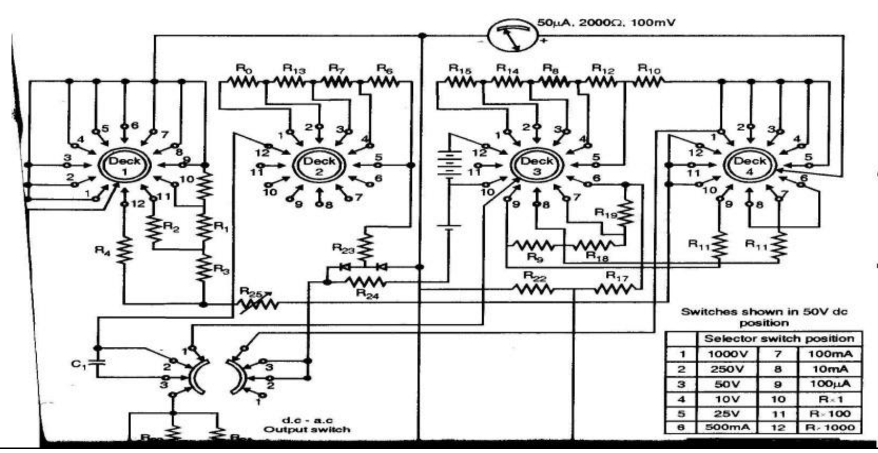
	meter then indicates a lower reading than what existed before the meter was connected. This is called the loading effect of an instrument.		
c)	**State any two advantages of digital instruments over analog instruments.**		**02**
Ans.	**advantages of digital instruments over analog instruments:** 1. They are having high input impedance, so there is no loading effect 2. They are having higher accuracy 3. An unambiguous reading is obtained 4. The output can be interfaced with external equipment 5. They are available in smaller size	**01 mark each (any two)**	
d)	**Define Accuracy in Digital Meters.**		**02**
Ans.	**Accuracy** - It is the degree of closeness with which an instrument reading approaches the true value of the quantity being measured.	**02 marks**	
e)	**State the function of delay line in CRO**		**02**
Ans.	The delay line is used in CRO to delay the signal for some time in the vertical sections. As horizontal channel consists of trigger circuit and time based generator. this causes more time to reach signal to horizontal plates than vertical plates. For synchronization of reaching input signal at same time to both the plates in CRT.	**02 marks**	
f)	**Define deflection sensitivity and deflection factor of a CRT**		**02**
Ans.	**Deflection sensitivity: -** The deflection sensitivity (S) of CRT is defined as the deflection on the screen (in meters) per volt of deflection voltage. **Deflection factor: -** The reciprocal of deflection sensitivity is called as the deflection factor (G) of CRT.	**01 mark** **01 mark**	
g)	**State the need of signal generators**		**02**
Ans.	The generation of signals is an important activity of electronic development and troubleshooting. Therefore a signal generator is a vital electronic instrument in laboratory test setup which provides signals for general test purposes. It is used to provide known test conditions for the performance evaluation of various electronic systems	**02 marks**	

	and for replacing missing signals in systems being analyzed for repair.		
h)	**Define wave analyzer**		**02**
Ans.	**Definition:** Wave analyzer is an instrument which is used to measure the magnitude of the various harmonics of a complex waveform. It is an instrument that is designed to measure the relative amplitudes of single frequency components in a complex or distorted waveform. **OR** **(Any other relevant definition shall be considered.)**	**02 marks for definition**	
B	**Attempt any two**		**08**
a)	**Define unit and give any two examples each of base, supplementary and derived units.**		**04**
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).	**01 mark** **03 marks (01 mark for each units)**	

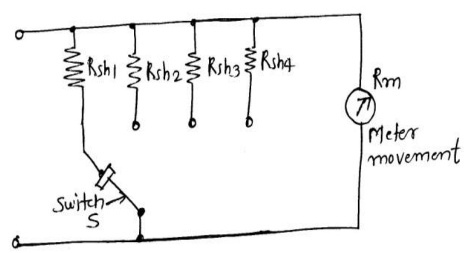
Examples of Base units			
Sr. No	Unit	Name	Symbol
01	Length	Meter	M
02	Mass	Kilogram	Kg
03	Time	Second	S
04	Intensity of electric current	Ampere	A
Examples of Supplementary units			
01	Plane angle	radian	rad
02	Solid angle	steradian	sr
Examples of Derived units			

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

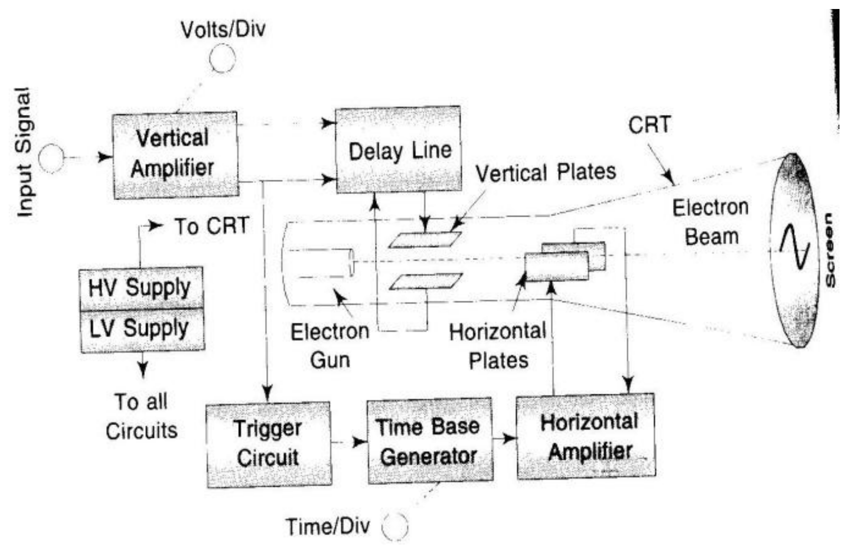
(Any other two relevant units for each typy shall be considered).

b)	**Define calibration and state its need.**		**04**
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.	**02 Marks for Definition** **02 Marks for need**	
c)	**Draw neat electrical circuit diagram of analog multimeter.**		**04**
Ans.		**04 marks for diagram**	

	Or **Any other relevant diagram shall be consider**		
Q. 2	**Attempt any four.**		**16**
a)	**Explain types of errors.**		**04**
Ans.	There are three types of error i. Gross Error ii. Systematic Error iii. Random Error. **Explanation:** 1. **Gross Error** - These errors are mainly human mistakes in reading instruments and recording and calculating measurement results. As human beings are involved, some gross errors will definitely be committed. Although complete elimination of gross error is impossible, one should try to anticipate and correct them. Some gross error is easily detected while others may be very difficult to detect. These errors cannot be mathematically treated. However can be avoided by great care should be taken in reading and recording the data and two, three or more readings should be taken for quantity under measurement. 2. **Systematic Error** – These types of error are divided into three categories a) Instrumental Errors ii) Environmental Error iii) Observational Error Instrumental error is due to inherent shortcomings in the instrument, due to misuse of the instrument and due to loading effects of instrument. Environmental errors are due to conditions external to the measuring device including conditions in the area surrounding the instrument. These may be effect of temperature, pressure, humidity, dust, vibrations or of external magnetic or electrostatic fields. Observational error is	**01 Mark for types** **03 Marks for explanation (01 mark for each type explanation)**	

	nothing but parallax error. As the pointer of analog measuring instruments rests slightly above the surface of scale it causes parallax error. To minimize parallax error meters are provided with mirror. 3. **Random Error** – These errors are due to unknown causes which are not determinable. Such errors those remain after gross and systematic errors have been substantially reduced.		
b)	**Derive the relation of shunt resistance with internal resistance of meter to extend Ammeter range.**		**04**
Ans.	 **Explanation:** The current range of ammeter is further extended by a number of shunts, selected by a range switch. Such meter is called a multirange ammeter. Figure shows a diagram of multirange ammeter. The circuit has four shunts R_{sh1}, R_{sh2}, R_{sh3} and R_{sh4} which can be put in parallel with the meter movement to give four different current ranges I_1, I_2, I_3 and I_4. Let m1, m2, m3 and m4 are the shunt multiplying powers for currents I_1, I_2, I_3 and I_4 Therefore $R_{sh1} = R_m / (m_1-1)$ $R_{sh2} = R_m / (m_2-1)$ $R_{sh3} = R_m / (m_3-1)$ $R_{sh4} = R_m / (m_4-1)$	**02 Marks for Diagram** **02 Marks for explanation**	
c)	**Draw the block diagram of CRO and state the function of each block.**		**04**

Ans.



02 Marks for Diagram

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

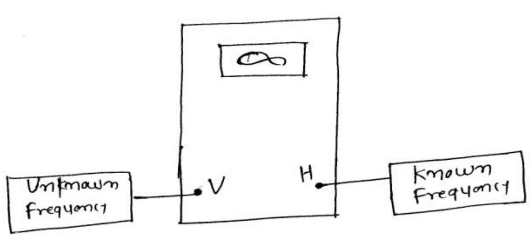
02 Marks for explanation

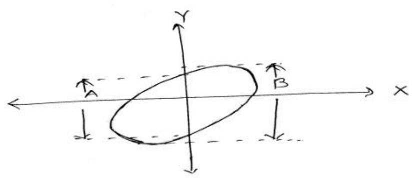
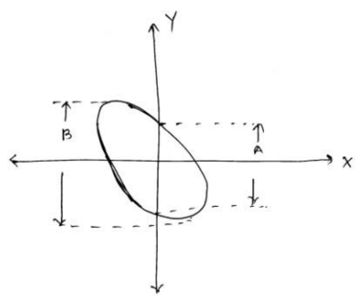
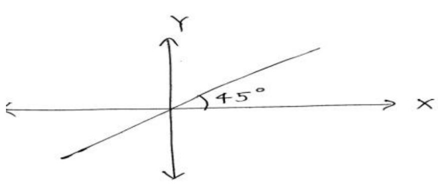
1. **Cathode ray tube** – The CRT is the heart of oscilloscope, which generates sharply focused electrons beam, accelerates the beam to a very high velocity, deflects the beam to create the image and contains the phosphor screen where the electron beam eventually becomes visible. To make these tasks,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

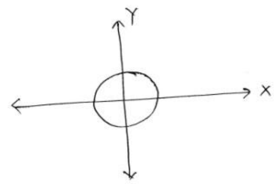
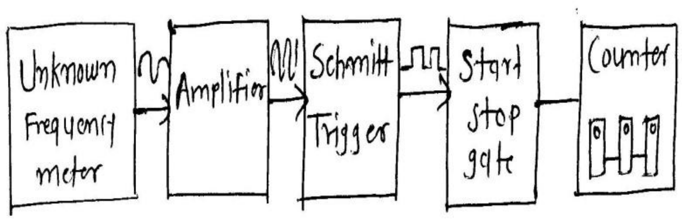
2. **Power Supply** – It provides the voltages required by the CRT to generate and accelerate the electron beam as well as to supply the required operating voltages for the other circuits of the oscilloscope. High voltages are required by the CRT for acceleration and low voltage is for the heater of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

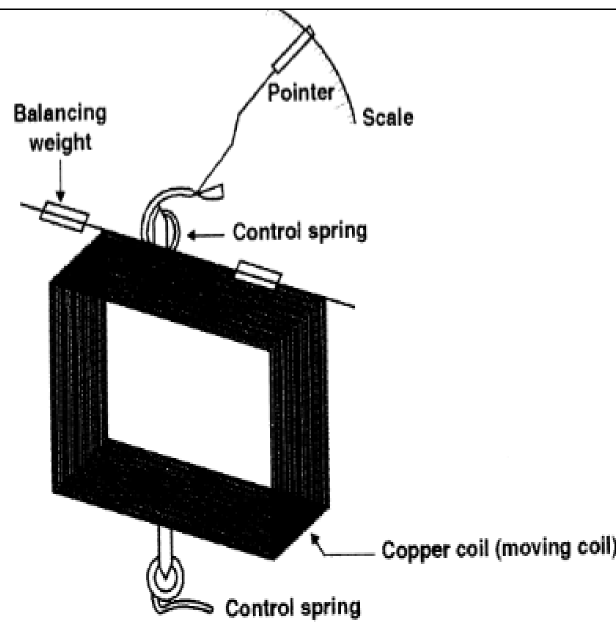
3. **Vertical Amplifier** – The input signal to be viewed on CRT screen is applied to the vertical amplifier, the push pull output of which is fed to the vertical deflection plates of CRT via delay line with sufficient power to drive the CRT spot in the vertical direction.

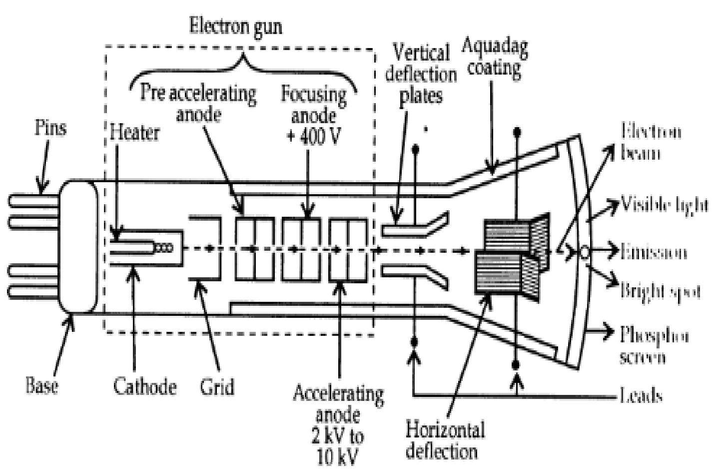
4. **Time base generator** – It develops a saw tooth waveform that is used as the horizontal deflection voltage of the CRT.

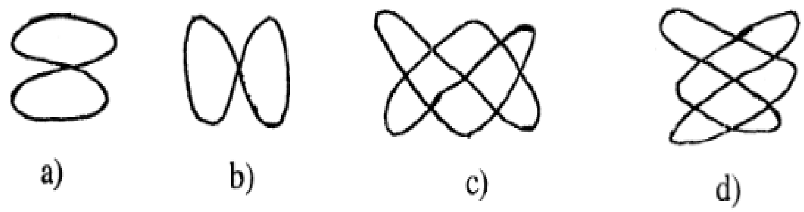
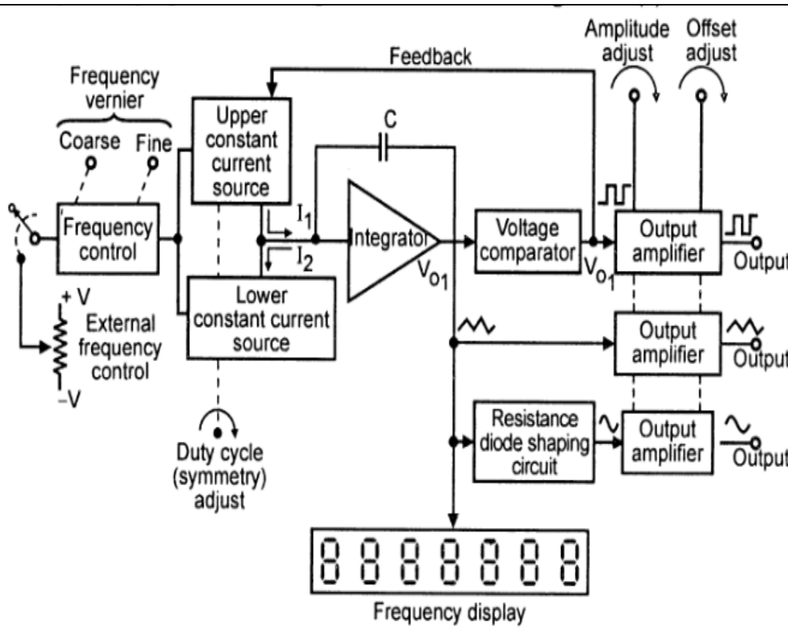
	5. **Horizontal Amplifier** – The saw tooth voltage is fed to the horizontal amplifier which includes a phase inverter and produces two simultaneous output waveform. The positive going saw tooth is applied to the right hand horizontal deflection plate of CRT and the negative going saw tooth to the left hand horizontal deflection plate. These voltages cause the electron beam to be swept across the CRT screen, from left to right. 6. **Trigger Circuit** – The trigger circuit is used to convert the incoming signal into trigger pulses so that the input signal and the sweep frequency can be synchronized.		
d)	**A basic d'Arsonval meter with an internal resistance Rm = 100 Ω and a full scale current of Im = 1 mA, is to be converted into a d.c. voltmeter with range of 0-10 V. Find the values of series resistance.**		**04**
Ans.	**Given Data**: Vin = 10 V, Ifsd = 1 mA, Rm = 100 Ω Rs = (Vin / Ifsd) – Rm Therefore Rs = $(10 / 1 * 10^{-3}) - 100$ **Rs = 9900 Ω = 9.9 K Ω**	**04 Marks (consider marks for steps)**	
e)	**Describe Lissajous pattern for phase measurement.**		**04**
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.  	**02 Marks for description**	

	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 0^0 and 90^0 are applied to the two channels of CRO. The phase shift is given by, $\theta = \sin^{-1}(A/B)$  2. For phase difference above 90^0 and less than 180^0, the ellipse appears. The phase shift is $\theta = 180^0 - \sin^{-1}(A/B)$  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 45^0 with X- axis  4. If the phase angle $\theta = 90^0$, frequency is identical and amplitudes are equal of the two input sinusoidal signals, the Lissajous pattern	**02 Marks for pattern (any two)**	

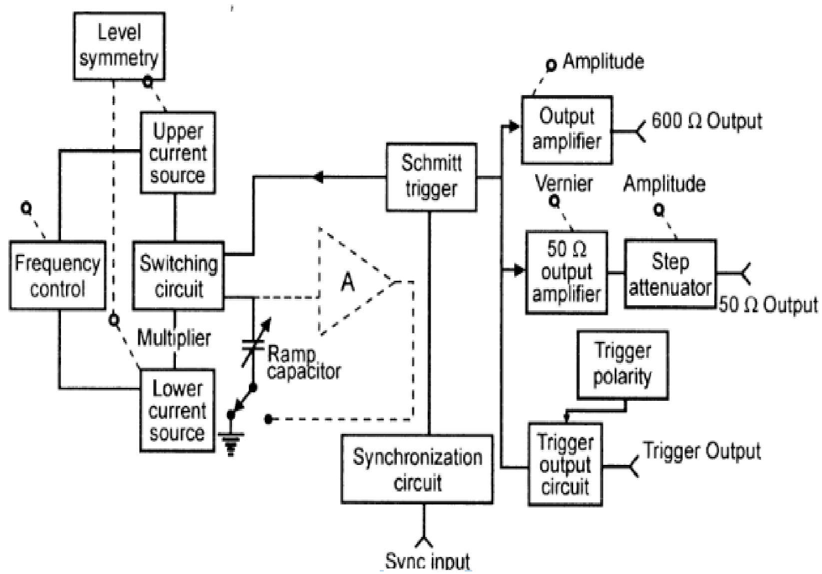
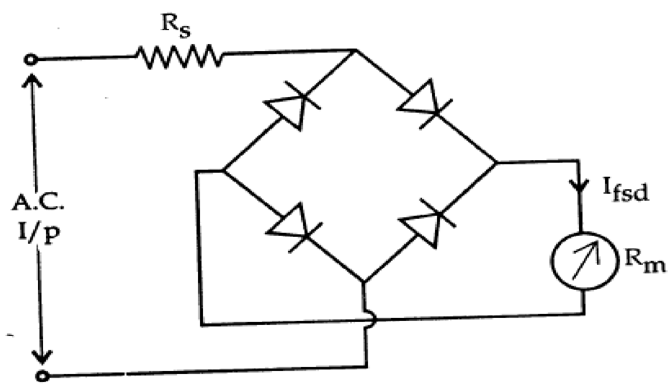
	will be a circle 		
f)	**Explain digital frequency meter with neat block diagram**		**04**
Ans.	 **Explanation:** The signal may be amplified before being applied to the Schmitt trigger. The Schmitt trigger converts the input signal into a square wave with fast rise and fall times, which is then differentiated and clipped. As a result the output from the Schmitt trigger is a train of pulses, one pulse for each cycle of the signal. The output pulses from the Schmitt trigger are fed to a START / STOP gate. When this gate is enabled, the input pulses pass through this gate and are fed directly to the counter which counts the number of pulses. When gate is disabled the counter stops counting the incoming pulses. The counter displays the number of pulses that have passed through it in the time interval between start and stop. If this interval is known the pulse rate and hence the frequency of the input signal cab be known. If f is the frequency of unknown signal, N is the number of counts displayed by counter and t is the time interval between start and stop gate then, frequency of unknown signal is, $f = N / t$	**02 Marks for Diagram** **02 Marks for explanation**	
Q. 3	**Attempt any four**		**16**
a)	**Define standards and give their classification.**		**04**

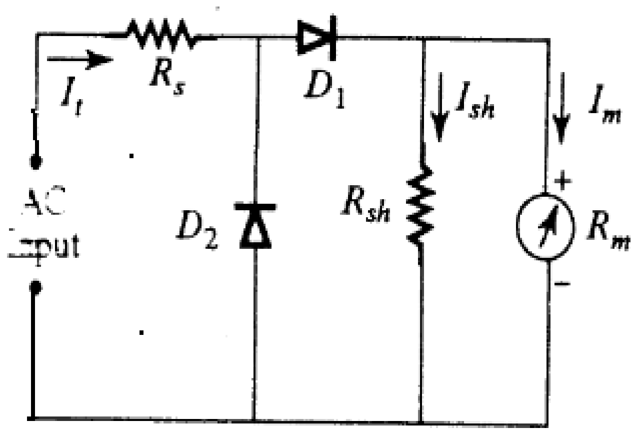
	Definition: Standard is the physical representation of unit of measurement. Or A known accurate measure of physical quantity is termed as Standard. Standards are classified as, 1) International Standard 2) Primary Standard 3) Secondary Standard 4) Working Standard	**01 mark for Definition** **03 mark for classification.**	
b)	**Derive torque equation for PMMC instruments.**		**04**
	 Construction Of PMMC Instruments Consider length of coil be ‘l’ meter and width of coil be ‘d’ meter. Assuming I is amount of current flowing in the coil having N turns , B is the flux density in the air gap and A is effective area of coil then,	**(Diagram is optional)**	

	F=BIL (N). Torque developed on each side of coil=F*(d/2) Total torque=2[BIL(N)*(d/2)] For a given instrument B L d and N are constant thus, Td= G* I= B* A*I*N Controlling torque Tc= C* ϴ As developed mechanical torque is counterbalanced by electromagnetic torque, Td=Tc= G* I = C* ϴ The deflection of pointer(ϴ) varies directly with current passed through coil (I)	**02 mark for Td Equation** **02 mark Tc Equation**	
c)	**Draw a neat and labeled diagram of internal structure of CRT**		**04**
		**04 marks for diagram**	
d)	**Calculate ratio of vertical and horizontal frequencies for an oscilloscope which displays the following Lissajous figures shown in fig,**		**04**

	 a) b) c) d) Fig. 1		
Ans	Fv= no.of horizontal tangents. Fx= no.of vertical tangents. a) Fv/Fx= 1/2 b) Fv/Fx=2/1 c) Fv/Fx= 3/2 d) Fv/Fx= 2/3	**01 mark for each ratio**	
e)	**State principle of operation of function generator with neat block diagram**		**04**
	 **Block diagram of function Generator**	**02 marks for Diagram**	

	OR **(Any Other relevant diagram should be considered)** **Principle of operation of function generator:** Function generator operates to produce different waveforms such as sine, square, triangular of adjustable frequency which is used to test functionality of various electronic circuits. This has capability of phase lock with other function generator or to a frequency standard and its output waveforms will have same accuracy and stability as standard source. In operation, frequency is controlled by varying the magnitude of current which drives the integrator. The frequency controlled voltage regulates two current sources. the upper current source supplies constant current to the integrator whose output voltage increases linearly with time. Voltage comparator multivibrator changes states at a predetermined maximum level of the integrator output voltage. This change cuts off the upper current supply and switch on lower current supply. The lower current source supplies a reverse current to integrator so that] its output decreases linearly with time. When output reaches predetermined minimum level, voltage comparator again change state and switch on the upper current source. The output of integrator is triangular waveform whose frequency is determined by the magnitude of current supplied by constant current sources.	**02 mark** **For Explan ation**	
f)	**Draw a neat block diagram of pulse generator**		**04**
	Block diagram of pulse generator:		

		**04 marks for correct diagram**	
Q. 4	**Attempt any four**		**16**
a)	**Explain with neat circuit diagram how full wave rectifier type analog AC voltmeter is used to measure unknown voltage.**		**04**
	 Bridge rectifier type AC voltmeter Or	**02 mark Diagram with waveform**	

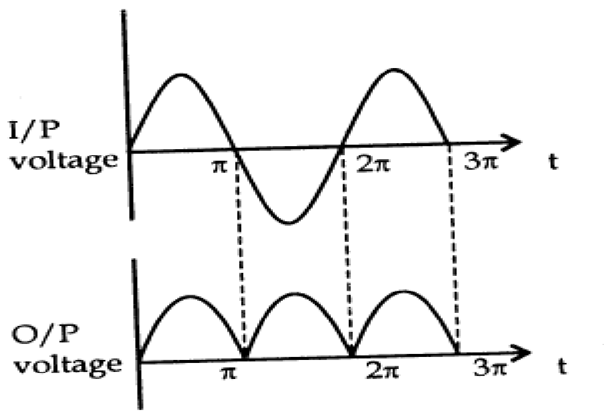


General rectifier type AC voltmeter

02 mark

For Explanation

Explanation:



Waveform

In full wave bridge rectifier the output voltage is double that of half wave rectifier . If we assume diode has zero forward resistance and infinite reverse resistance then,

$$R_s = \frac{V_{dc}}{I_{fsd}} - R_m$$

where, $R_s \rightarrow$ series resistance.

$V_{dc} \rightarrow$ d.c. output voltage.

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

$R_m \rightarrow$ Internal resistance of meter.

If sinusoidal voltage is applied at input, then the output voltage is given by,

$$V_{dc} = \frac{2}{2\pi} \int_0^{\pi} V_m \sin \omega t \, .d\omega t$$

$$= \frac{1}{\pi}(-V_m)\left[\cos \omega t\right]_0^{\pi}$$

$$= \frac{-V_m}{\pi}[-1-1]$$

$$V_{dc} = \frac{2V_m}{\pi} \qquad \text{------ (1)}$$

we know,

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$\therefore V_m = \sqrt{2}\, V_{rms}$$

Put this value in equation (1)

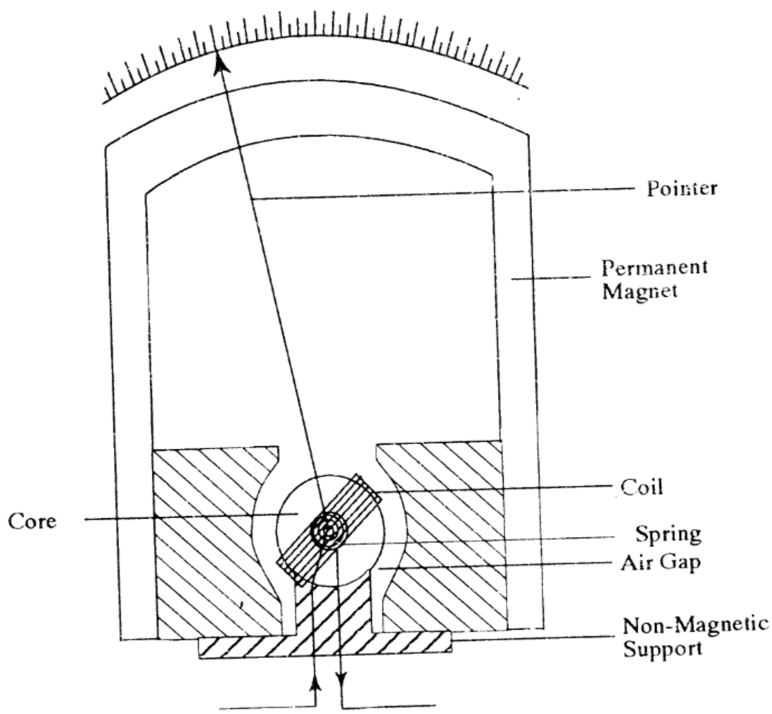
$$\therefore V_{dc} = \frac{2\sqrt{2}\, V_{rms}}{\pi}$$

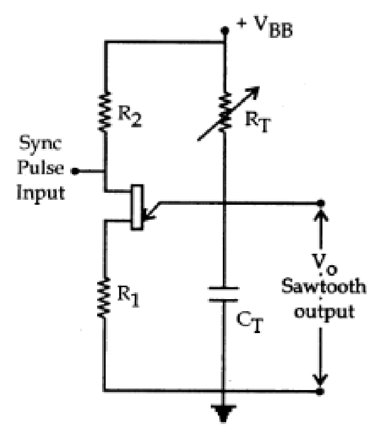
$$\therefore V_{dc} = 0.903\, V_{rms}$$

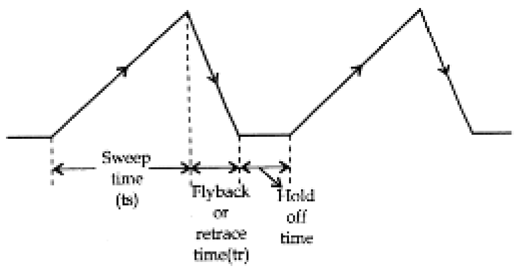
The above equation shows that such type of voltmeter shows 90.3% efficiency that of d.c. voltmeter.

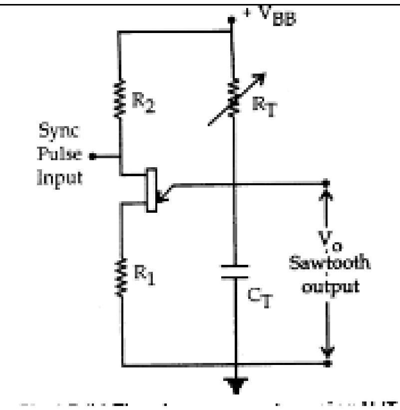
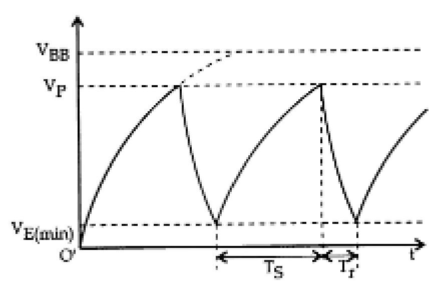
OR

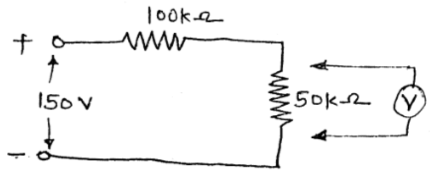
(Any other relevant explanation shall be considered).

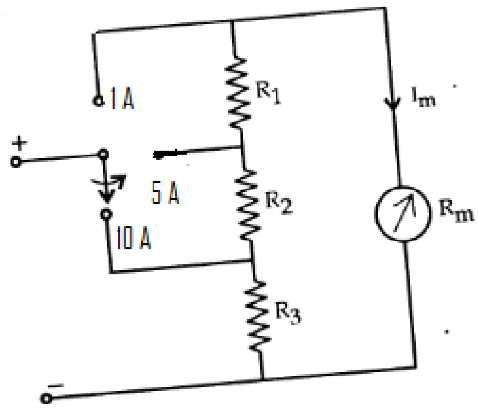
b)	**Describe working principle of PMMC instrument with neat construction diagram**		**04**
	 **OR** **(Any other relevant diagram shall be considered)** **Working principle of PMMC:** 1.The working principle of PMMC is based on basic meter movement known as D'Arsonval principle stated as when current passes through the coil a deflecting torque is produced due to interaction between magnetic field produced by permanent magnet and magnetic filed produced by moving coil. 2.Due to this torque coil deflects and this deflection is proportional to the current flowing through the coil. 3.The pointer attached with coil indicates the magnitude of quantity being measured. 4.Another torque is developed by spring known as controlling torque.t	**02 mark Diagram** **02 mark For working principle**	

	his torque helps to stabilize the pointer 5. When controlling torque becomes equal to deflecting torque then pointer attached with scale become stable at equilibrium.		
c)	**Give the classification of analog ammeter and voltmeter.**		**04**
Ans	The classification of Analog instruments(ammeter and voltmeter) are as follows, 1) Permanent Magnet Moving Coil Instrument(PMMC) 2) Electro dynamometer type instruments. 3) Moving iron type instruments (a)Attraction type moving iron instruments. (b) Repulsion type moving iron instruments. 4) Thermocouple Instruments 5)Electrostatic Instruments 6) Induction Instruments 7) Hot wire instruments	**O4 marks for classification** **(Any four)**	
d)	**Describe time base generator to produce waveforms on CRO.**		**04**
Ans.	The motion of spot on CRT screen from left to right is called sweep. The generator which generates signals to move beam spot on screen horizontally is called time base or sweep generator.  Time base Generator using UJT	**02 marks for diagram**	

	Explanation: The time base convert given signal into sawtooth waveform. As shown in figure which deflect the beam in the horizontal direction. Diagram:  The waveform is divided into two parts i.e. sweep time and retrace time. During sweep time t_s the beam moves left to right horizontally. The beam is deflected towards right by increasing amplitude of ramp voltage and the fact that positive voltage attracts the negative electrons. During retrace time or flyback time T_r the beam returns quickly to the left side of screen. The control grid is generally "gated OFF" which back out the beam during retrace time and prevent an undesirable retrace pattern from appearing on the screen. The base generator performs the task of producing such repetitive and synchronized voltage signal. **OR** The time base generator is shown in figure.	**02 marks for explanation**	

	 **Explanation:** UJT relaxation oscillator is main part of time base generator. It is used to produce sweep. When power is applied to UJT, initially it is off and the capacitor charge through R_T. When voltage across capacitor reaches V_P (peak voltage), then UJT turn ON. Then capacitor discharge rapidly through R_1 and turn OFF UJT. The cycle of charging and discharging repeats and sawtooth waveform produced as shown in figure.  		
e)	**It is desired to measure the voltage across a 50 K Ω resistor in a circuit shown in fig. 2. Two voltmeters are available for this purpose: voltmeter A with a sensitivity of 1000 Ω/V and voltmeter B with sensitivity of 20000 Ω/V. Both meters have 0-30V range. Calculate the reading of each voltmeter**		**04**

	 Fig. 2		
Ans.	True value of voltage across the 50 kΩ resistor $= \frac{50}{(100+50)} \times 150 = 50V$ (*a*) **Voltmeter A.** Resistance of voltmeter $R_v = S_v V = 1000 \times 50\ \Omega = 50\ k\Omega$. Now this voltmeter is connected across the 50 kΩ resistor and therefore the resistance of parallel combination of voltmeter and resistor $= \frac{(50) \times (50)}{(50+50)} = 50\ k\Omega$. Voltage across the combination of voltmeter and resistor $= \frac{25}{100+25} \times 150 = 30\ V$. Hence voltmeter A indicates a voltage of 30 V. **Voltmeter B.** Resistance of voltmeter $R_v = S_v V = 20{,}000 \times 50\ \Omega = 100\ k\Omega$. Resistance of combination of voltmeter in parallel with 50 kΩ resistor $= \frac{(1000) \times (50)}{(1000) \times (50)} = 47.6\ k\Omega$. ∴ Voltage across the combination of voltmeter and resistor $= \frac{47.6}{100+47.6} \times 150 = 48.36\ V$. Hence voltmeter *B* indicates a voltage of 48.36 V.	**02 mark for voltmeter A** **02 mark for voltmeter B**	

f)	**Design an Ayrton shunt to provide an ammeter with current ranges 1A, 5A and 10A. A basic meter with an internal resistance of 50ohm and full scale deflection current of 1mA is to be used.**		**04**
Ans.	 To find values of R1,R2,R3 i. For 1mA range, (I -Im) (R1+R2+R3)=Im.Rm (1-0.001) * (R1+R2+R3)= 0.001*50 (R1+R2+R3)= 0.05/0.999=0.050 ohm. Eq(1) ii. For 5mA range, (I -Im) (R2+R3)=Im.(Rm+R1) (5-0.001) * (R2+R3)= 0.001*(50+R1) 4.999*(R2+R3)= 0.05+0.001R1 Eq(2) iii. For 10mA range, (I -Im) (R2+R3)=Im.(Rm+R1+R2) (10-0.001) * R3= 0.001*(50+R1+R2) 9.999*R3= 0.05+0.001R1 +0.001R2	**01 mark for diagram** **03 marks** **(01 mark for each R1, R2, R3)**	

9.999*R3- 0.05=0.001(R1 +R2)

(R1 +R2) = 9999R3-50 Eq(3)

Put value of (R1 +R2) in eq(1) we get,

(R1+R2+R3)= 0.050

9999R3-50+R3=0.050

10000R3=0.050+50

R3=50.05/10000

R3=5.005*10^{-3} ohm

Put value of R3 in equ (3) we get,

(R1 +R2) = 9999R3-50

=9999*5.005*10^{-3} -50

= 0.04499

R2= 0.04499 -R1 eq(4)

Put value of R2 & R3in eq(2) we get,

4.999*(R2+R3)= 0.05+0.001R1

4.999(0.04499 -R1)+ 4.999*5.005*10^{-3} =0.05+0.001R1

o.2249-4.999R1+0.0250=0.05+0.001R1

0.2499-0.05=4.999R1+0.001R1

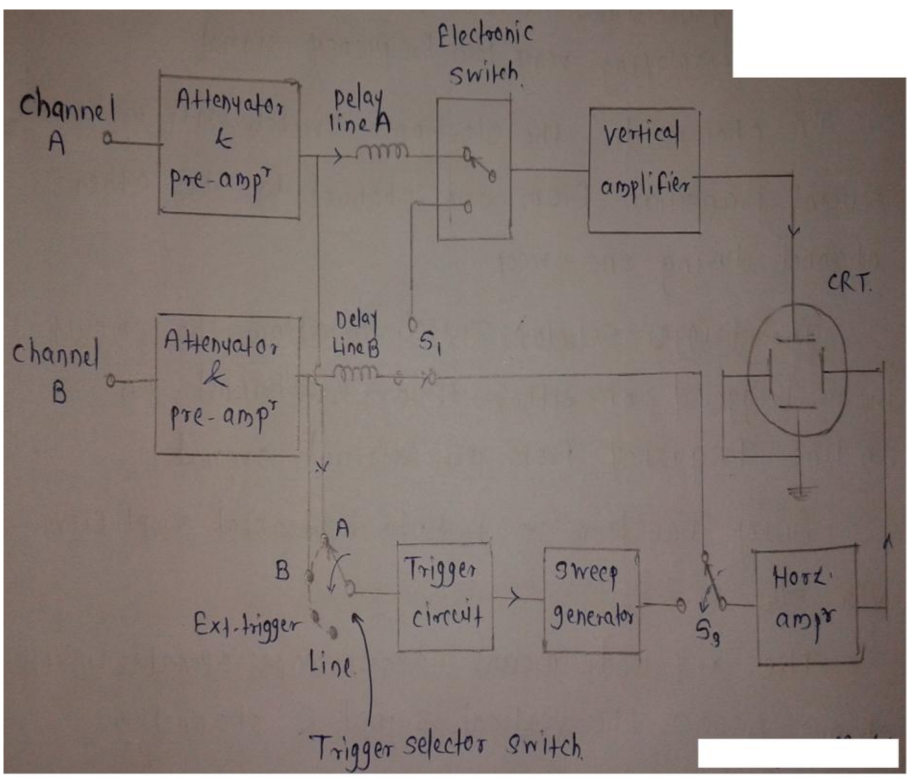
R1=3.998*10^{-2} Ohm

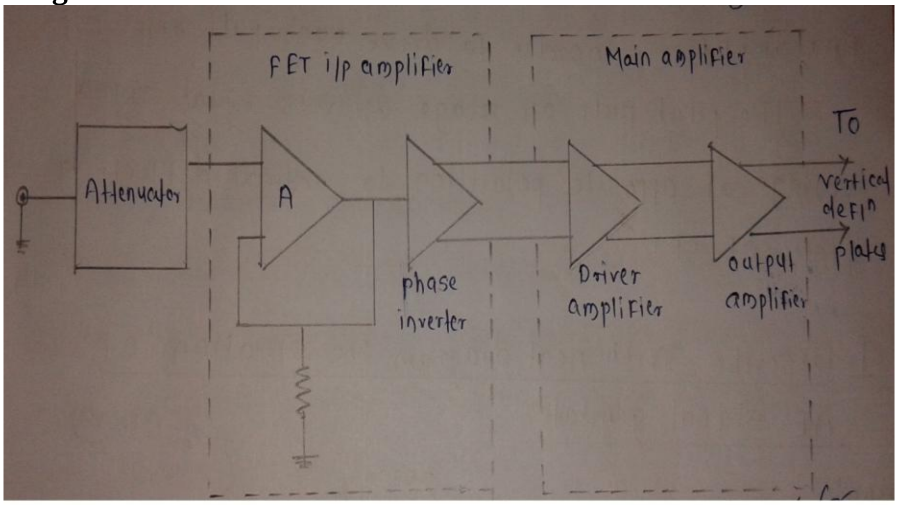
R1 = 0.0398 Ohm

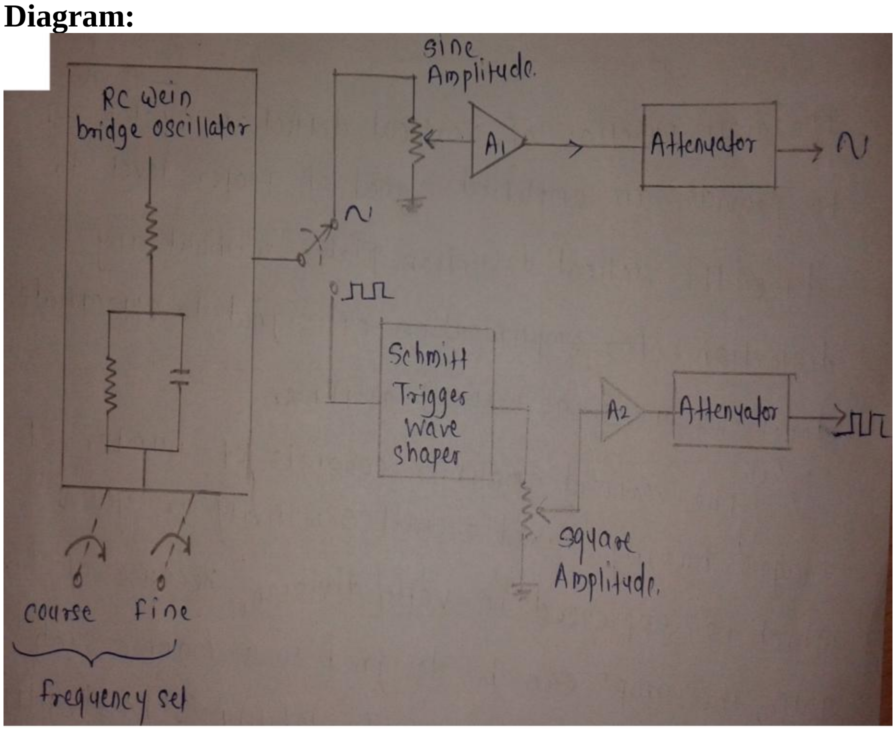
Put value of R1 in eq(4)

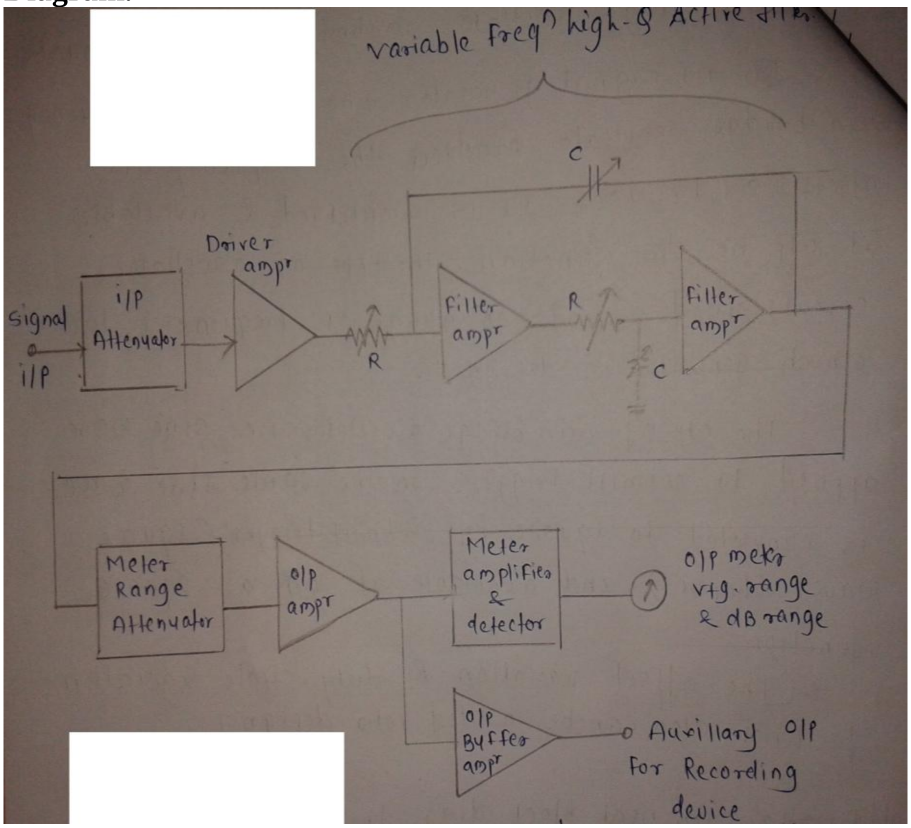
R2= 0.04499 -R1

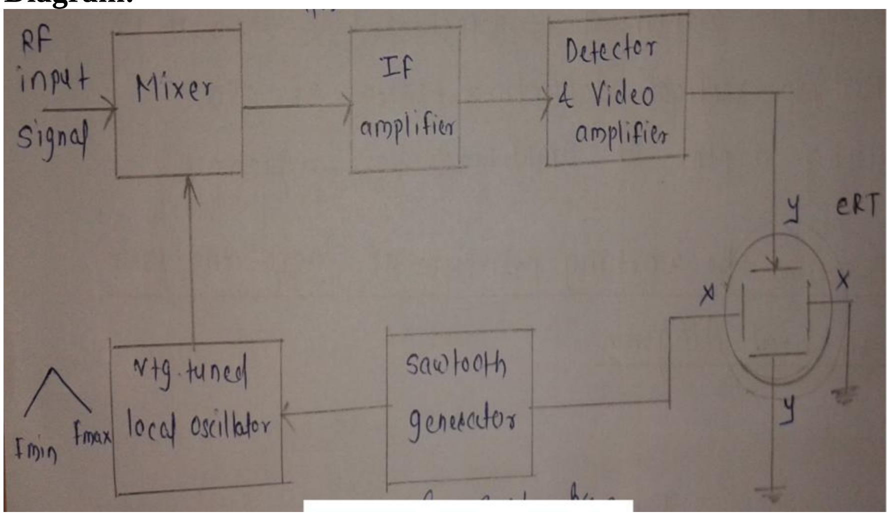
R2= 0.04499 - **3.998*10^{-5}**

	R2= 0.04495 ohm **Hence values are :** **R1= 0.039 Ohm = 0.04 Ohm** **R2= 0.04495 Ohm = 0.05 Ohm** **R3=0.005 Ohm** **(Values by rounding may vary little shall be considered)** **OR** **(Any other suitable method for correct calculation shall be considered).**		
Q.5	**Attempt any FOUR of following**		**16**
a)	**Explain with neat block diagram the operation of single beam dual trace oscilloscope.**		**04**
Ans	**Diagram:** 	**02 mark for diagram**	

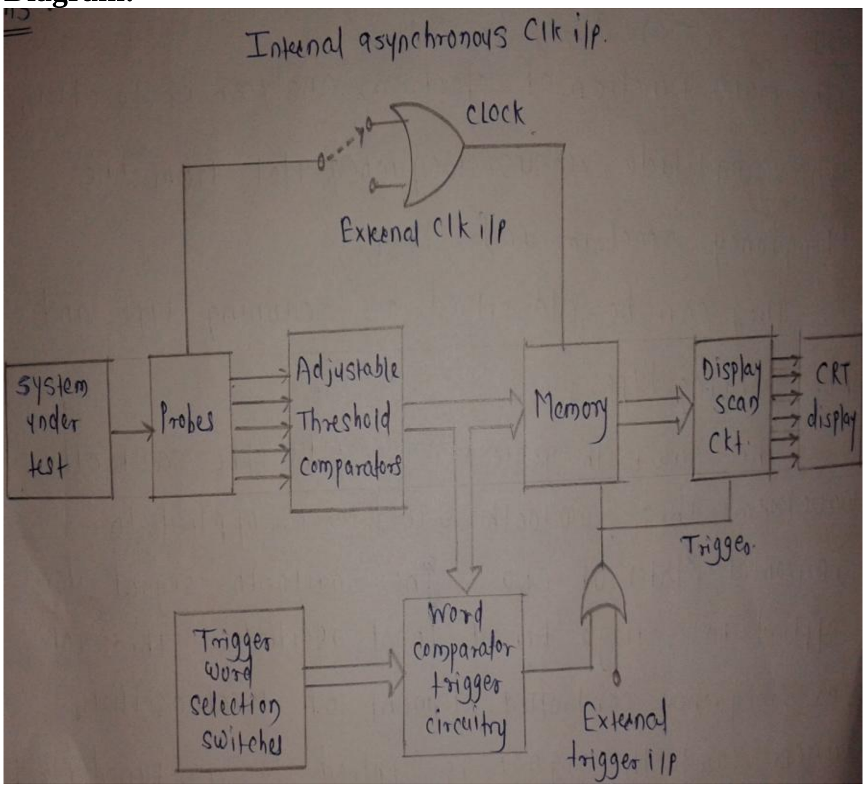
	Operation: Fig. illustrates construction of single beam dual trace oscilloscope. There are two separate vertical input channels A and B. They use separate attenuator & pre-amplifier stages. Therefore the amplitude of each i/p as viewed on oscilloscope can be controlled individually. After completion of both channels are applied to electronic switch. This switch will pass one channel at a time to vertical amplifier via delay line. There are two common modes for electronic switch called alternate & chop. In “alternate mode” electronic switch connects the two channels A & B alternately in successive cycles of sweep generator. The alternate mode can not be used for displaying very low frequency signal. In “Chop mode” electronic switch will make several transition from one channel to the other channel during one sweep. The trigger selector switch S_2 allow the circuit to be triggered on either A or B channel on line frequency from an external signal. Sweep waveform is fed to horizontal amplifier via s/w S_1 & S_3 The X-Y mode means, oscilloscope operates with channel A as the vertical signal & channel B as the horizontal signal. Accurate measurement can be done in thi mode.	**02 mark for operation**	
b)	**Explain with neat diagram the operation of vertical deflection system**		**04**
Ans	**Diagram.**  	**02 mark for diagram**	

	Explanation: The main function of vertical deflection system is to provide an amplified signal of proper level to drive the vertical deflection plates without any distortion. The i/p stage of pre-amplifier, consists of FET source follower. The FET source follower has high impedance. This impedance FET amplifier from attenuator. The FET source follower i/p stage is followed by BJT emitter follower. This is done in order to match the medium impedance of FET amplifier with low i/p impedance of phase inverter. Two 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.	**02 mark for explanation**	
c)	**Describe with neat diagram the operation of AF signal generator.**		**04**
Ans	**Diagram:**  **OR** **(Any other relevant diagram shall be considered)** **Explanation:** Fig. illustrates AF signal generator. It consist of RC wein bridge oscillator, Schmitt trigger, Attenuator.	**02 mark for diagram** **02 mark for explan**	

	In AF signal generator, the variable frequency wein bridge oscillator produces the frequency of interest set by user. It is amplified & available at o/p as since function. The type of oscillator circuit used depends on range of frequencies for which generator is designed. The o/p of wein bridge oscillator i.e. since wave applied to Schmitt trigger. So the same sine wave is converted to square by Schmitt trigger(square wave shaper) and available at o/p as square function.	**ation**	
d)	**Describe with neat block diagram the operation of frequency selective wave analyser**		**04**
Ans	**Diagram.**  **Explanation:** The waveform to be analysed in terms of its separate frequency components is applied to an i/p attenuator i.e. set by meter range switch on front panel. A driver amplifier feeds the attenuated waveform to a high & active filter. The filter consists of a cascaded arrangement of RC resonant sections & filter amplifiers. The passband of total filter section is converd in decade steps over entire audio range close-tolerance polystyrene capacitors are generally used for selecting frequency ranges. A final amplifier stage supplies selected signal to meter circuit & unturned buffer amplifier. Buffer amplifier used to	**02 mark for diagra m** **02 mark for explan ation**	

	drive recorder or electronic counter. The meter is driven by average type detector.		
e)	**Describe with neat block diagram the spectrum analyser.**		**04**
Ans	**Diagram:**  **OR** **(Any other relevant diagram shall be considered)** **Explanation:** The main function of spectrum analyzer is to be obtain the amplitude vs frequency plot from the frequency spectrum under test. They can be classified as scanning type & non-scanning type. The sawtooth generator generates the sawtooth waveform. This sawtooth waveform is applied to horizontal plates of CRO. The sawtooth signal also applied to voltage tuned local oscillator. This act as frequency controlled element of local oscillator. When sawtooth signal is applied to voltage tuned local oscillator its frequency changes from Fmin to Fmax. The RF i/p signal is applied to the mixer. The o/p of voltage tuned oscillator is used to beat with i/p signal in order to produce intermediate frequency. This, If component is produced when corresponding component is present in i/p signal. The resulting, if signal is applied to detector &video amplifier. The if component is amplified & delectected & then it is applied to vertical deflecting plates of CRO, producing a plot of amplitude vs frequency.	**02 mark for diagram** **02 mark for explanation**	

f)	**Describe the working principle of logic analyser with neat diagram**		**04**
Ans	**Diagram:**	**02 mark for diagram**	



02 mark for explanation

Explanation: Logic analyzer used to analyze digital signals. Logic analyzer deals with digital domain.

This is basically multichannel oscilloscope. The probes connect the logical analyzer to system which is under test. The probes operates as voltage divides , the lowest possible s/w rate can be selected by dividing the i/p signal.

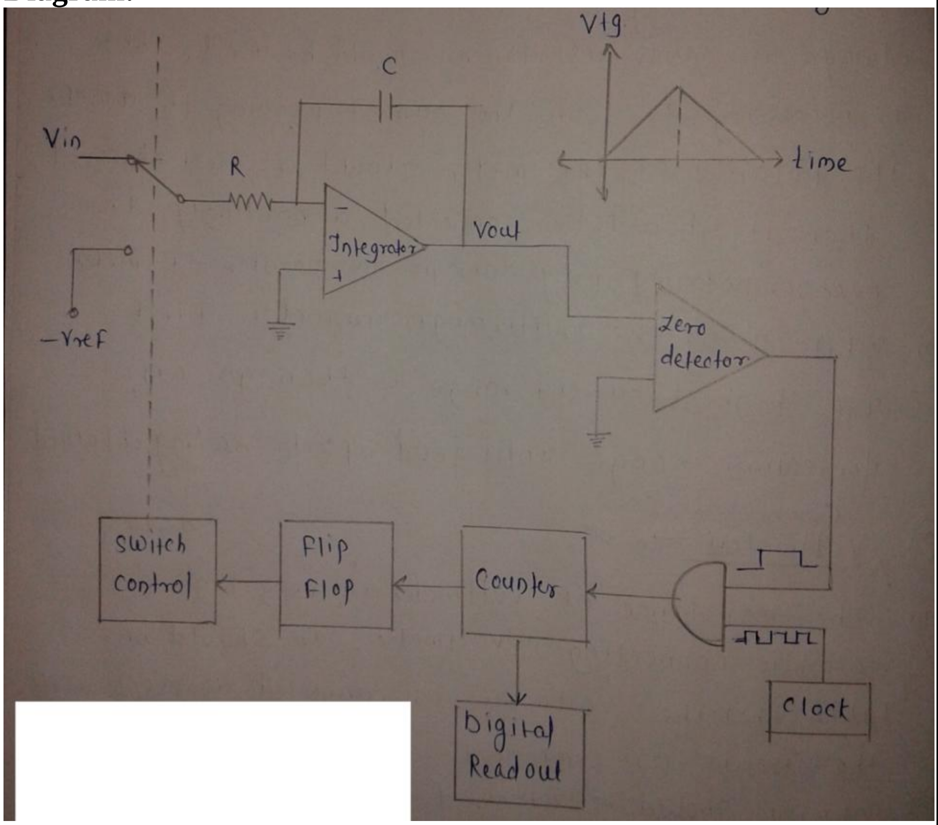
The different logic families i.e, TTL, CMOS,NMOS…etc have different threshold voltage. Hence adjustable threshold comparators are used. Each signal is connected to each line of logic analyzer. The reference signal of each comparator is set to a voltage.

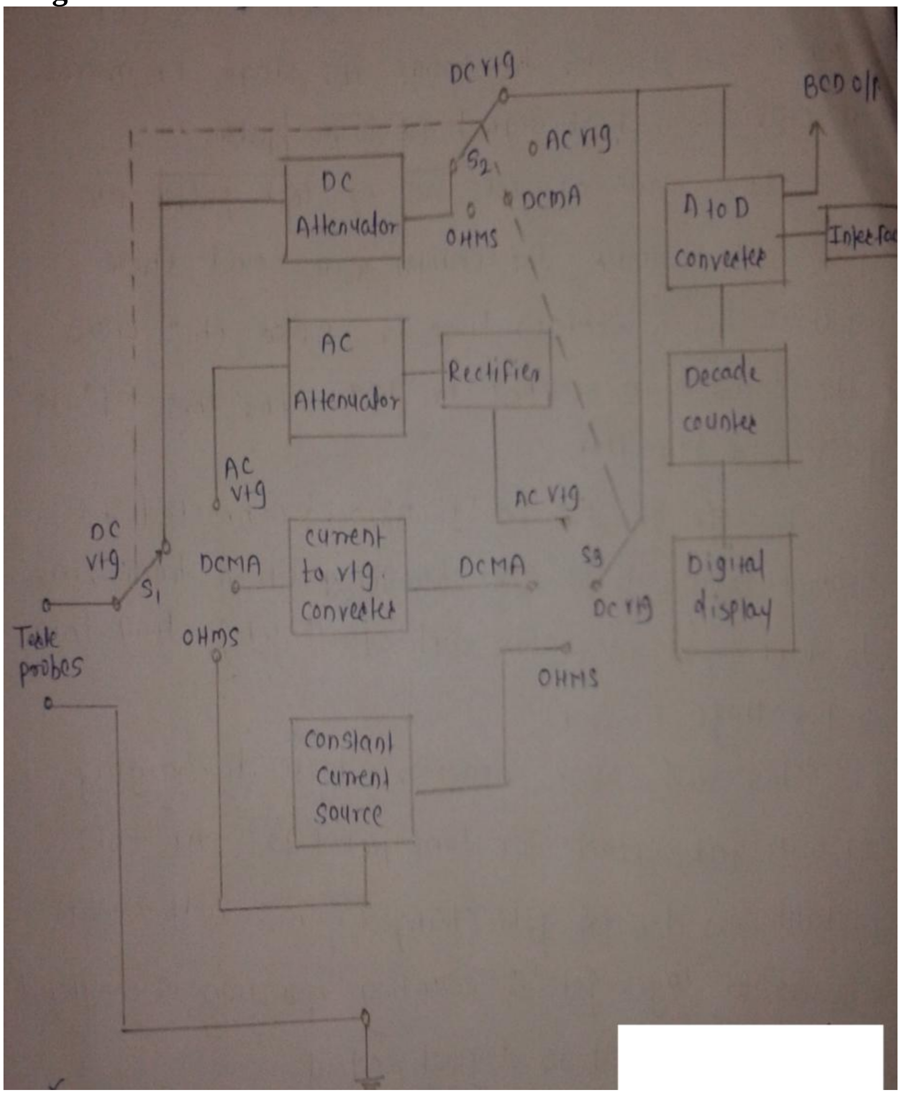
The logic analyzer memory consists of a RAM. The clock signals I.e, internal or external clock i/p is connected to memory on receiving

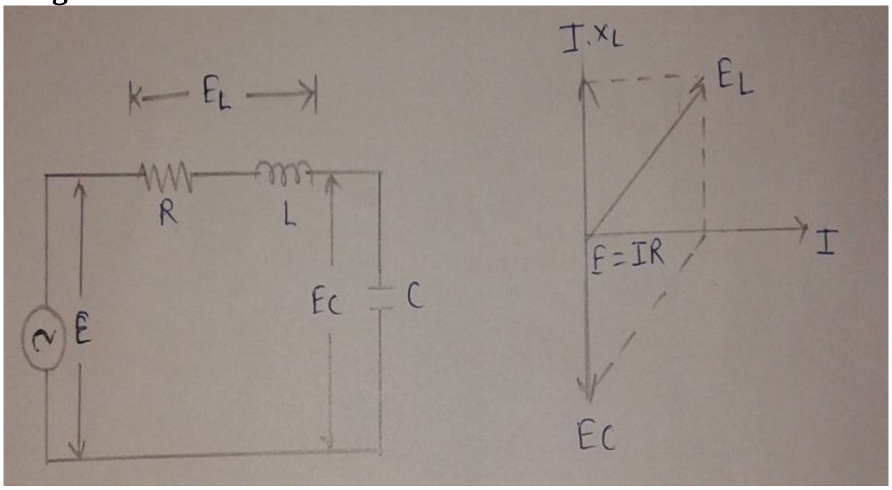
	clock signal, the logic analyzer samples the data present on i/p signals. These samples are stored in memory. For each i/p channel the analyzer can store from 256 to 1024 samples. When memory receives trigger signal then samples are stored in it & displayed on CRT.		
Q.6	**Attempt any FOUR**		**16**
a)	**Compare analog instrument with digital instruments (any four points).**		**04**
Ans.	(table below)	**01 mark for each point (any 4 points)**	

Sr. No.	Parameter	Analog instrument	Digital instrument
01	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
02	Accuracy	Low	High
03	Resolution	Low	High
04	Power required	Require more power	Require less power
05	Cost	Cheap	costly
06	Portability	Portable	Less
07	Observational error	Considerable Observational error	Free from Observational error
08	examples	PMMC instrument, analog ammeter, analog voltmeter.	DMM, DVM

	(Any other relevant points should be considered)		
b)	**List the applications of DSO.**		**04**
Ans.	**Applications:** 1. It can be used to measure AC as well as DC Vtg. Duty cycle etc. 2. It can be used to measure frequency, time period. 3. It can be used to give visual representation for target of radar. 4. It can be used tin medical field. 5. It can be used to save signals. 6. It can be used to determine modulation characteristics. 7. It can be used to observe V-I characteristics of diode, transistors etc. 8. It can be used to observe B-H curves, P-V diagrams. 9. It can be used to observe radiation pattern generated by transmitting antenna. 10. In modern DSO it is possible to add, subtract the wave form.	**01 mark for each point (any 4 points)**	
c)	**How to connect ammeters and voltmeters in electrical circuits? Give justification.**		**04**
Ans.	**Connections of 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. **Connections of Voltmeters:** 1. The resistance of Voltmeter is very high & so while connecting a 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. 4. Loading effect can be minimized by using high sensitivity	**02 marks** **02 marks**	

	Voltmeters.		
d)	**Explain operation of Integrating type digital voltmeter with neat block diagram.**		**04**
Ans.	**Diagram:**  OR **(Any other relevant points should be considered)** Operation: At the start of measurement counter is reset to zero. So output of Flip-Flop is zero. This is applied to switch control. The switch control now connects input vtg. (V_{in}) to the integrator. Integrator now starts integrating the input vtg. that means capacitor starts charging. Because of this output of integrator changes from zero value. It causes zero detector to change its stage. It means it provides a high signal to logic gate. Logic gate opened, no. of clock pulses are passed to counter. The counter will count these pulses for a certain time $T_{1.}$ After this time the counter is reached to 999. After this '1' is passed to Flip-Flop. The output of Flip-Flop is '1'. This is connected to control logic. Now s/w changes position from V_{in} to V_{ref}. so integrator will starts integrating this ref. voltage ($-V_{ref}$). This will cause capacitor starts discharging. It will take place for time period t_2. At this instant zero detector gets changed. This will cause	**02 marks for diagram** **02 marks for explanation**	

	closing of logic gate & counting operation is completed. Then data passed to digital readout.		
e)	**Explain digital multimeter with neat block diagram.**		**04**
Ans.	**Diagram:**  **Explanation:** In order to measure unknown current, current to vtg. (I to V) converter is used. An unknown current applied to op-amp. I/P impedance of op-amp is very high. So current passing through it is negligible. Thus $I_{in} = I_{Fb}$. This feedback current pass through resistance. This will cause a vtg. drop across resistance. This vtg. is applied to A to D converter & finally digital display is obtained. Thus o/p is directly proportional to unknown current. In order to measure unknown resistance; a constant current source is	**02 marks for diagram** **02 marks for explanation**	

	used. The current from this constant current source is allowed to pass through unknown resistance. Thus proportional vtg. is obtained. This o/p directly proportional to unknown resistance. To measure AC vtg, a rectifier & filter is used. This rectifier converts AC into DC signal & this DC signal is applied to A to D converter & to digital display.		
f)	**Explain working principle of Q meter with neat circuit diagram.**		**04**
Ans.	**Diagram:**  **OR** **(Any other relevant points should be considered)** **Explanation:** The Q factor is called as quality factor or storage factor. Working principle of Q meter is based on characteristics that vtg. across the coil or capacitor is equal to applied vtg. times the Q factor of the circuit. If a fixed vtg. is applied to the circuit, the voltmeters across the capacitor can be calibrated to read Q value directly. At resonant frequency, $X_L = X_C$ $F = \frac{1}{2\pi\sqrt{LC}}$ & $I = \frac{E}{R}$ ……………………. (1) The vtg. across capacitance, $Ec = IXc = IX_L = I_W L$ ………………(2) Dividing equation (2) by (1) Therefore E = IR Therefore $E_C/E = I_W L/ IR = IX_C = Q$ $Q = WL/ R = E_C/E$ $E_C = Q_E$	**02 marks for diagram** **02 marks for explanation**	