MODEL ANSWER

WINTER– 17 EXAMINATION

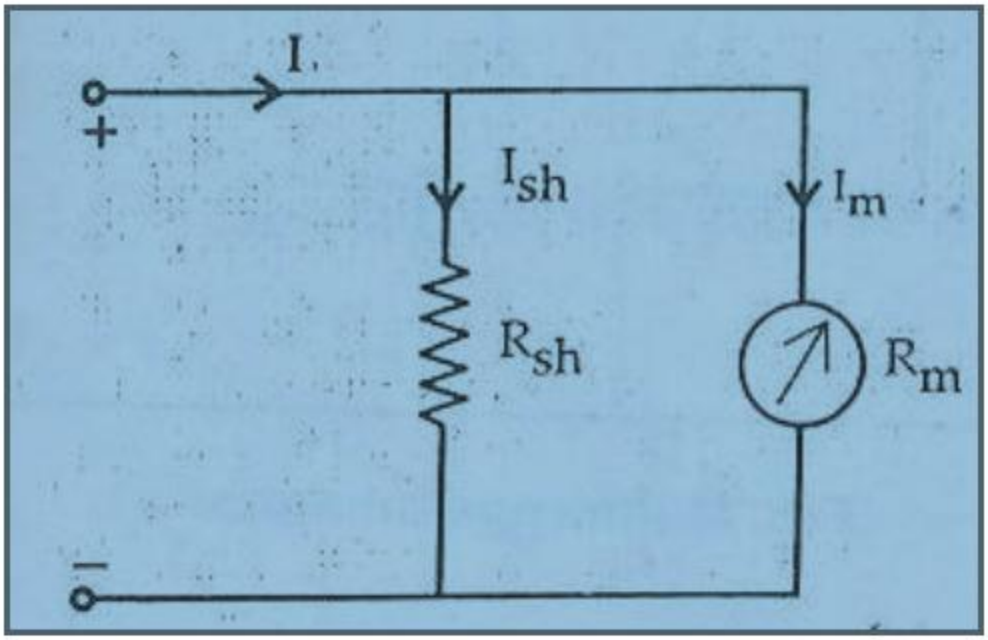
Subject Title: Electronic Instruments & Measurements Subject Code: 17317

Important Instructions to examiners:

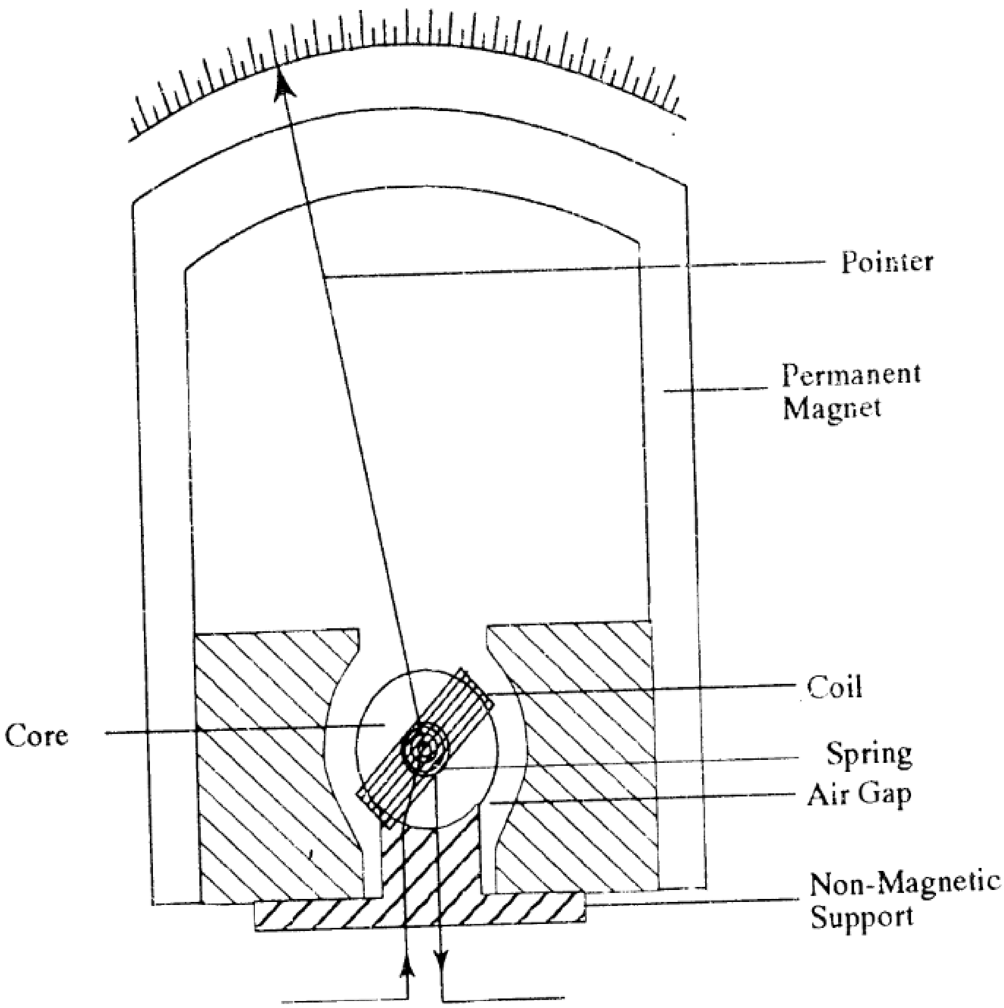
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent 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.

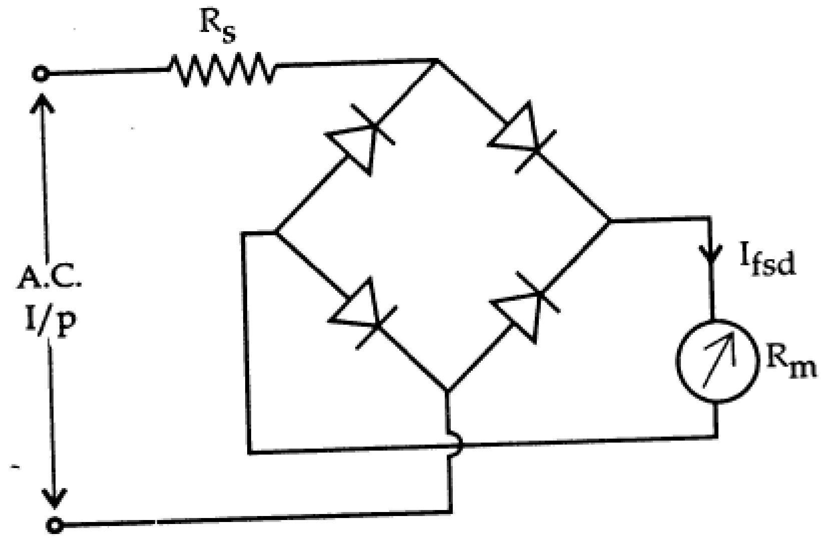
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	A)	**Attempt any six :**	**12-Total Marks**
	a)	**Define the term 'accuracy' and 'sensitivity' .**	**2M**
	Ans:	**Accuracy:** The degree of closeness with which an instrument approaches the true value of the quantity being measured is known as accuracy. **Sensitivity:** 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.	**1M each**
	b)	**State the types of standards of measurement.**	**2M**
	Ans:	• International Standard • Primary Standard • Secondary Standard • Working Standard	**1/2M each**
	c)	**List four application of CRO.**	**2M**
	Ans:	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.	**½ M each**

		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.	
	d)	**List four dynamic characteristics.**	**2M**
	Ans:	**<u>Characteristics-</u>** • Speed of response • Lag • Fidelity • Dynamic Error	**½ M each**
	e)	**State two advantages of moving coil instrument.**	**2M**
	Ans:	**<u>Advantages-</u>** 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.	**1M each**
	f)	**What is the requirement of shunt in multirange ammeter?**	**2M**
	Ans:	**<u>Requirement-</u>** 1. The temperature coefficients of the shunt and instruments should be low and nearly identical 2. The resistance of shunt should not vary withj time. 3. It should carry the current without excessive temperature rise. 4. It should have a low thermal emf.	**1M any two**
	g)	**What is the role of delay line in CRO ?**	**2M**
	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.	**2M**
	h)	**State the need of signal generators (any two).**	**2M**
	Ans:	**<u>Need-</u>** 1. The generation of signals is an important activity of electronic development and troubleshooting. Therefore a signal generator is a vital electronic instrument in laboratory test setup which provides signals for general test purposes. 2. It is used to provide known test conditions for the performance evaluation of various electronic systems and for replacing missing signals in systems being analyzed for repair.	**1M each**

B)	**Attempt any two:**	**8-Total Marks**
a)	**Draw the circuit diagram of DC ammeter using basic 'D' Amsoval movement and derive the expression for shunt resistance.**	**4M**
Ans:	**Circuit 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. Vsh=Vm IshRsh=ImRm Rsh=ImRm/Ish Rsh=ImRm/(I-Im)	**2M** **2M**
b)	**Give significance of calibration.**	**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.	**4M**

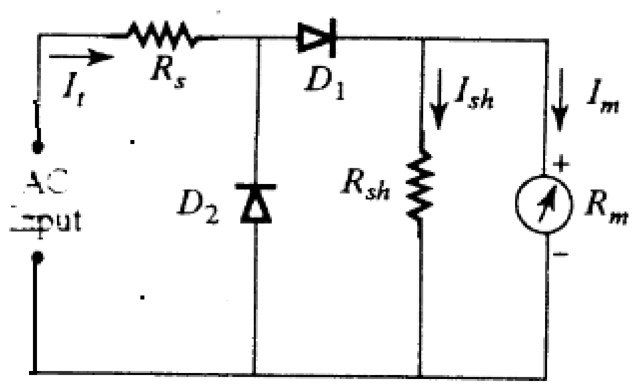
		Need of calibration: 1. To ensure reading from an instrument are consistent with other measurements. 2. To determine the accuracy of the instrument reading. 3. To establish the reliability of the instrument i.e. it can be trusted. 4. Calibration increases productivity, optimizes resources and assures consistency	
	c)	**List different types of errors and its source of generation/occurrence.**	**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 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.	**1M- List 3M explanation**
Q . 2		**Attempt any four :**	**16-Total Marks**
	a)	**Describe the construction of PMMC instrument.**	**4M**

	Ans:	 **OR** ***Note-Any other relevant diagram shall be considered*** 1. The PMMC movement employ's a spring- loaded coil through which the measured current flows. 2. The coil is in magnetic field of a permanent magnet and moves in a rotary fashion. 3. The amount of rotation is directly proportional to the amount of current flowing through the coil. 4. A pointer attached to the coil indicates the position of the coil on a scale calibrated in terms of current or voltage. 5. It responds to dc current only and has an almost linear calibration. 6. Magnetic shunt that varies the field strength is used for calibration.	**2M** **2M**
	b)	**Explain the working of rectifier type of AC voltmeter with neat diagram (any one).**	**4M**
	Ans:	**Diagram-**	**2M**



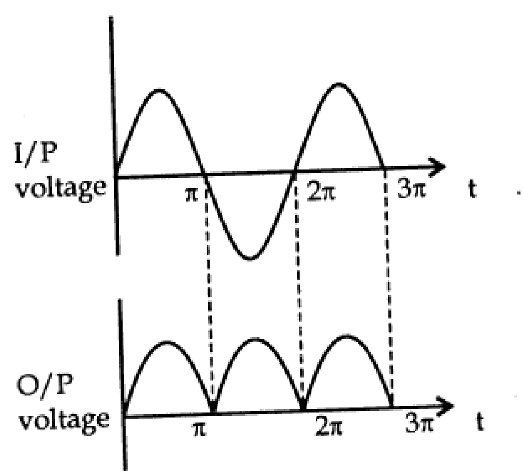
Bridge rectifier type AC voltmeter

OR



General rectifier type AC voltmeter

Explanation: **2M**



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)

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

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

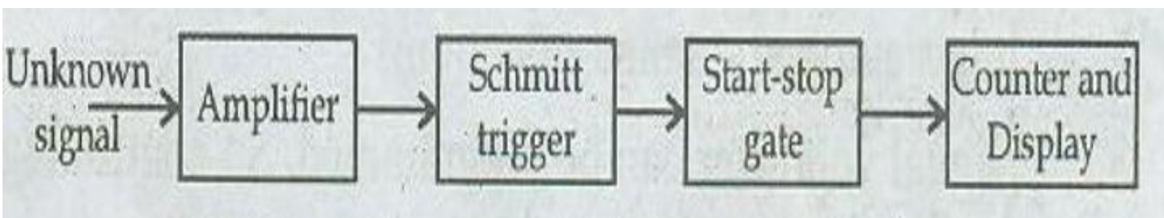
The above equation shows that such type of voltmeter shows 90.3% efficiency that of d.c. voltmeter.

OR

Note-Any other relevant diagram shall be considered (half wave can be considered)

c)	**State the reason for voltmeter never connected in series with source of emf.**	**4M**
Ans:	The voltmetre is used for measuring the electrical potential difference between two points of a line ,where as the potential difference measured between two points of same wire/line is zero. In short, the internal resistance of voltmetre is generally high, so you cannot connect it in series.	**4M**
d)	**Explain the block diagram of DFM (Digital Frequency Meter).**	**4M**

Ans: **Block diagram –** **2M**



OR

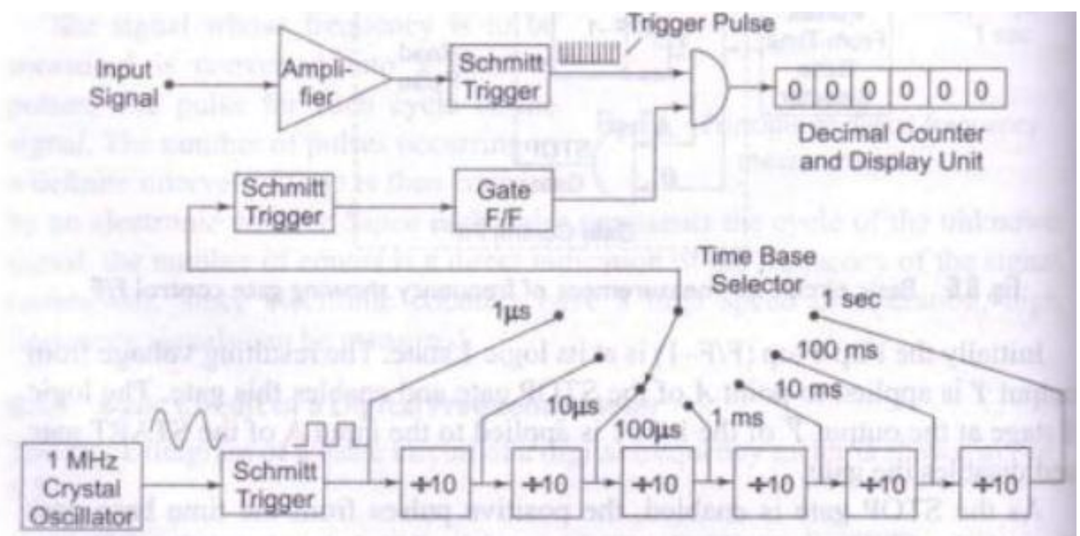


Fig. 6.7 Block diagram of a digital frequency meter

Explanation:

Digital frequency meter: **2M**

- 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.

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) **Compare DSO with CRO (any four points).** **4M**

Ans: **1M each any four points**

SR.NO	CRO	DSO
1	It is analog oscilloscope	It is digital oscilloscope
2	Less accurate	More accurate
3	No memory	Memory present
4	Cost is less	Cost is more
5	Cannot store signal	Can store signal

f) **Explain the concept of time domain and frequency domain.** **4M**

Ans: **2M each**

Time Domain:
In general we observe electrical signals in amplitude versus time format where time is on X- axis and amplitude is on Y- axis, this is known as time domain.

Example: CRO.

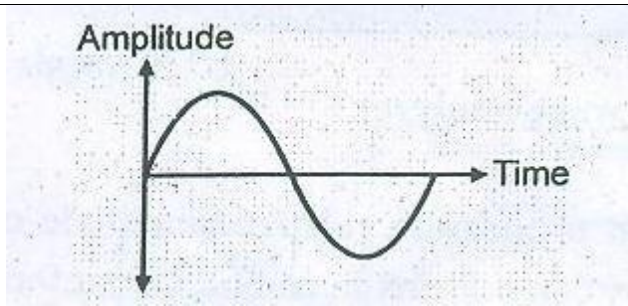


Fig: Waveform observed on CRO

Frequency Domain:

We know that during long distance communication signal get distorted. The main advantage of time domain analysis is that we cannot differentiate the complex frequency signals or distorted signal.

- To overcome disadvantage of time domain, we observed the signal in amplitude versus frequency format is known as frequency domain.
- In frequency domain the complex frequency signal can be plotted as separate spectrum for each frequency so it becomes easy to analyze the information present in the signal.
- Example: Spectrum analyzer.

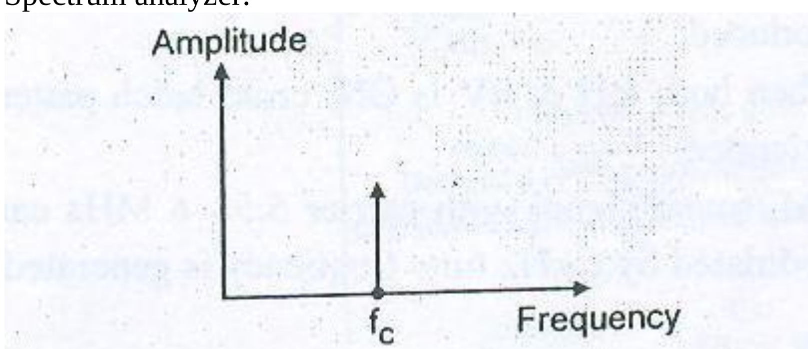
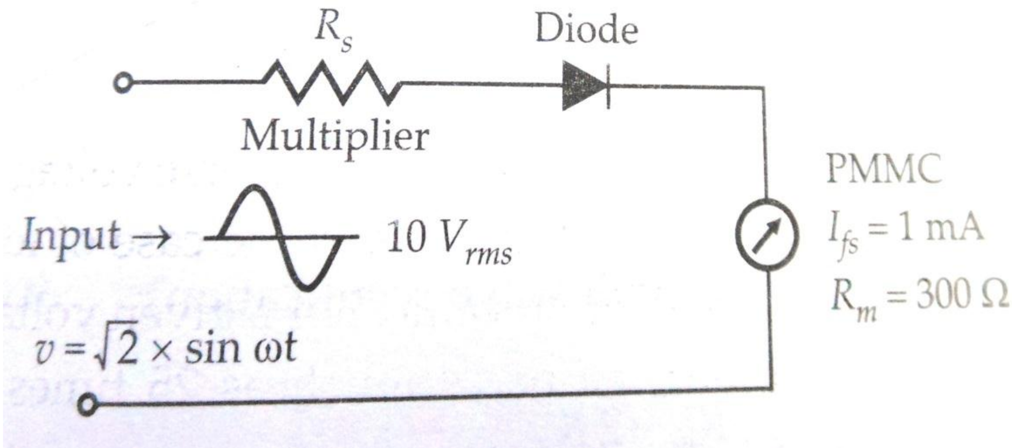
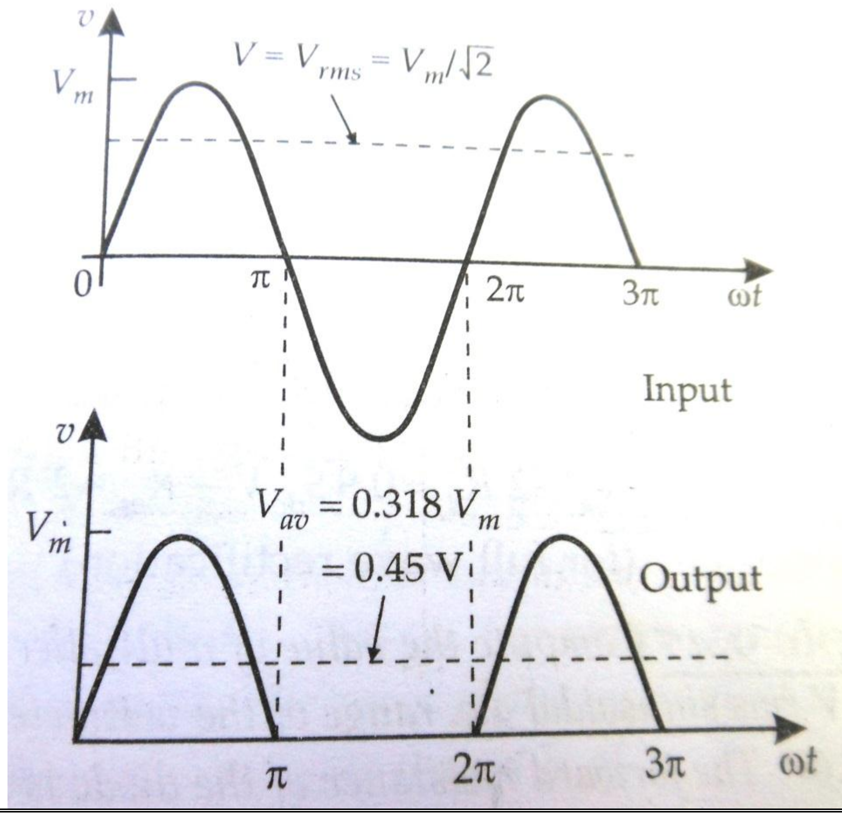


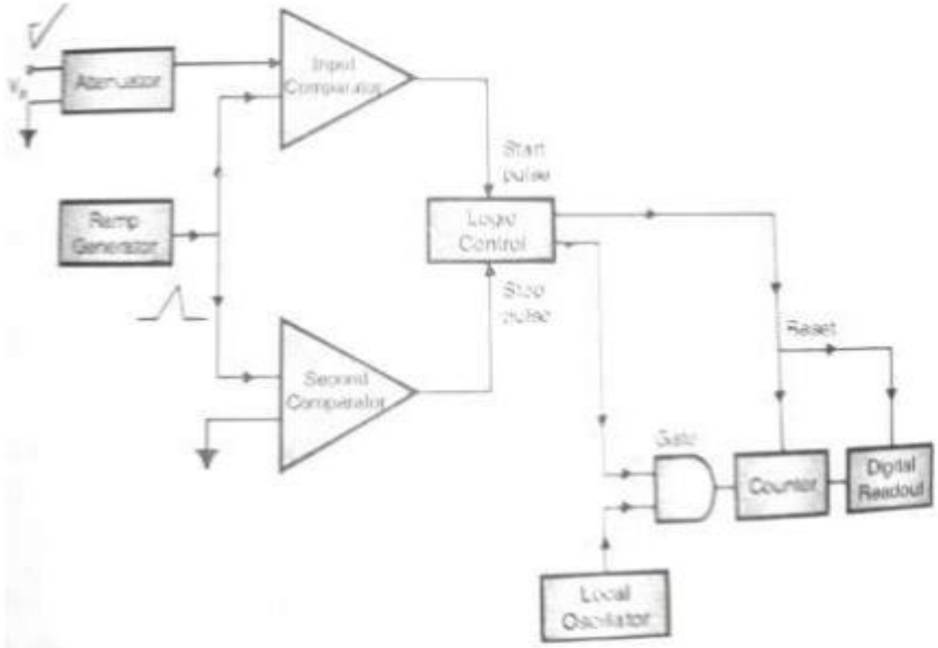
Fig: Waveform of Spectrum analyzer.

Q. 3		**Attempt any four:**	**16-Total Marks**
	a)	**What is loading effect and sensitivity of multirange voltmeter?**	**4M**
	Ans:	**Loading Effect:** 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 meter then indicates a lower reading than what existed before the meter was connected. This is called the loading effect of an instrument. **Sensitivity:** The sensitivity of voltmeter means the response given by a voltmeter to input signal. It is the ratio of total resistance (RT) to the voltage range S = RT / V Where, RT – Total resistance…… RT = RS + Rm V= Voltage range. OR	**Loading effect (2M)** **Sensitivity (2M)**

		It is also defined as the reciprocal of full scale deflection current of the basic movement. S = 1 / Ifsd Ifsd = full scale deflection current.	
	b)	**How does electron beam generate horizontal refline on CRT screen?**	**4M**
	Ans:	• The Electron Gun Assembly produces a sharply focused beam of electron which is accelerated to a high velocity. • The electrons are accelerated by high positive potential which is applied to the pre-accelerating and accelerating anodes. • The electron beam is focused by the focusing anode. • This focused beam of electron strikes the fluorescent screen with sufficient energy to cause a luminous spot on the screen. • After leaving the electron gun, the electron beam passes through two pairs of 'electrostatic deflection plates'. The voltages applied to these plates deflect the beam. • Voltages applied to horizontal deflecting plates move the beam horizontally from one side to another. • Due to the horizontal movement the beam is positioned horizontally on the screen and a horizontal trace on CRO screen is obtained	**½ M for each point**
	c)	**Write the steps (and procedure) for measurement of frequency and phase of signal by CRO.**	**4M**
	Ans:	**<u>Phase :</u>** The phase measurement can be done by using Lissajous figures. The CRO is set to operate in the X- Y mode, then the display obtained on the screen of a CRO is called Lissajous pattern, when two sine waves of the same frequency are applied to the CRO. (One vertical and one horizontal deflection plates). Depending on the phase shift between the two signals, the shape of the Lissajous pattern will go on changing. The phase shift is given by, $\Theta = \sin^{-1} (A/B)$ **<u>Frequency :</u>** • 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= no of divisions × position of time/div knob. • The frequency is inversely proportional to the period. **Frequency= 1/Period**	**Phase-2M** **Frequency-2M**
	d)	**How does Halfwave rectifier typeAC analog voltmeter use to measure unknown voltage.**	**4M**
	Ans:		

		Diagram- 	**1M**
		• A circuit of a voltmeter using a half wave rectifier is shown • Suppose that the meter resistance is R_m and that of a multiplier is R_s , neglect the forward resistance of the diode. • When a d.c voltage V_{dc} = V is applied to the circuit, the current through the meter is $I_m = \frac{V}{R_m + R_s}$ which produces full scale deflection. • Now suppose an a.c sinusoidal voltage V = $V_m = \sqrt{2}V \sin wt$ is applied to the same circuit where V_m= peak value of a.c voltage & V = rms value of a.c voltage. • This voltage gets rectified and a unidirectional pulsating voltage is produced at the output of the rectifier. This pulsating voltage produces a pulsating current and hence a pulsating torque. • Because of the inertia of the moving parts PMMC indicates a deflection corresponding to average value of current which is dependent up on the average value of applied voltage. • Average value of voltage • $V_{av} = \frac{1}{2\pi} \int_0^{\pi} V_m \sin wt \, d(wt) \quad = \frac{1}{\pi} V_m$ $= 0.318\, V_m$ $= 0.318 * \sqrt{2}V$ $= 0.45\, V$ • Therefore, current through the meter is $\frac{0.45\, V}{R_m + R_s}$ which produces a deflection that is 0.45 times that produced with d.c of equal magnitude, V. • Hence sensitivity of a half wave rectifier instrument with a.c 0.45 times its sensitivity with d.c. • S_{ac} = 0.45 S_{dc} • Therefore the pointer will deflect for a full scale of 10V d.c is applied and 4.5V when a 10 V_{rms} sinusoidal signal is applied. This means that an a.c voltmeter is not as sensitive as a d.c voltmeter.	**2M**

			**1M**
	e)	**Calculate the value of multiplier, i fbasic movement having (l fsd) full scale deflection current of lOrnA and Internal resistance Rm of 50 n is used to measure 400 volts.**	**4M**
	Ans:	Given data: Ifsd=10mA Rm=50Ω V=400volts. Rs= $\frac{V}{\text{Im}} - Rm$ $= \frac{400}{10\text{mA}} - 50\Omega$ Rs= 40000-50 Rs= 39950Ω Rs= 39.95kΩ	 **1M** **1M** **1M** **1M**
	f)	**Describe the block diagram of Ramp type of voltmeter.**	**4M**
	Ans:	**<u>Block diagram-</u>**	**2M**



Working:

Unknown voltage to be measured is applied to the input side.

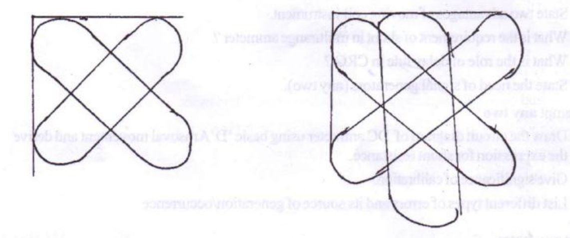
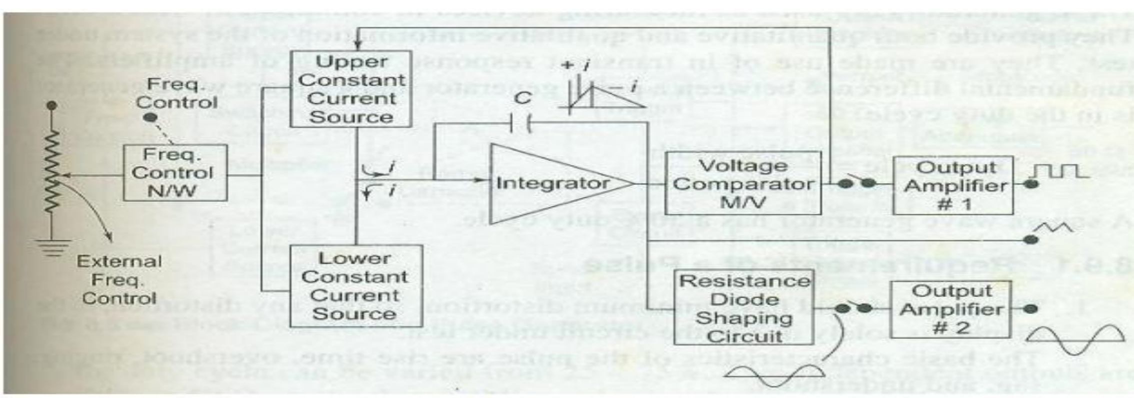
2M

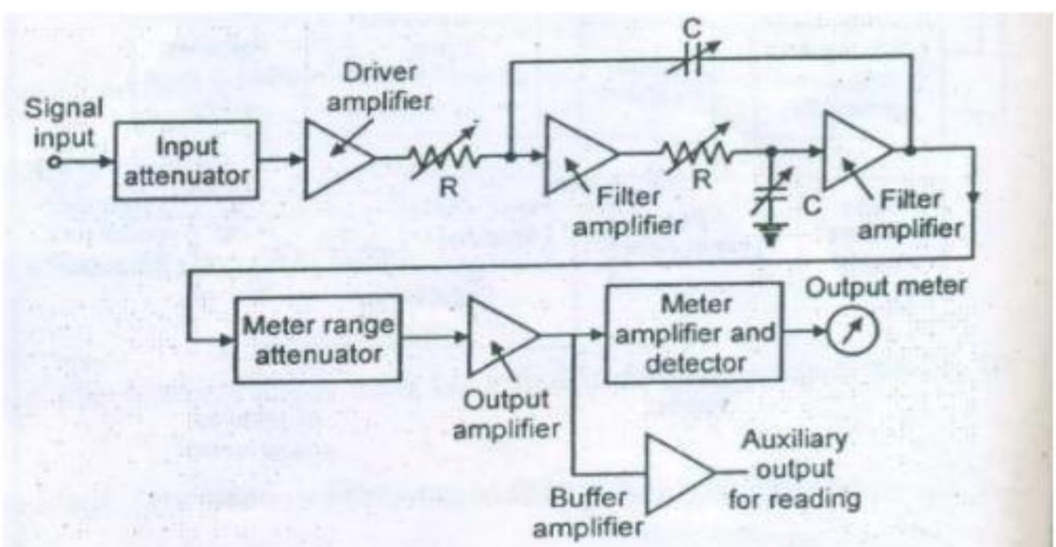
- Initially the logic circuit sends the reset signal to the counter and digital readout.
- Before the starting of measurement the counter and digital readout are resetted.
- The ramp generator, generates the ramp wave. This ramp may be positive going or negative going. Consider a positive going ramp. This ramp signal is applied to the both of the comparators.
- Here each comparator is design in such a way that when both the input signals of a comparators are equal then the comparator changes its states. That means when both input signals are equal then the output voltage swing of a comparator takes place.
- In this system, one comparator is used to open the gate while other comparator is used to close the gate.
- In this case we have considered a positive going ramp pulse.
- The reference voltage for the second comparator is the ground level.
- When the ramp signal crosses the zero voltage then both inputs of seconds comparators becoms equal.
- So the output stage of this comparator changes. This signal is sent to the logic control.
- The logic control circuit gives the signal to the logic gate. This causes the opening of gate.
- Once the gate is opened; the counter starts counting the number of pulses. These number of pulses are provided by the local oscillator.
- The number of pulses generated by the local oscillator in a particular time interval depends on the frequency of local oscillator.
- The ramp signal is applied to both comparators. One input terminal of first comparator is connected to the input unknown voltage.
- When the ramp voltage becomes equal to input unknown voltage; then both input signals of first comparators are equal. So the output stage of this comparator are changes.

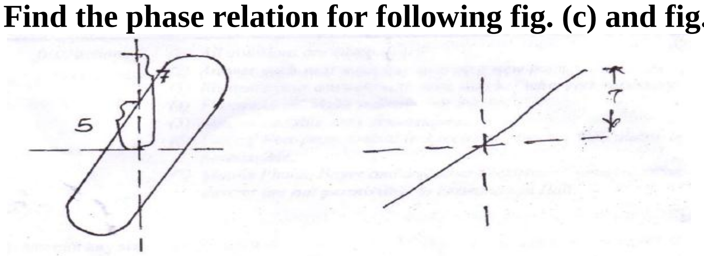
		• Now the signal from logic control circuit is used to close the gate. • Once the gate is closed, the number of pulses will stop passing to counter. So the counter will stop the counting operation. • During the time interval between opening and closing the gate; a definite number of pulses will be counted by the counter. • This number is displayed by the digital readout.	
Q. 4	**A)**	**Attempt any four :**	**16-Total Marks**
	a)	**Compare analog instruments with digital instruments.**	**4M**
	Ans:	(see table below)	**each 1M**

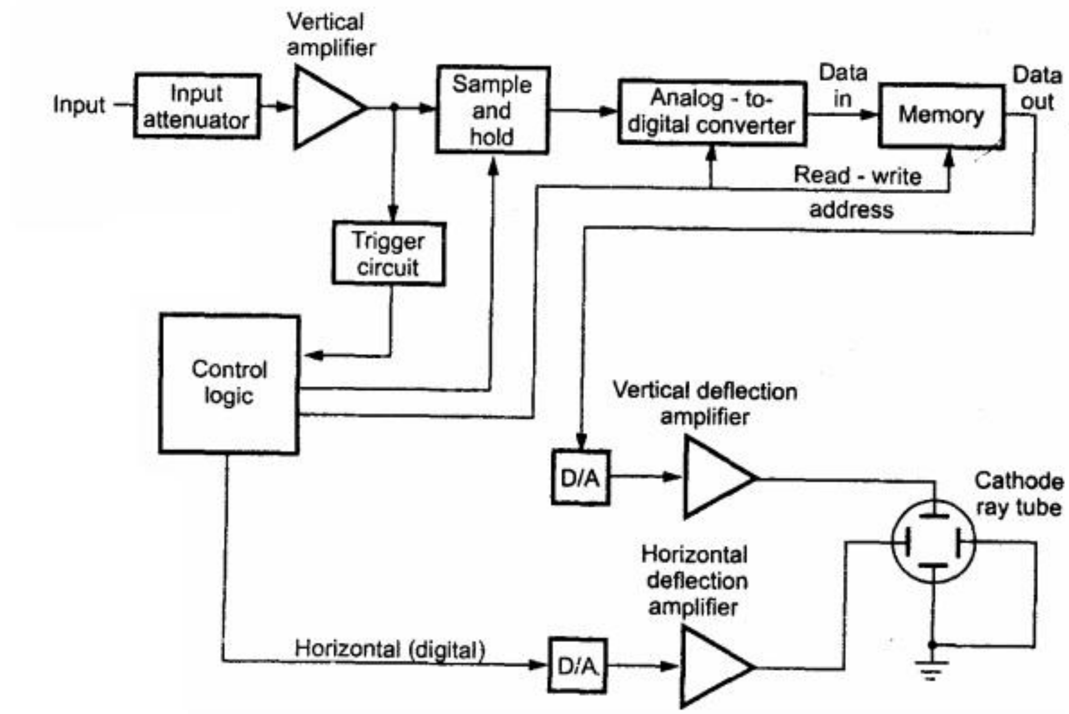
Sr. No.	Parameter	Analog instrument	Digital instrument
1	Principle	The instrument that displays analog signals is called as an analog instrument	The instrument that displays digital signals is called as an digital instrument
2	Accuracy	Low	High
3	Resolution	Low	High
4	Power required	Require more power	Require 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

	b)	**A 2mA meter with internal resistance of 100 n is to be converted to 0 - 150 rnA ammeter.** **Calculate the value of Shunt resistance required.**	**4M**
	Ans:	**Given data:** **Im=2mA** **Rm=100Ω** **I=1-150mA**	**1M**
		Rsh $= \frac{ImRm}{\mathrm{I-Im}}$	**1M**
		$= \frac{2mA\times 100\Omega}{150\mathrm{mA}-2\mathrm{mA}}$	**1M**
		$= \frac{2mA\times 100\Omega}{148\mathrm{mA}}$	
		Rsh=1.35Ω	**1M**
	c)	**State two advantages and two disadvantages of PMMC meter.**	**4M**
	Ans:	<u>**Advantages of PMMC meter: (Any two)**</u> 1. It has uniform scale. 2. Power consumption is low	**2M**

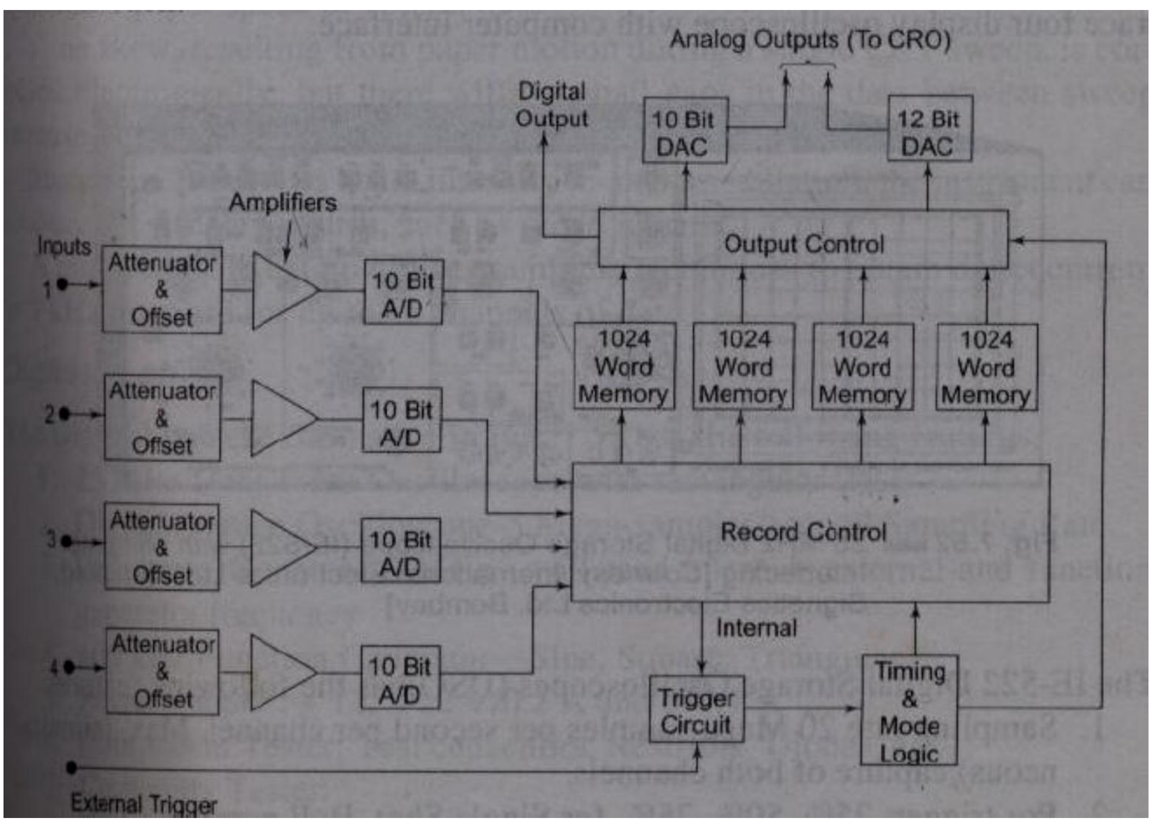
		3. It can be obtained in wide ranges. 4. High sensitivity & accuracy 5. It is unaffected by external magnetic field. 6. Additional damping device not required. **Disadvantages of PMMC meter: (Any two)** 1. It is suitable for d.c. measurement only. 2. Comparatively high cost than moving iron type instrument. 3. Ageing of permanent magnet & spring introduce errors 4. Friction due to jewel- pivot suspension.	**2M**
	d)	**Calculate the vertical input frequency if horizontal frequency is 1500 Hz for fig. (a) and fig. (b).**  Fig. (a) Fig. (b)	**4M**
	Ans:	**Fig a .** **X=2, Y= 2** Therefore, fy= X/Y x f Fy = 2/2 x 1500 Fy= 1.5 KHZ **Fig b.** X=3, Y=2 Therefore, fy= X/Y x fx = 3/2 x1500Hz Fy= 2.25 KHZ	**1M** **1M** **1M** **1M**
	e)	**Explain the block diagram of function generator.**	**4M**
	Ans:	**Block diagram:**  **Fig: Function Generator.** **Working:** • The frequency is controlled by varying the capacitor in LC or RC circuit. In this instrument the frequency is controlled by varying the magnitude of current which	**2M** **2M**

		drives the integrator. The instrument produces sine, triangular and square waves with a frequency range of 0.01 Hz to 100 kHz. • The frequency controlled voltage regulates two current sources. • The upper current source supplies constant current to the integrator whose output voltage increases linearly with time, according to the equation of the output signal voltage. • t eout = -1 ∫ i dt C 0 An increase or decrease in the current increases or decreases the slope of the output voltage and hence controls the frequency. • The voltage comparator multivibrator changes states at a pre- determined maximum level of the integrator output voltage. • This change cuts off the upper current supply and switches on the lower current supply. • The lower current source supplies a reverse current to the integrator, so that its output decreases linearly with time. • When the output reaches a pre-determined minimum level, the voltage comparator again changes state and switches on the upper current source. • The output of the integrator is a triangular waveform whose frequency is determined by the magnitude of the current supplied by the constant current sources. • The comparator output delivers a square wave voltage of the same frequency. • The resistance diode network alters the slope of the triangular wave as its amplitude changes and produces a sine wave with less than 1% distortion.	
	f)	**Explain the working principle of wave analyser with neat block diagram.**	**4M**
	Ans:	**<u>Block diagram:</u>**  **<u>working principle:</u>** • A wave analyzer consists of a primary detector, which is a simple LC circuit. • This LC circuit is adjusted for resonance at the frequency of the particular harmonic component to be measured.	**2M** **2M**

		• The intermediate stage is a full-wave rectifier to obtain the average value of input signal. • The indicating device is a simple DC voltmeter that is calibrated to read the peak value of the sinusoidal input voltage. • Since the LC circuit is tuned to a single frequency, it passes only the frequency to which it is tuned and rejects all other frequencies. • A number of tuned filters, connected to the indicating device through a selector switch would be required for a useful wave analyzer.	
Q.5		**Attempt any four :**	**16-Total Marks**
	a)	**i) What is the resolution of 4 ½ DMM.** **ii) Write two uses of Video pattern generator.**	**4M**
	Ans:	**i) <u>Resolution of 4 ½ DMM</u>:** The number of digit positions used in a digital meter determines the resolution. Hence a four and a half digit meter could display up to 19999. Resolution can also be defined as the ratio of change in analog output voltage resulting from a change of 1 LSB at the digital input. **ii) <u>Uses of Video pattern generator</u>**: It is a device which can generate video signals that can be fed to a TV or video monitor. The pattern consists of geometrical figures such as circles, ellipses, horizontal/vertical lines and bars, checker board, dots etc. **<u>The various patterns are used for</u>** (1)The **<u>horizontal pattern</u>** is used to check vertical linearity. (2) The **<u>vertical pattern</u>** is used to check horizontal linearity (3) The **<u>cross hatch pattern</u>** is used to check vertical and horizontal linearity simultaneously and more precisely. (4) **<u>FM signal</u>** is used for aligning sound IF as well as discriminator circuit.	**2M** **2M**
	b)	**Find the phase relation for following fig. (c) and fig. (d).**  Fig. (c) Fig. (d)	**4M**
	Ans:	**$\Theta=\sin^{-1}A/B$** where **A=** Y axis intersect **B**= maximum vertical deflection 1) A=5, B=7 $\Theta=\sin^{-1}A/B = 45.58^0$ 2) A=0, B=7 $\Theta=\sin^{-1}A/B = 0^0$	 **2 M** **2 M**
	c)	**Draw the block diagram of DSO.**	**4M**
	Ans:	**<u>Block diagram-</u>**	**4M for Labeled diagram**

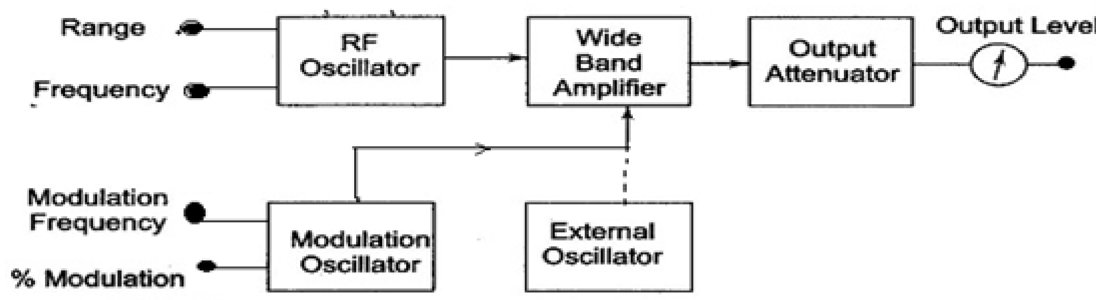

Vertical amplifier
Input
Input attenuator
Sample and hold
Analog - to- digital converter
Data in
Memory
Data out
Read - write
address
Trigger circuit
Control logic
Vertical deflection amplifier
D/A
Cathode ray tube
Horizontal deflection amplifier
Horizontal (digital)
D/A

OR


Analog Outputs (To CRO)
Digital Output
10 Bit DAC
12 Bit DAC
Amplifiers
Inputs
Output Control
Attenuator & Offset
10 Bit A/D
1024 Word Memory
Record Control
Internal
Trigger Circuit
Timing & Mode Logic
External Trigger

<table>
<tr><td></td><td>d)</td><td>Draw and explain RF signal generator.</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>

<u>Diagram-</u>

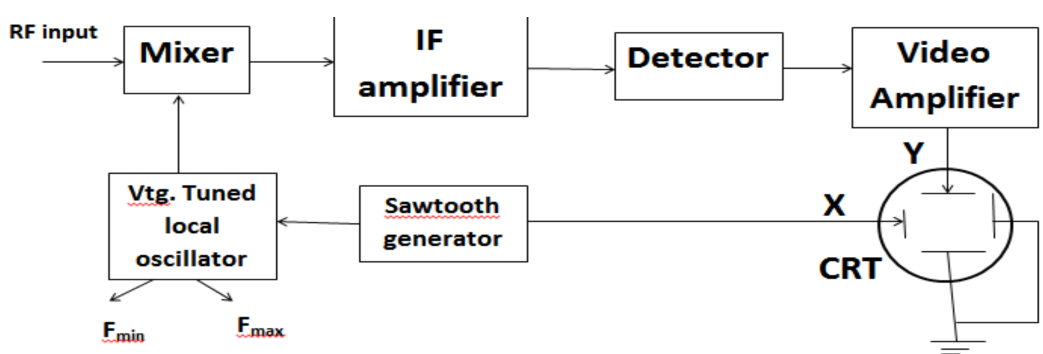


-The RF signal generator produces **controllable voltage and frequency**. The output signal from a signal generator is either frequency modulated or amplitude modulated. It is commonly used in **radio receivers and transmitters**. It is basically an RF signal generator.

<u>Operation:</u> Figure shows the block diagram of RF signal generator. The RF oscillator is formed by an LC tank circuit. It generates a stable carrier frequency over any frequency range. The oscillator is an LC tank circuit, so the frequency stability is limited. The frequency range is selected by connecting a switch to particular capacitor. The amplitude modulation is provided by an internal sine wave generated. It may also provide by an external source. The modulation is done in a wide band amplifier. For modulation sine, square, triangular wave or pulse maybe used. The output of wideband amplifier is connected to attenuator. The required range of attenuation is selected and level of output signal can be controlled. The output meter is used to give an indication of output signal.
</td><td>2M for Diagram (Any relevant diagram can be considered)

2M for Explanation</td></tr>
<tr><td></td><td>e)</td><td>Explain the block diagram of spectrum analyser.</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>

<u>Diagram-</u>



<u>Explanation-</u>

The main function of spectrum analyzer is to be obtaining 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 F_{min} to F_{max}. 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
</td><td>2M

2M</td></tr>
</table>

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 & detected & then it is applied to vertical deflecting plates of CRO, producing a plot of amplitude vs frequency.

f) What is the use of Q meter? Draw its neat diagram. **4M**

Ans: **<u>Q-meter :</u>** **2M for Q-meter uses**

- The Q meter is an instrument which is designed to measure the value of Q directly and is useful for measuring the characteristics of coils and capacitors i.e. it used for testing of inductors and capacitors.
- The Q factor is equal to $Q = \omega L / R$
  where ω = Angular frequency at resonance, L = inductance, R = Effective resistance of coil.

2M for diagram (Any relevant answer can be considered)

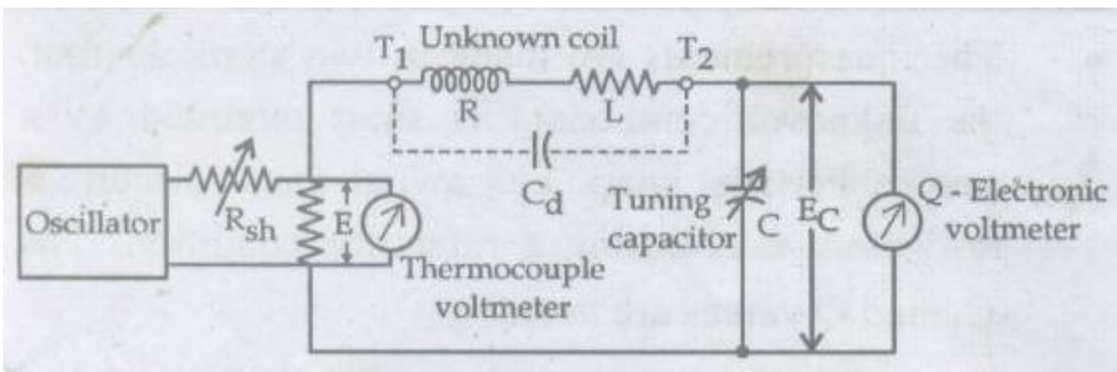
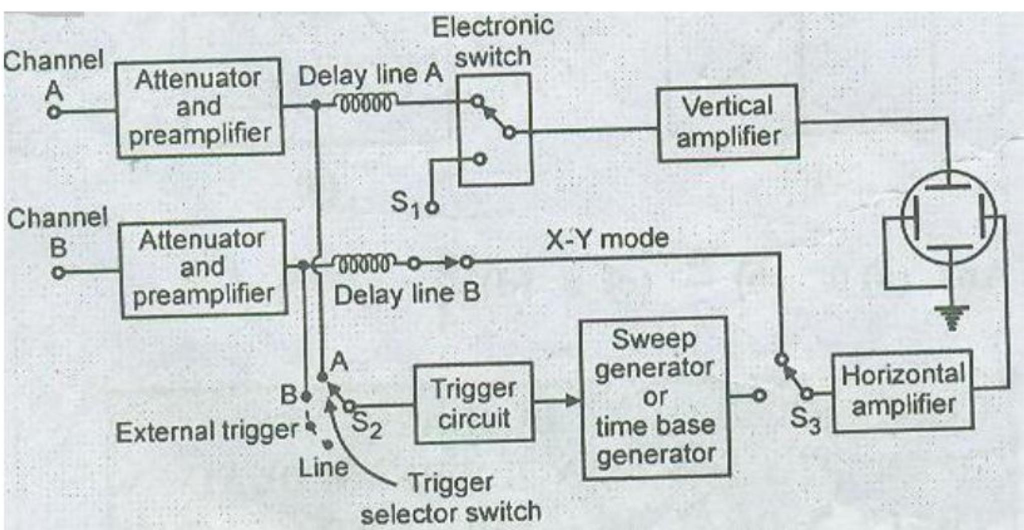


Fig. Q meter

Q.6		Attempt any four :	16-Total Marks

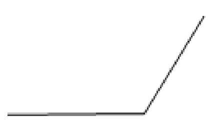
a) Draw dual trace CRO and explain the function ofAltiChop mode. **4M**

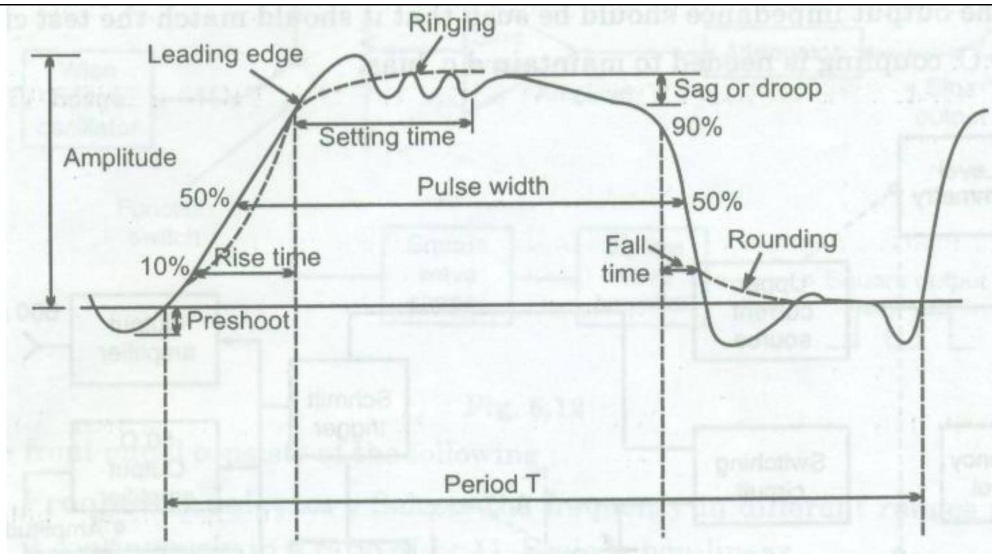
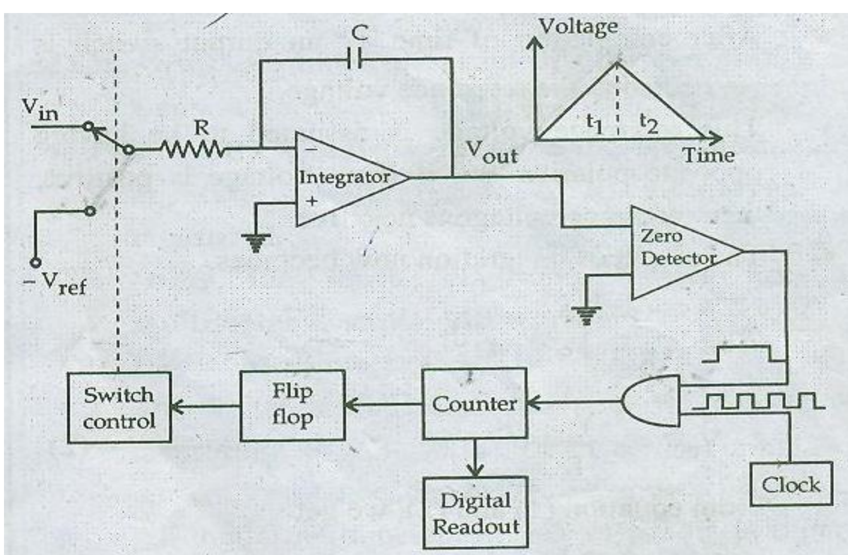
Ans: **<u>Diagram-</u>** **2M**



- In **"alternate mode"** electronic switch connects the two channels A & B alternately in successive cycles of sweep generator. The alternate mode cannot be used for displaying very low frequency signal. **1M**
- In **"Chop mode"** electronic switch will make several transition from one channel to the other channel during one sweep. **1M**

b) How diode and transistor are tested with help of (i) DMM (ii) CRO? **4M**

	Ans:	**1) <u>Using DMM:</u>** i)**<u>DMM for diode testing</u>:** Digital multimeters can test diodes using one of two methods: Diode test mode and resistance mode. **Diode Test mode**: A diode is best tested by measuring the voltage drop across the diode when it is forward-biased. A forward-biased diode acts as a closed switch, permitting current to flow. A multimeter Diode Test mode produces a small voltage between test leads. The multimeter then displays the voltage drop when the test leads are connected across a diode when forward-biased. **ii)<u>DMM for transistor testing</u>:** Assuming you know if the transistor is NPN or PNP, and assuming you know where B, C, and E are, then just test the B-C junction and the B-E junction as if they were standard diodes. if one of those junctions is a "bad diode", then the transistor is bad. Also, check the resistance from C to E using a higher Ohms scale (say, the 2 Meg scale). Be sure your fingers don't touch the metal test points or you will just measure your skin resistance. If the transistor is good, you should get an open-circuit reading from collector to emitter. **<u>2)Using CRO</u>: Component testing mode** i.e. **CT Mode** is used to test various components. **i)<u>CRO for Diode testing</u>:** when diode is forward biased, a current will flow, producing voltage drop across 1k ohm resistor. This is applied to vertical input. If diode is good, the current must be unidirectional & must show a curve which rises vertically from its horizontal position. This is shown in fig 1. The horizontal portion represents very small i.e. almost zero current in reverse direction. The angle between rising portion & horizontal portions indicates condition of the diode as shown in fig 2. If current rise is not shown at all, then we get only horizontal trace on CRO & diode can be concluded to be open i.e. faulty. This is shown in fig 3.  Fig 1. Good Diode  Fig 2. Parrially or shorted diode Fig 3. Open diode i.e. Faulty **ii) <u>CRO for transistor testing</u>:** The transistor consists of two p-n junctions. Each p-n junction can be tested using the procedure describe for diode testing, by this way transistor can also be tested by CRO.	**2M** **2M**
	c)	**i) Draw characteristics of pulse and label it.** **ii) Define - Rise Time, Overshoot.**	**4M**
	Ans:	**<u>Diagram-</u>**	**2M for correct labeled diagram**

		 **Fig. characteristics of pulse** **<u>Rise time:</u>** The time required for the pulse to reach from 10% to 90% of it's amplitude, is called Rise time. **<u>Overshoot</u>**: It is maximum height immediately following leading edge.	1M 1M
	d)	**Explain the block diagram of Dual slope DVM.**	**4M**
	Ans:	**<u>Dual Slope Integration Type DVM:</u>** • The ramp type DVM (single slope) is very simple yet has several drawbacks. The major limitation is the sensitivity of the output to system components and clock. • The dual slope techniques eliminate the sensitivities and hence the mostly implemented approach in DVMs. • Dual slope integration technique is basically voltage to time conversion method. In thiscase, integration is done for unknown voltage and then the same integrator is used to dothe integration with reverse slope. So, this is called as dual slope integration method.  **Fig. Block Diagram of Dual Slope Type Digital Voltmeter**	**2M for diagram** **2M for explanation**

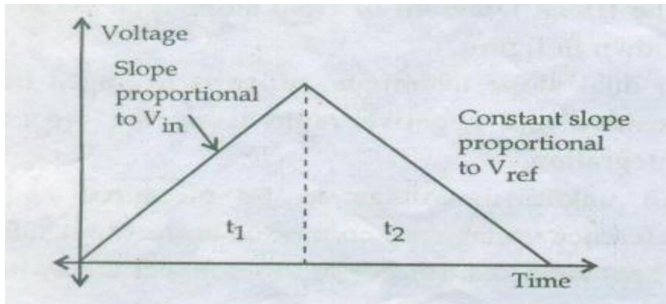


Fig. Waveform of Voltage versus Time

Operation:

- At the start of measurement the counter is reset to zero. So output of flip flop is zero.
- This is applied to the switch control. The switch control now connects input voltages (**Vin**) to the integrator.
- Integrator now starts integrating the input voltage.
- The integrator output is given by,

Vout= $-\frac{1}{RC}\int_0^{t1} \text{Vin}\,dt$

Vout= $-\frac{\text{Vin t1}}{RC}$ --------------------(1)

Here, Vin = Unknown voltage to be measured.
R= resistor connected in series with op amp.
C= Capacitor connected in the feedback path.
t1 = Time period for which the capacitor was charged.

- That means the capacitor starts **charging**. Because of this the output of integrator changes from zero value.
- It causes the zero detector (comparator) to change is stage. That means it provides a high signal to the logic gate. Thus the **opening of logic gate** takes place.
- When the logic gate is opened, the number of clock pulses is passed to the counter. The counter will count these pulses for certain time t1.
- After this time the counter is reached to 999. After this "1" is passed to flip- flop.
- The output of flip –flop is now "1". This is connected to the control logic.
- The switch control logic now changes the position of switch from Vin to Vref.
- So integrator will starts integrating this reference voltage **(-V ref**).
- The integrator output is given by,

Vout= $\frac{1}{RC}\int_0^{t2} -\text{Vref}\,dt$

Vout= $-\frac{\text{Vref t2}}{RC}$ ---------------------(2)

Subtracting (1) from (2), we get

Vin= -Vref $\frac{t2}{t1}$

Here, Vref = Known reference voltage.
R= resistor connected in series with op amp.
C= Capacitor connected in the feedback path.
t2 = Time period for which the capacitor was discharged.

- This will cause the capacitor to start discharging. The **discharging** of capacitor will take

		place for the time period. The discharging path is having a constant negative slope. This slope is as shown in Fig. • A stage will be reached at which output of integrator becomes zero. • This stage is obtained at the end of time period t2. At this instant the output of zero detectors gets changed. This will cause the **closing of logic gate**. • Now the pulses from clock are not allowed to pass towards the counter. The counting operation is completed. Then the data from counter is passed to the digital readout for display purpose.	
	e)	**List the specification of DMM.**	**4M**
	Ans:	**Specifications of DMM are as follows:** **1. D.C. Voltage:** • Voltage range from +20V to +1000V • Accuracy about +0.03% • Resolution is about 10µV **2. AC Voltage:** • Voltage range from 200mV to 750V • Accuracy is frequency dependent • Resolution: 10µV **3. Resistance:** • Resistance range from 200Ω to 20 M Ω • Accuracy: +0.1% of reading **4. DC current:** • Current range from +200µA to 2A • Accuracy +0.3% of reading • Resolution +0.01µA **5. A.C Current:** • Range from 200µA to 2A • Accuracy depends on frequency	**1M each for any correct 4 points**
	f)	**Give the functions any four knob of following:** **i) X-shift on CRO.** **ii) CT MODE Button on CRO.** **iii) Symmetry knob on function generator.** **iv) Level knob on function generator.** **v) V/div on CRO.** **vi) Mono/Dual Button on CRO.**	**4M**
	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)**