WINTER– 18 EXAMINATION

Subject Name: Electronic Instruments & Measurements **Model Answer** 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 any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	A	**Solve any six:**	12
	a)	Define: i)Accuracy ii)Precision Ans **Accuracy:** The degree of closeness with which an instrument approaches the true value of the quantity being measured is known as accuracy. **Precision:**The measure of the degree to which successive measurements differ from each other is known as precision	(1M Each)
	b)	**Compare analog and digital multimeter.** Ans:	(Any two points-2M)

Sr. No.	Analog Multimeter	Digital Multimeter
1.	Power supply is not required.	Power supply is required.
2.	Better visual indication of changes in the reading is obtained.	Visual indication of changes in the reading is not that much better.
3.	Less suffered from electric noise.	More suffered from electric noise.
4.	Less isolation problem.	More isolation problems.
5.	Accuracy is less	High accuracy is obtained.
6.	The output cannot be interfaced with external equipment	The output can be interfaced with external equipment
7.	Construction is simple	Construction is complicate.
8.	Bigger in size	Smaller in size.
9.	Many times output is ambiguous	An unambiguous reading is obtained.
10.	Less expensive	More expensive.

c) **State applications of digital frequency meter.** (Any two applications- 2M)

Ans:

1. For testing radio equipment
2. Measuring the temperature, pressure, and other physical values.
3. Measuring vibration, strain
4. Measuring transducers

d) **State the advantages of Digital instrument**. (Any two-2M)

Ans:

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

e) **List different types of CRO probes (any four)** (Any four-2M)

Ans:

1. Passive probes
2. Active probes
3. High voltage probes
4. Current probes
5. Differential probes

f) **State the difference between CRO and DSO**. (Any Two-2M)

Ans:

CRO	DSO
Direcly reads analog voltage and displays it on screen.	It reads the analog voltage and converts it into digital form before being displayed on the screen.
Do not require ADC, microprocessor and acquision memory	Requires ADC, microprocessor and acquisition memory
Can only analyze signal in real time as there is no storage memory available.	Can analyze signal in real time as well as can analyze previously acquired large samples of data with facility of storage available.
Can not analyze high frequency sharp rise time transients	Can analyze high frequency transients due to advanced DSP algorithms available and ported on microprocessor which can operate on stored samples of input voltage.

g) **Define signal generator and state its need.** (Definition-1M, Need-1M)

Ans:

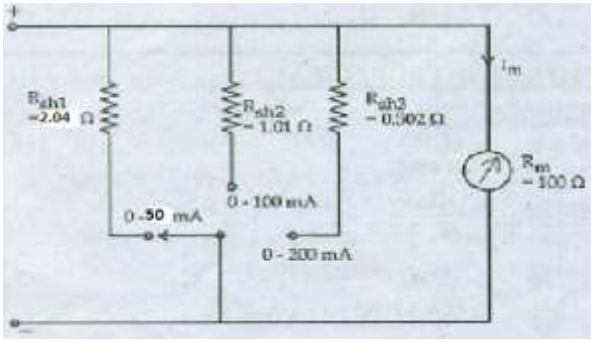
Signal Generator: A signal generator is an electronic device that generates repeating or Non-repeating electronic signals in either the analog or the digital domain.

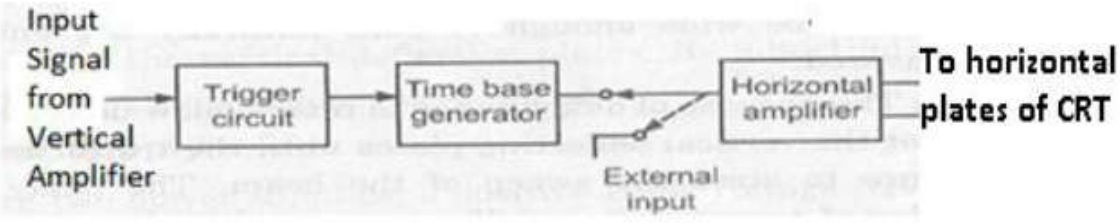
Need: The generation of signals is an important activity of electronic development and troubleshooting. Therefore a signal generator is a vital electronic instrument in laboratory test setup which provides signals for general test purposes.

1. It is used to provide known test conditions for the performance evaluation of

		various electronic systems and for replacing missing signals in systems being analysed for repair.	
	h)	**State two uses of logic analyser.** Ans: 1. Real time application 2. Troubleshooting and analysis of digital systems 3. Compatible with printer using RS 232 and IEEE 488 interface 4. Testing the IC"s to detect defect before constructed. 5. To find out hardware defect. 6. VLSI chip design Industries. 7. In various software industries. 8. To find fault in Bio- medical instruments.	(Any Two Uses-2M)
	B	**Attempt any two:** **a) Define standards. State and explain classification of standards.** 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.	8 (Definition-1M, State-1M, Explanation-2M)

		These are not available to ordinary user for measurement. **2) Primary standards** These standards are preserved and maintained by National Standard Laboratories which are located at different part of the world. e.g.-NBS (National Bureau of Standards) located at Washington. These standards are periodically calibrated by International standards. **3) Secondary standards** These standards are also called as basic standards. These standards are used by industries and calibration laboratories. Each industry has its own laboratory. **4) Working standards** These standards are used in general laboratories. These standards are used to check components and calibrating laboratory instruments to achieve good accuracy and better performance.	
	b)	**How are instruments classified? Describe the different types.** Ans: **The instruments are classified depending upon:** a. Principle of operation: E.g.: Magnetic meter, induction meter. b. Permissible percentage error c. Depending upon application: E.g.: ammeter, voltmeter, energy meter etc. **Different types:** The electronic instrument may be classified into two types: 1. **Absolute instrument:** The instruments which give the output in the terms of physical constants of the instruments are called as absolute instruments. Example: Tangent galvanometer works on balance condition of current. Basically these instruments are time consuming; it takes a lot of time to complete the magnitude of the quantity under measurement. Absolute instruments are seldom used except in standard institution.	(Correct reason-2M, Different types-2M)

		2. **Secondary instrument:** These are simple in construction and easy to understand. Here the quantity can only be measured by observing the output indicated by instrument. Example: Voltmeter, Thermometer, pressure guage.	
	c)	**Design a multirange DC ammeter (Shunt resistor type) for R_m=100Ω, $I_{m=}$ 1mA and required current ranges are 0-50mA, 0-100mA and 0-200mA** Ans: **Given:** $R_m = 100\Omega$, $I_m = 1mA$ I1 = 50 mA, I2 = 100mA I3 = 200mA To find : 1) Rsh1 2) Rsh2 3) Rsh3 Soln. m1 = I1 / Im = 50mA / 1 mA = 50 Therefore, Rsh1 = R_m / m1 -1 = 100 / 50 – 1 = 2.04 Ω **Therefore, Rsh1 = 2.04 Ω** **(1M)** m2 = I2 / Im = 100mA / 1 mA = 100 Therefore Rsh2 = R_m / m2 -1 = 100 / 100 – 1 = 1.01 Ω **Therefore Rsh2 = 1.01 Ω** **(1M)** M3 = I3 / Im = 200mA / 1 mA = 200 Therefore Rsh3 = R_m / m3 -1 = 100 / 200 – 1 = 0.502 Ω **Therefore Rsh3 = 0.502 Ω** **(1M)** **Design** **(1M)** 	(Correct design- 4M)
2		**Attempt any four:**	**16**

	a)	**Explain gross error, systematic error and random error.** Ans: 1) **Gross Errors** -These errors occur due to human mistakes while taking reading, handling instrument, incorrect setting or adjustment and improper used of instrument. The complete elimination of gross errors is not possible but we can minimize it. These errors may be avoided by taking reading and recording it carefully. 2) **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. These errors are further classified as – i) Instrumental errors – These errors arise due to inherent shortcoming of instrument, misuse of instrument, loading effect of instrument. These errors can be removed by selecting suitable instrument for particular application. ii) Environmental error- These errors occur due to external condition to the measuring instrument, such as temperature, pressure, humidity, dust and external magnetic field. These errors can be avoided by keepingcondition constant with the help of air conditioning, temperatures control, enclosure etc. iii) Observational error – observational error introduced by observer. The most common error is the parallax error introduced in reading a meter scale. 3) **Random Errors** – These errors are due to unknown causes. These errors remain since the systematic and gross error are removed. Generally these errors are very small.	(Correct Answers-4M)
	b)	**Draw and explain block diagram of Horizontal deflection system.** Ans:  Fig. Block diagram of horizontal deflection system **Trigger circuit:** A trigger circuit is used to convert the incoming signal into trigger pulses, so that the input signal and the sweep frequency can be synchronized.	(Diagram-2M, Explanation-2M)

The trigger circuit is activated by signals of a variety of shapes and amplitudes, which are then converted to trigger pulses of uniform amplitude, for the precision sweep operation.

Time base Generator:

A time base generator is used to generate the saw tooth voltage required to deflect beam in the horizontal section. The circuit used to generate the saw tooth is called the continuous sweep generator.

But the disadvantage of the sweep generator is that, it cannot follow the variations of fast varying signals, like voice signals or music signals.

Hence this circuit has to be modified. The modified circuit is called the triggered Sweep Generator. The timing circuit of the time based generator gives the time/div control on the front panel.

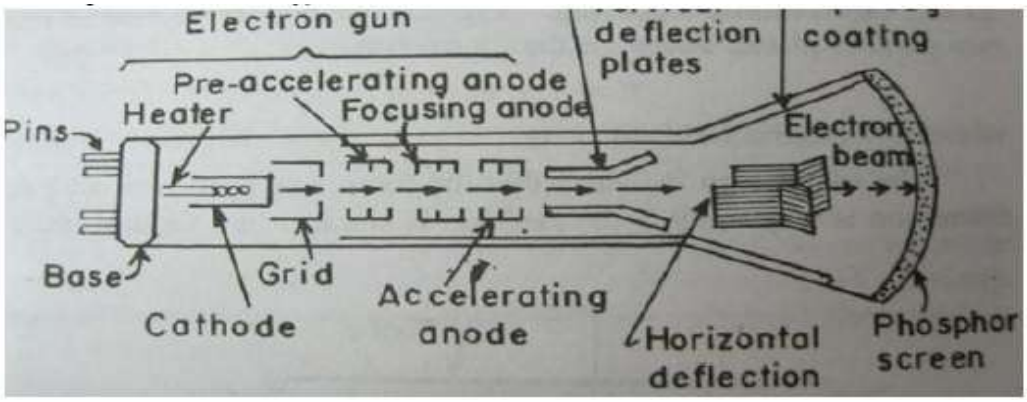
Horizontal Amplifier:

The Horizontal amplifier is used to amplify the saw tooth voltage, before it is applied to the horizontal section. The block consists of a push- pull amplifier

c) **Draw the construction of CRT. Write two materials used for CRT display screen.**

(Diagram: 3M, Two materials- 1M)

Ans: Diagram:



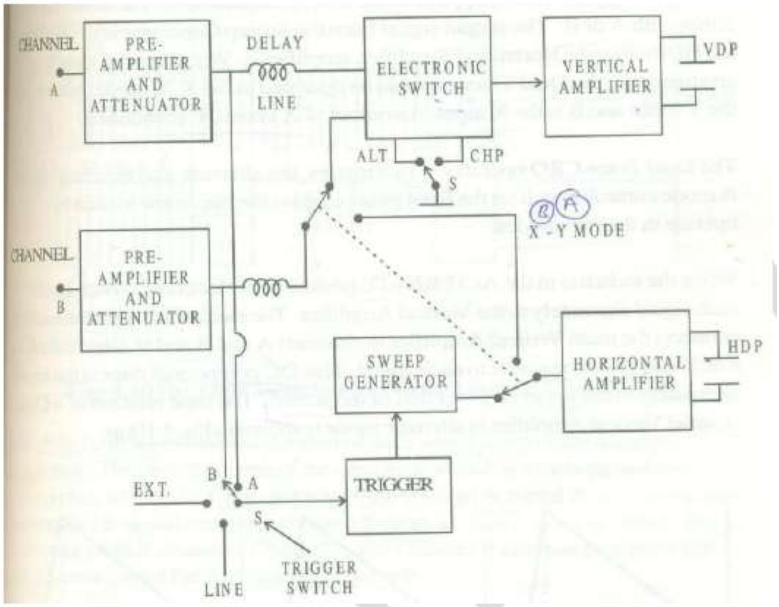
Two materials used for CRT display screen:

The role of this part is to display where the electrons are hitting the CRT.

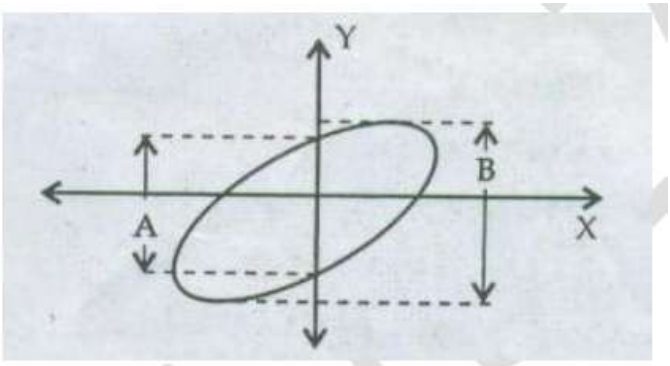
It is a screen coated with a material that emits light when struck by electrons.

Zinc sulphide or Phosphorus are two commonly used materials.

	d)	**Explain the measurement of voltage and frequency using CRO.** Ans: **Voltage Measurement:** CRO displays the voltage signal as a function of time on its screen. The amplitude of that voltage signal is constant, but we can vary the number of divisions that cover the voltage signal in vertical direction by varying volt/division knob on the CRO panel. Therefore, we will get the amplitude of the signal, which is present on the screen of CRO by using following formula. A=j×nv Where, A is the amplitude j is the value of volt/division nv is the number of divisions that cover the signal in vertical direction. **Frequency measurement:** • The period and frequency of periodic signals are easily measured. • The period is the time between two identical points of successive cycle of the waveform. $$Period = Number\ of\ divisions\ \times poisition\ of\ \frac{time}{div}\ knob$$ • The frequency is inversely proportional to the period. $$\boldsymbol{Frequency = \frac{1}{period}}$$	(2M Each)
	e)	**Explain the concept of single beam dual trace CRO with its block diagram.** Ans: **Diagram:**	(Diagram-2M, Explanation-2M)



Explanation: The single beam dual trace CRO consists of one electron gun, an electronic switch which switches the two signals to a single vertical amplifier and a single pair of horizontal deflection plates, as compared to a dual beam CRO. The block diagram of a Dual Trace CRO is shown in fig. It consists of a single electron gun, whose electron beam is split into two by an electronic switch. There is one control for focus and another for intensity. The two signals are displayed simultaneously. The signals pass through identical vertical channels or vertical amplifiers. Each channel has its own calibrated input attenuator and positioning control so that the amplitude of each signal can be independently adjusted. As shown in fig., two channels A and B are used. Signals from A and B are applied through a pre-amplifier and attenuator, which brings the signal within an acceptable level for amplification. It is then passed through a delay line, to delay the signal to the vertical section so that the sweep or the horizontal section can start well in advance. The output from both channels A and B are applied to an electronic switch, which operates in two modes, alternate and chop mode. In the alternate mode, signals from the two channels are applied alternately to the VDP and in the chop mode, small segments of the signal from the two channels are applied alternately to a single pair of VDPs. The dual trace CRO operates in two modes, the alternate and the chop mode. A mode control switch on the front panel enables the electronic switch to operate in two modes. When the switch is in the ALTERNATE position, the electronic switch feeds each signal alternately to the vertical amplifier. The electronic switch alternately connects the main vertical amplifier to channels A and B and at same time adds a different DC component to each signal. This DC component directs the beam alternately to the upper or lower half of the screen. When the switch is in the CHOP mode position, the electronic switch is free and running at the rate of 100-500 KHz, entirely independent of the frequency of the Sweep Generator. The switch successively connects small segments of A and B waveforms to the main vertical amplifier at a relatively fast chopping rate of 500 KHz. In the X-Y mode of operation, the Sweep Generator is disconnected and channel B is connected to the Horizontal

		Amplifier. Since both pre-Amplifier are identical & have the same delay time, accurate X-Y measurements can be taken.	
	f)	**Explain measurement of phase and frequency using Lissajous pattern. Write the formula for each one.** Ans: (2M Each) **Phase measurement of Lissajous pattern:** 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, $\Theta = \sin^{-1}(A/B)$  A. The Lissajous pattern will be an ellipse if the sine waves of equal frequency but phase shift between 00 and 900 are applied to the two channels of CRO. The Lissajous pattern will be as shown below-	

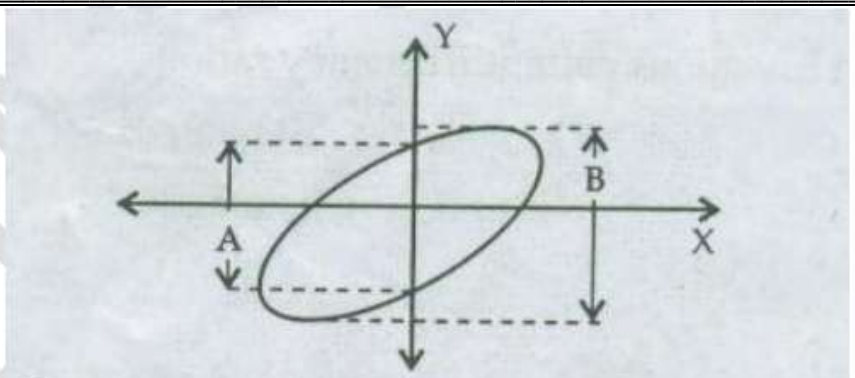
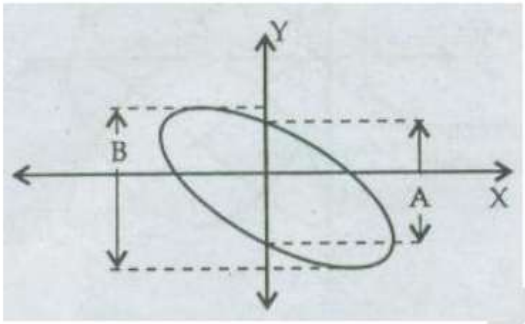
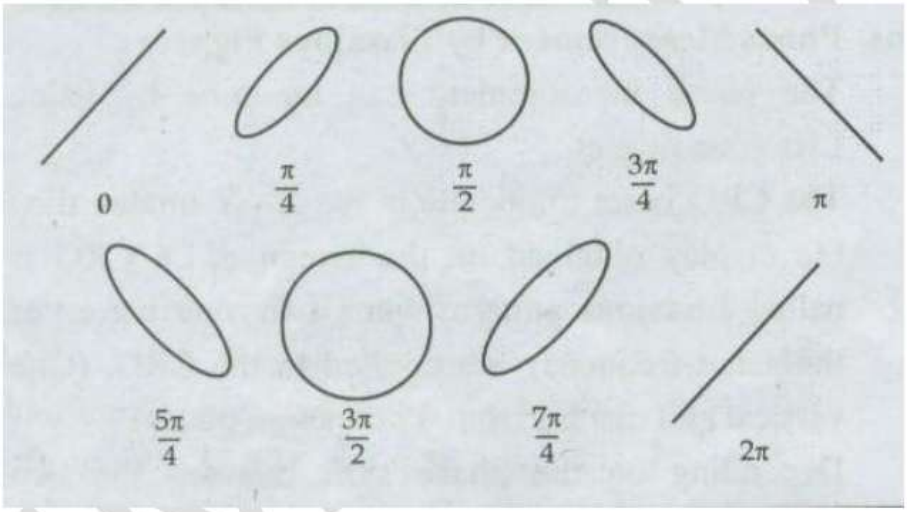


Fig. Lissajous pattern for ellipse for $0° < \theta < 90°$

B. For the phase difference above 90^0 and less than 180^0, the ellipse appears as shown

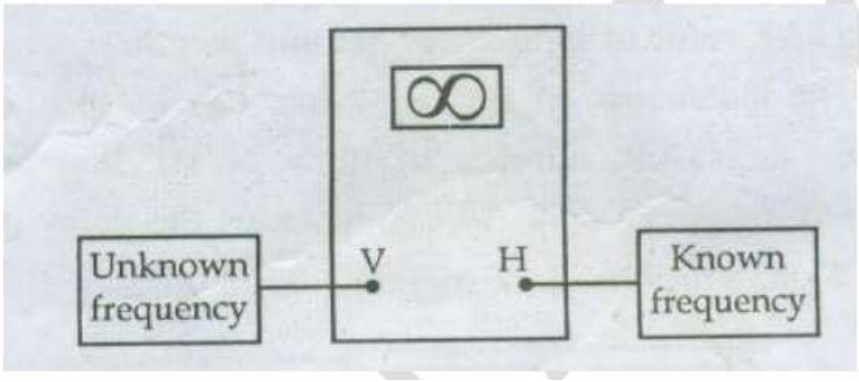


C. Different Lissajous figure for phase difference 0^0, 45^0, 90^0, 135^0, 180^0, 225^0, 270^0, 315^0, 360^0 are shown below respectively



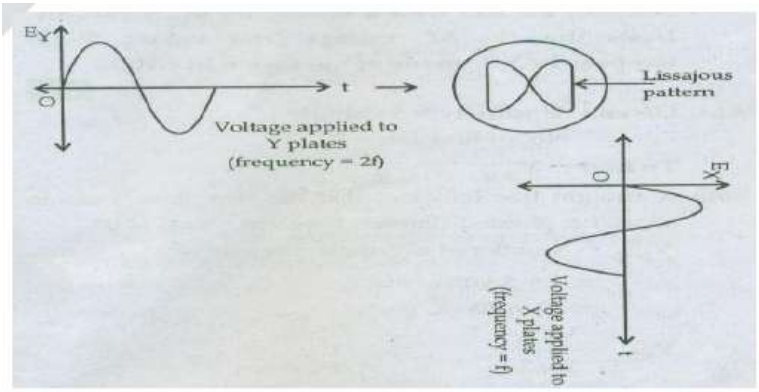
Frequency measured using Lissajous pattern:
Lissajous pattern can be used for measurement of unknown frequency.

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.

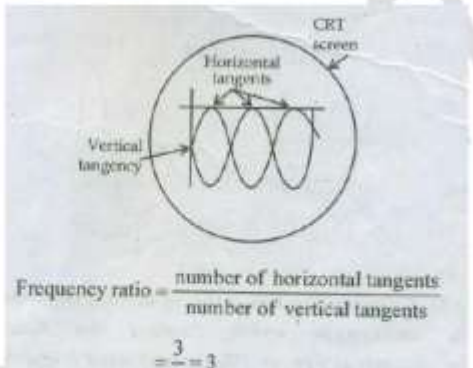


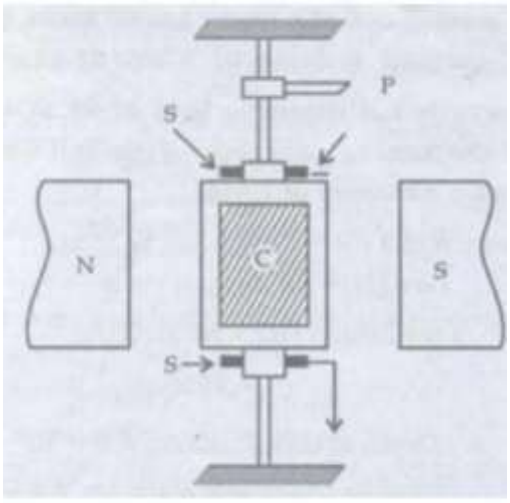
- Consider two sine waves are applied to Y plate and X plate of the CRO.
- The frequency applied to Y plate is twice that applied to the X plates. The Lissajous patte obtains is shown in figure.
- The figure ratio is given by,

$$\frac{fy}{fx} = \frac{\text{number of horizontal tangents}}{\text{number of vertical tangents}}$$

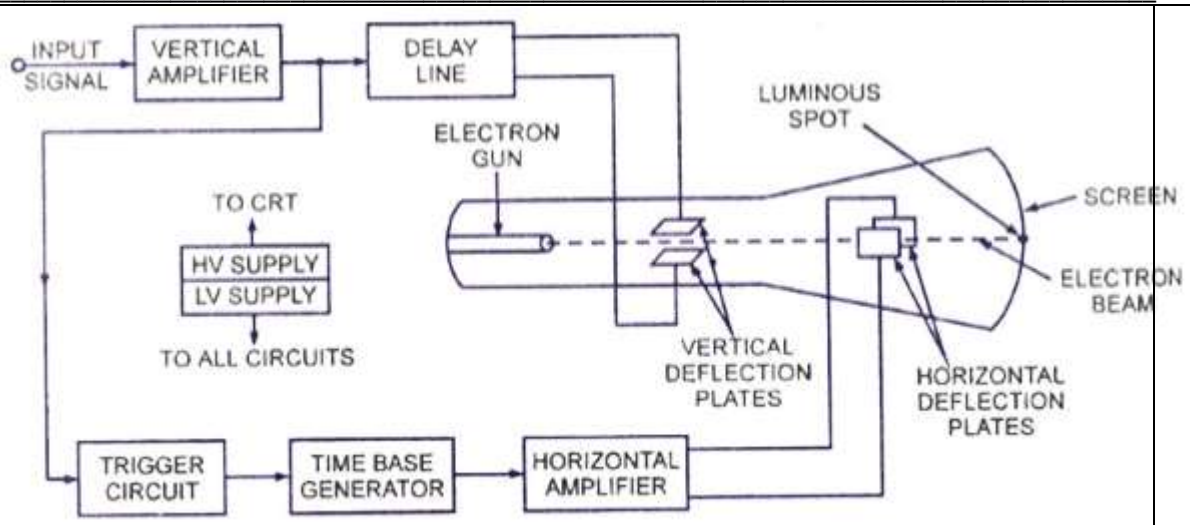
Some examples are given below,

1. Lissajous pattern for ratio 3:1



3	a)	**Attempt any four** **Define the following:** **1) Speed of response 2) Lag 3) Fidelity 4) Dynamic Error.** **Ans:** **(1) Speed of Response:** It is the rapidity with which an instrument responds to changes in the measured quantity. (2) **Lag :** It is the retardation or delay in the response of an instrument to changes in the measured variable. (3) **Fidelity:** It is the degree to which an instrument indicates the changes in the measured variable without dynamic error (faithful reproduction). (4) **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.	**16** (Each definition for 1M)
	b)	**Draw the construction and explain working principle of PMMC instruments** **Ans:**  **Fig: PMMC Instrument** **Working:** When current passes through the coil a deflecting torque is produced. This deflecting torque is produced due to interaction between magnetic field produced by permanent magnet and magnetic field produced by moving coil. Due to this torque the coil deflects and this deflection is proportional to the current flowing through the coil. The pointer attached to the coil indicated the magnitude of quantity being measured. The another torque is developed by the hair spring known as controlling torque. This torque helps to stabilize the pointer. The pointer becomes stable at equilibrium; this is possible only when the controlling torque becomes equal to the deflecting torque	**(Construction2 M, Working Principle 2M)**
	c)	**Derive the relation for deflection torque in PMMC instrument.** **Ans:** The length of coil be l meter and width of coil be d meter. Assume I is the current	**(Derivation 4M)**

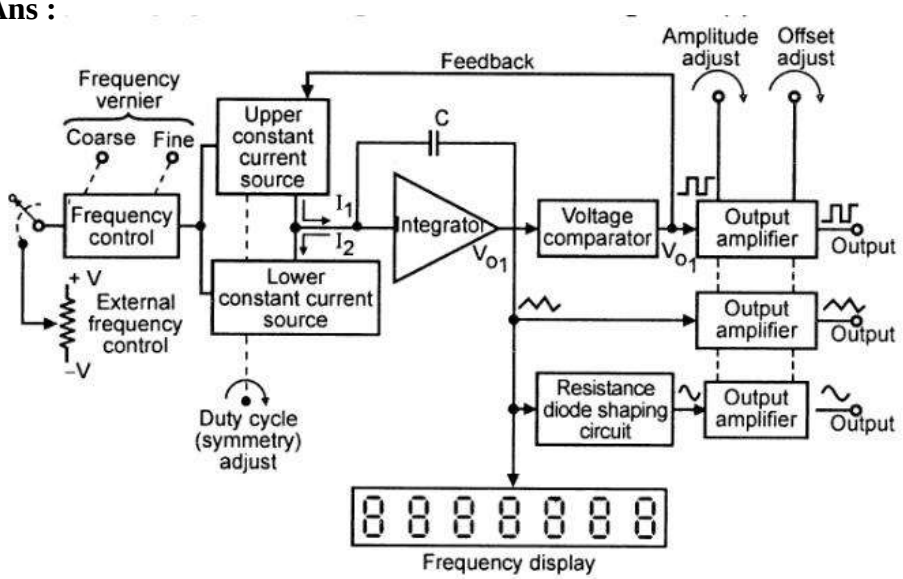
		flowing in the ciol having N turns. Assume B as the flux density in the air gap then F=BIL(N) Therefore torque on each side of coil =F* $\frac{d}{2}$ Hence total torque= 2 [BILN* $\frac{d}{2}$] = BILd N **OR** The equation for the developed torque, derived from the basic law for electromagnetic torque is Ƭ= 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 I = current in the movable coil (amperes) The equation shows that the developed torque is proportional to the flux density of the field in which the coil rotates, the current coil constants (area and number of turns). Since both flux density and coil constants are fixed for a given instrument, the developed torque is a direct indication of the current in the coil. The pointer deflection can therefore be used to measure current.	
	d)	**Draw the basic block diagram of single trace CRO and describe the function of delay line.** **Ans:**	**(Block diagram 3M, function 1M)**



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.

e) **Draw block diagram of function generator and list two specifications of it.**

Ans :



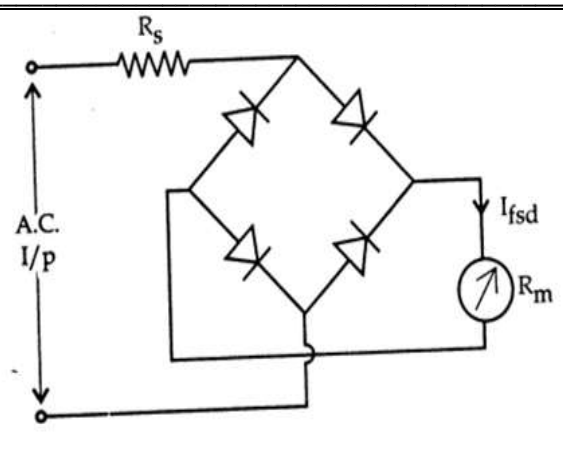
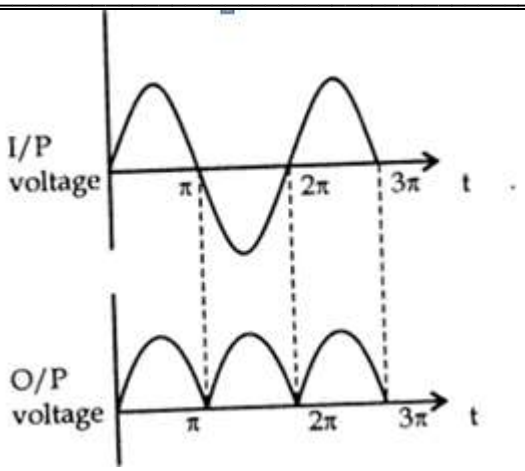
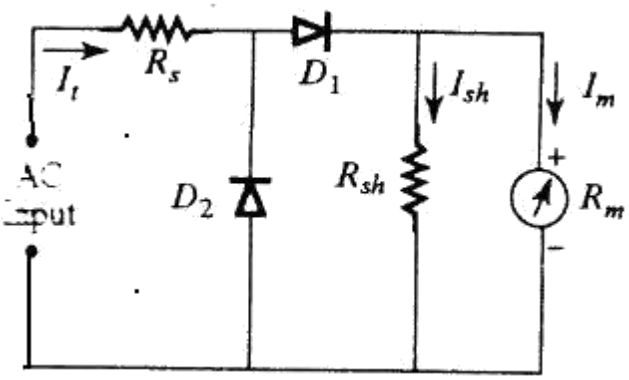
Specifications:

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
4. Pulse and Ramp Aspect Ratio-95:5

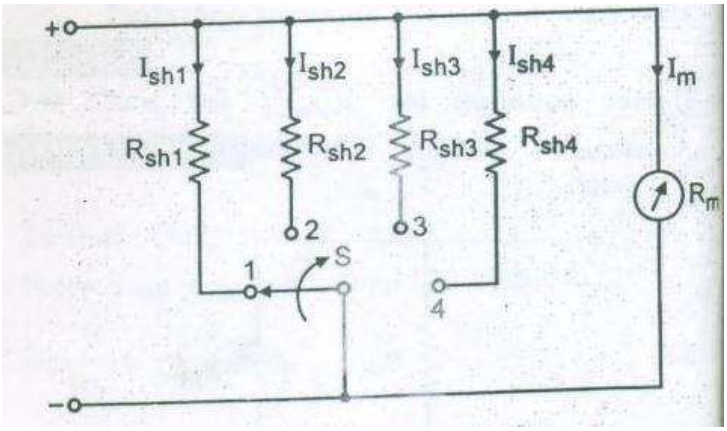
Diagram – 3M,Any2 specifications 1M

	f)	**What is video pattern generator? State its application.** **Ans:** A pattern generator provides video signals directly, and with RF modulation, on standard TV channels for alignment ,testing and servicing of TV receivers. The output signal designed to produce simple geometric patterns like vertical and horizontal bars, checkerboard, cross –hatch, dots etc. **Applications :** 1. Checking line and frame time bar linearity 2. Checking picture height and width 3. Video IF checking 4. Adjustments of sound IF stage and checking 5. AGC section checking 6. Trouble shooting video amplifier and using variable video output.	**(Explanation 2M, Applications 2M)**
Q. 4		**Attempt any four**	**16**
	a)	**A basic D'Arsonval movement with internal resistance of 50Ω and full scale deflection current of 1mA is to be used as multirange voltameter, Design a series of string of multiplier to obtain the voltage range of 0-20 V and 0-40V.** **Ans:** Given: Im=1mA, Rm=50Ω Case 1: For range 0-20V $Rs = \frac{V}{Im} - Rm$ $= \frac{20}{1*10-3} - 50$ =19.95K Ω Case 2: For range 0-40V $Rs = \frac{V}{Im} - Rm$ $= \frac{40}{1*10-3} - 50$ =39.95K Ω	**(Value of each Range 2M)**

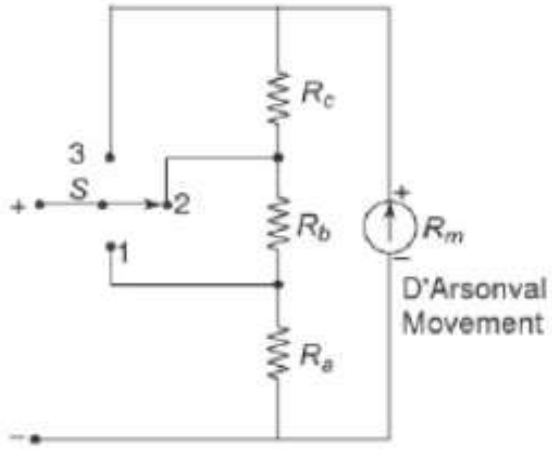
	b)	**Explain sensitivity and loading effect in voltmeter.** **Ans: Sensitivity:** The sensitivity of a voltmeter is just its capability to detect voltage, usually meaning smaller and smaller voltages. When selecting a meter for a certain voltage measurement, it is important to consider the sensitivity 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. **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.	**(Each point 2M)**
	c)	**State and explain any four specifications of analog multimeter.** **Ans:** **AC / DC** — The device can measure both AC and DC parameters. **DC Voltage Range** — The DC voltage range that devices can measure. **AC Voltage Range** — The AC voltage range that devices can measure. **DC Current Range** — The DC current range that devices can measure. **AC Current Range** — The AC current range that devices can measure.	**(Any four specifications for 4M)**
	d)	**Explain the working of full wave rectifier type analog AC Voltmeter with its circuit diagram.** **Ans:**	**(Circuit Diagram 2M, Working 2M)**

		  	
	e)	**Write four specifications of DMM.** **Ans:** • DC Current -1) five ranges are available. This range is from +- 200 uA to 2 amp. 2) accuracy is about +-0.3% of reading. 3) resolution is about +- 0.01 uA. • AC Current-1) Five current ranges available. This range is from +- 200 uA to 2 amp. 2)Accuracy is dependent on frequency. Best accuracy obtained is about +- 1% • 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 fro 200mV to 750 V 2. Accuracy is dependant on frequency. Best accuracy obtained ist 0.5% • Resistance 1. Six resistance ranges from 200Ω to 20MΩ	**(Any four specifications 4M)**
	f)	**Draw and state how Aryton shunt type DC ammeter . State advantage of using Aryton shunt.**	**(Diagram 2M, Explanation 1M, Any one advantage 1M)**

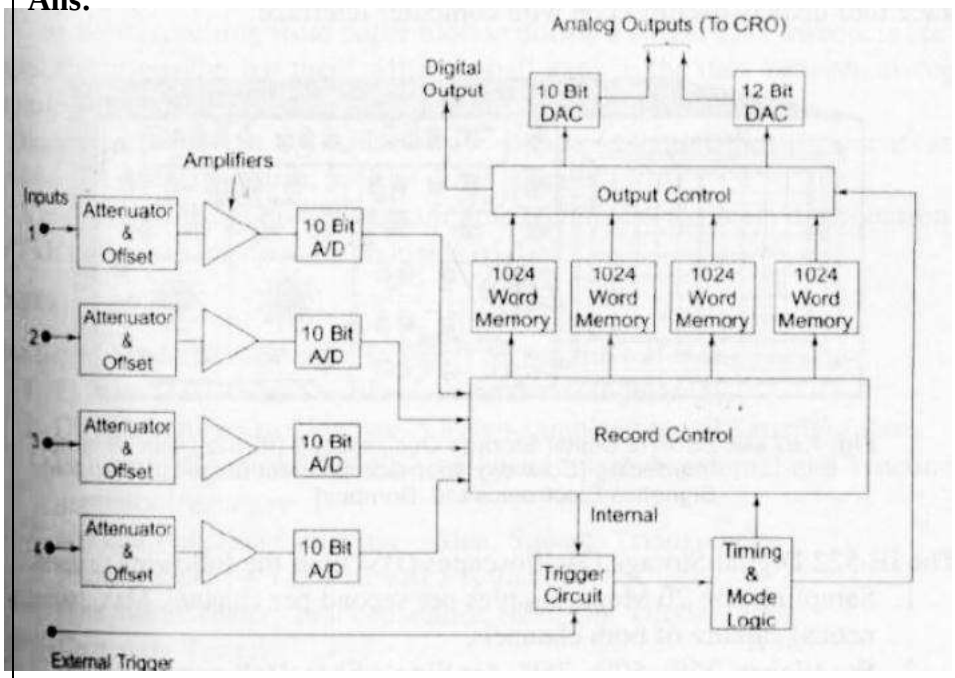
Ans:

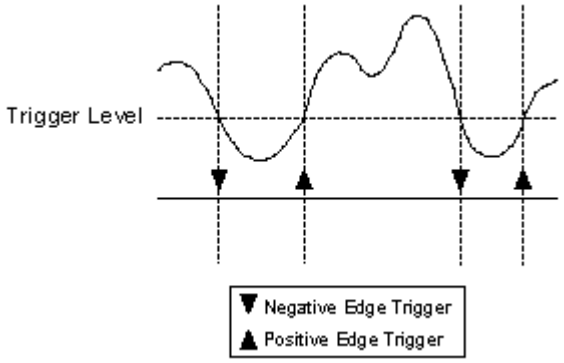


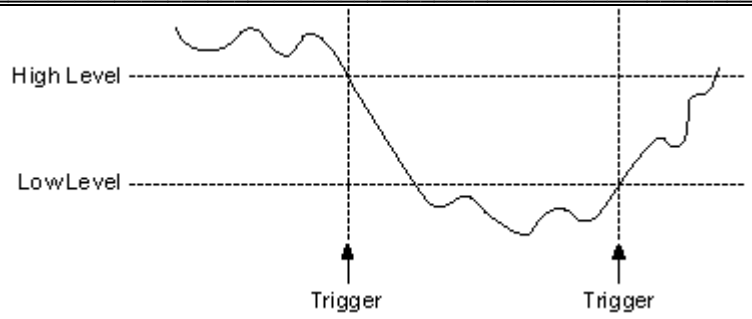
OR



The Aryton shunt eliminates the possibility of' having the meter in the circuit without a shunt. This advantage is gained at the price of slightly higher overall Aryton shunt ammeter. In this circuit, when the switch is in position "1". resistance Ra is in parallel with the series combination of Rb, Rc and the meter movement. Hence the current through the shunt is more than the current through the meter movement, l thereby protecting the meter movement and reducing its sensitivity. If the switch is connected to position '2', resistance Ra and Rb arc together in parallel with the series combination of Rc and the meter. Now the current through the meter is more than the current through the shunt resistance. If the switch is connected to position "3" Ra,Rb and Rc are together in parallel with the meter. Hence maximum current flows through

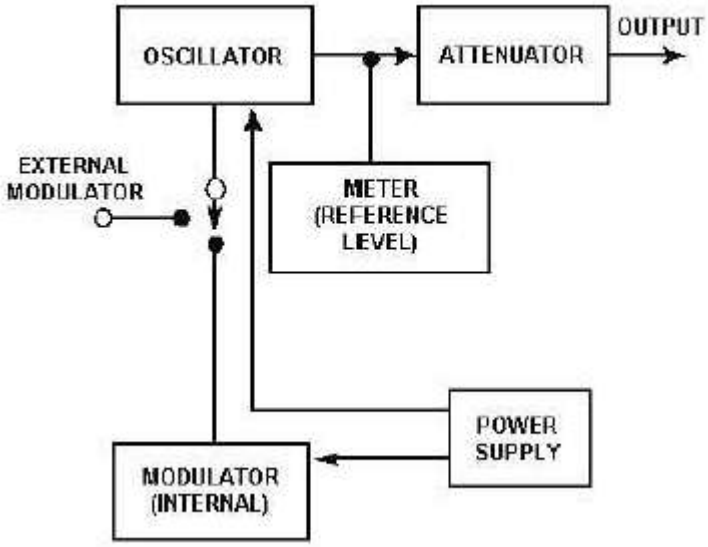
		the meter movement and very little through the shunt, This increases the sensitivity. **Advantage of using Aryton shunt.** 1. On a multiple-range ammeter, the Ayrton shunt is frequently a more suitable design. 2. One advantage of the Ayrton shunt is it eliminates the possibility of the moving coil to be in the circuit without any shunt resistance where they protect the deflection instrument of the ammeter from an excessive current flow when switching between shunts. 3. Another advantage is that it may be used as a wide range ammeter.	
5		**Attempt any four**	**16**
	a)	**Draw block diagram of DSO . State applications of DSO** **Ans:**  **Applications of DSO :** 1. It can be used to measure both AC and DC voltages and currents. It can also calculate RMS value, peak value, peak to peak value etc. 2. It can be used to measure frequency, time period, time interval between two signals. 3. It can be used to measure inductance and capacitance .It is used to observe the V-I characteristics of diodes and transistors. 4. It is used to observe radiation pattern generated by the transmitting antenna. 5. It can be used to determine the modulation characteristics and detect the standing	**(Block Diagram 3 M, Any 2 Advantages 1M)**

		waves of transmission lines.	
	b)	**State and describe different triggering available in CRO** **Ans:** A trigger is an external signal or input signal condition that initiates one or more instrument functions. Trigger settings include digital edges, software functions, and analog levels. This tutorial describes different trigger types that can be used with NI oscilloscopes. You can use several kinds of triggering with NI high-speed digitizers, including immediate, software , hysteresis , edge, window, digital , and video triggering. Each kind of triggering uses a different NI-SCOPE Configure Trigger function **Edge Triggers** An edge trigger occurs when a signal crosses a trigger threshold that you specify. You can specify the slope as either positive (on the rising edge) or negative (on the falling edge) to the trigger. Edge triggering is possible on all analog trigger channels, such as 0, 1, or on the external trigger channel. The following figure shows edge triggering.  **Window Triggers** A window trigger occurs when a signal either enters or leaves a window you specify with the window mode parameters in the Configure Trigger Window function. Window triggering is possible on all analog trigger channels, such as 0, 1, or the external trigger input. The following figure shows an entering window trigger.	**(Any two method- 2M each)**



c) **Draw block diagram of RF signal generator and explain its operation.** **(Block Diagram 2M, Explanation 2M)**

Ans:

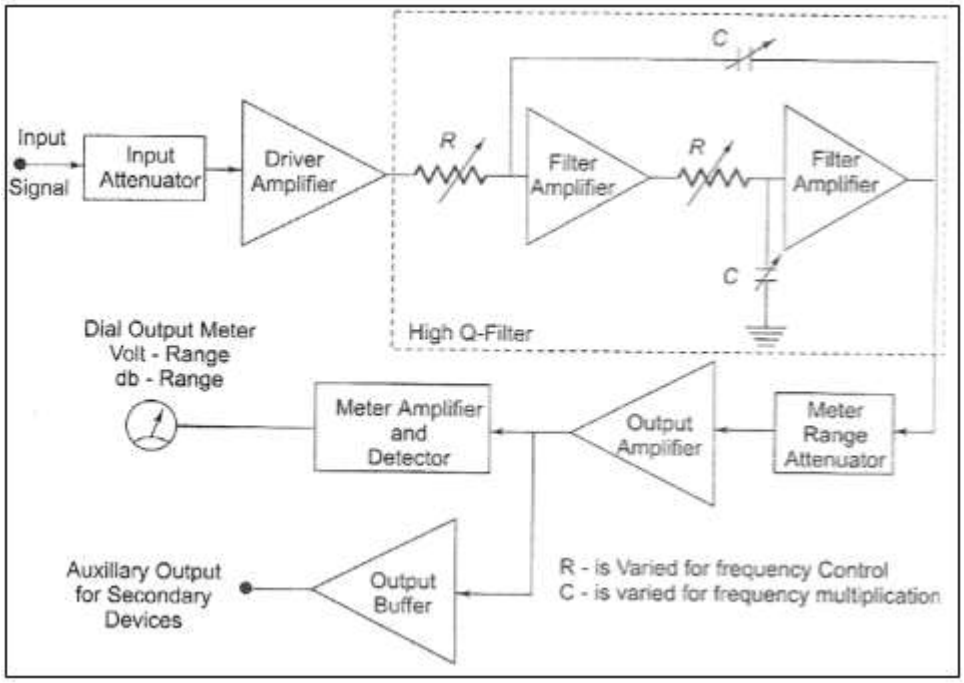


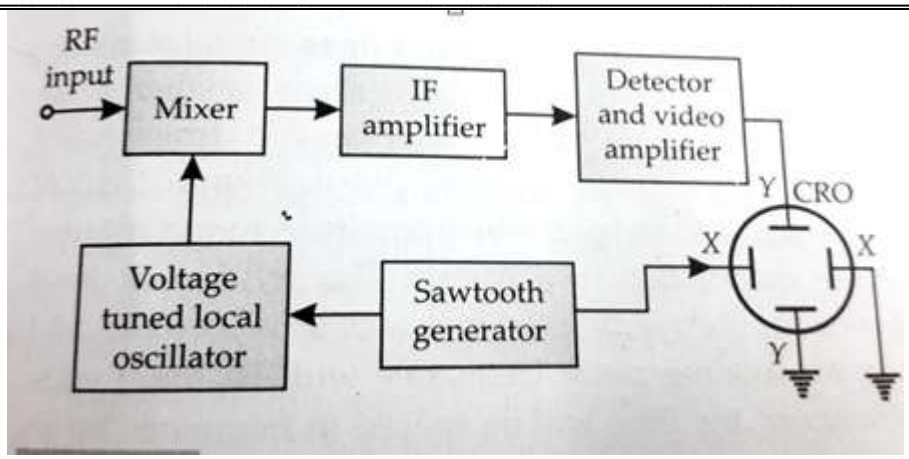
RF signal generator contains three other main sections:

1.OSCILLATOR CIRCUIT,
2. MODULATOR,
3. OUTPUT CONTROL CIRCUIT.

The modulator modulates the RF signal of the oscillator. In addition, most RF generators are provided with connections through which an external source of modulation of any desired waveform can be applied to the generated signal. Metal shielding surrounds the unit to prevent signals from the oscillator from affecting the circuit under test

d) Define wave analyser and state its need, Draw the block diagram of it. **(Definition 1M, Need 1M, Block**

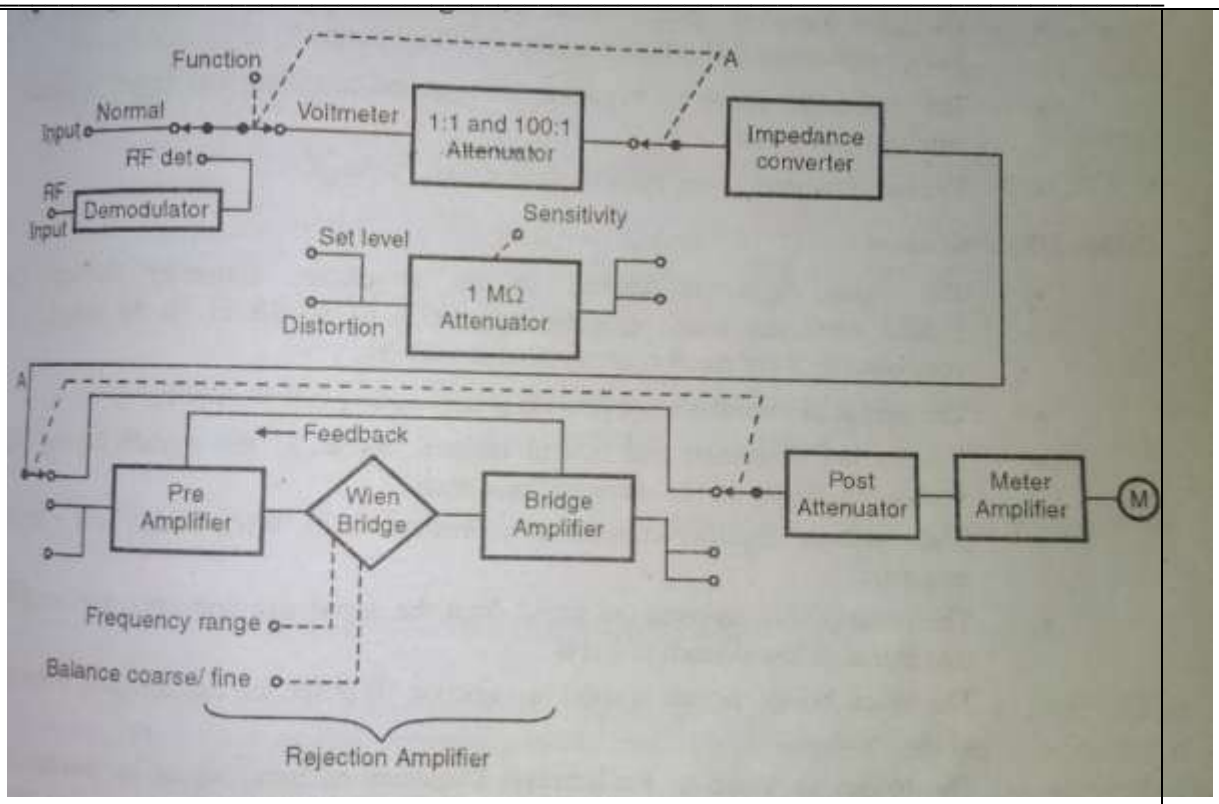
		Ans: **Wave analyzer:-** Wave analyzer is an instrument which is used to measure the magnitude of the various harmonics of a complex waveform. It is an instrument that is designed to measure the relative amplitudes of single frequency components in a complex or distorted waveform. **Wave analyzer need:** Signal analysis of both random and periodic signal in the frequency domain is used extensively in electronic and telecommunication. The frequency stability and special purity of signal sources can be measured by the use of these signal analyzers. These signal analyzer can be used along with a frequency generator or a source of white or pseudo-random noise to measure the frequency response of amplifiers, filters or other networks. The operational characteristics of a trans receiver and communication system are determine by measuring various parameters, such as spectral purity of the carrier wave, spectral power distribution of the amplitude or frequency modulated wave, signal distortion and the system signal to noise ratio. **Block Diagram of Wave analyser**  	**Diagram 2M)**
	e)	**Draw block diagram of spectrum analyser, State applications of spectrum analyser.** **Ans: Block Diagram:**	**(Block diagram 2M, Any 2 Applications- 2M)**



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

	f)	**Draw block diagram of distortion factor meter and explain its operation.** **Ans: Block Diagram**	**(Block Diagram 2 M, Operation 2M)**



Operation

This meter consist following four sections

1. Impedance converter along with input circuit

2. Rejection amplifier

3. Metering circuit

4. Power circuit

1. The impedance converter provides a low noise , high impedance input circuit , independent of the signal source impedance placed at the input terminals to the instrument

2. The rejection amplifier rejects the fundamental frequency of the input signal and passes the remaining frequency to the meter.

3. The meter has visual indication of the THD in term of percentage of the total input voltage.

4. The power supply unit provides the supply for proper operation

6		**Attempt any four**	**16**

a) **Compare analog and digital instruments** — **4points 4 marks**

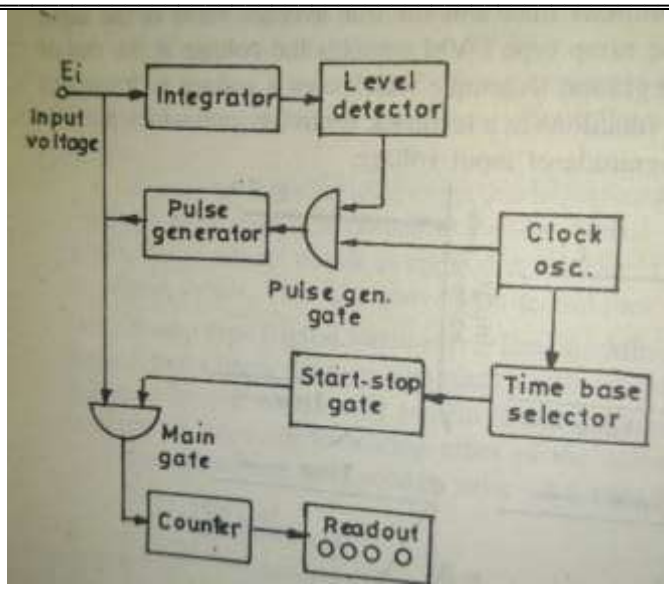
Analog instrument	Digital instrument
The instrument which gives output that varies continuously as quantity to be measured is known as analog instrument.	The instrument which gives output that varies in discrete steps and only has finite number of values is known as digital instrument.
The accuracy of analog instrument is less.	The accuracy of digital instrument is more.
The analog instruments required more power.	The digital instruments required less power.
Sensitivity of analog instrument is more.	Sensitivity of digital instrument is less.
The analog instruments are cheap.	The digital instruments are expensive.
The analog instruments are extremely portable.	The digital instruments are not easily portable.
The resolution of analog instruments is less.	The resolution of digital instruments is more.

b) **Draw block diagram of digital voltmeter and describe its operation.** — **(Block diagram 2M, Operation 2M)**

Ans: (Note: Any one type of digital voltmeter can be consider

1. Ramp type of digital voltmeters
2. Voltmeters of integrating type
3. Successive approximation type digital voltmeters)

Voltmeters of integrating type



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.

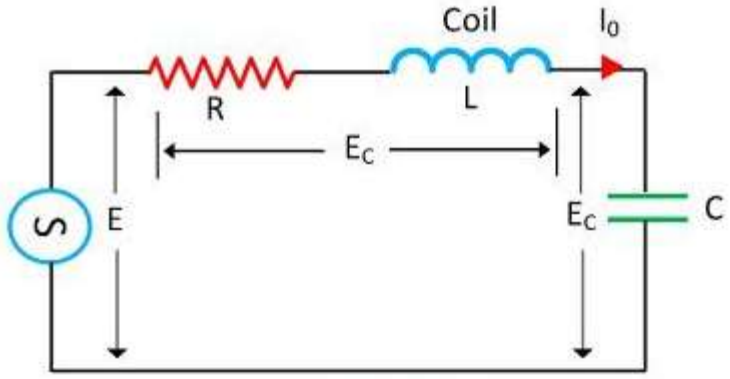
Integrator now starts integrating the input vtg. that means capacitor starts charging. Because of this output of integrator changes from zero value. It causes zero detector to change its stage. It means it provides a high signal to logic gate.

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.

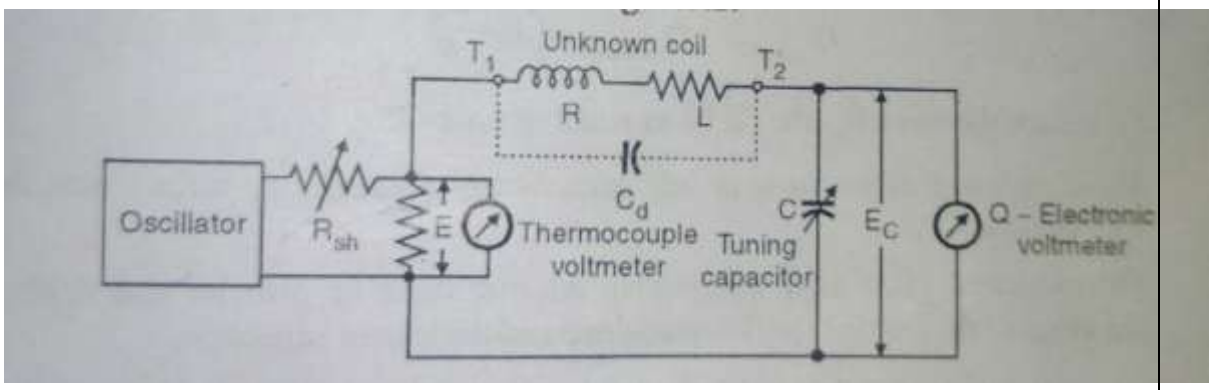
The output of Flip-Flop is '1'. This is connected to control logic. Now s/w changes position from V_{in} to V_{ref}. so integrator will starts integrating this ref. voltage ($-V_{ref}$).

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 closing of logic gate & counting operation is completed. Then data passed to digital readout.

	c)	**Draw Q meter circuit of series connection and explain it.** **Ans: Q meter circuit of series connection** .	**(Diagram 2M,Explanation 2M)**



OR



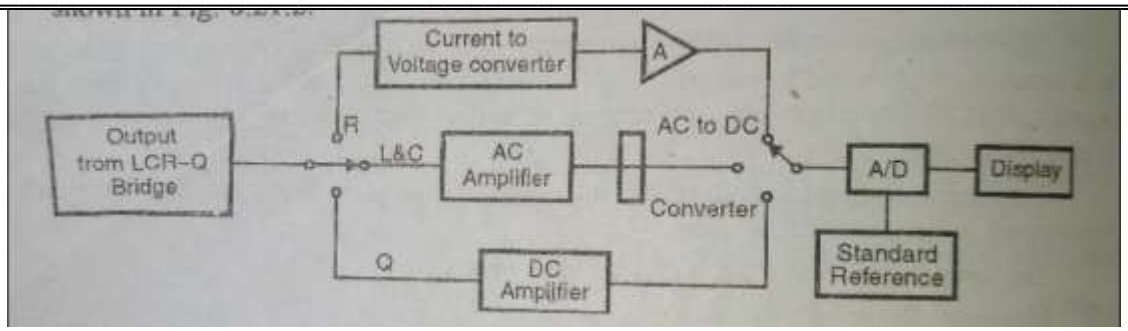
Explanation

The Q meter works on series resonant. The resonance is the condition exists in the circuit when their inductance and capacitance reactance are of equal magnitude. They induce energy which is oscillating between the electric and magnetic field of the capacitor and inductor respectively.

The Q-meter is based on the characteristic of the resistance, inductance and capacitance of the resonant series circuit. The figure below shows a coil of resistance, inductance and capacitance connected in series with the circuit.

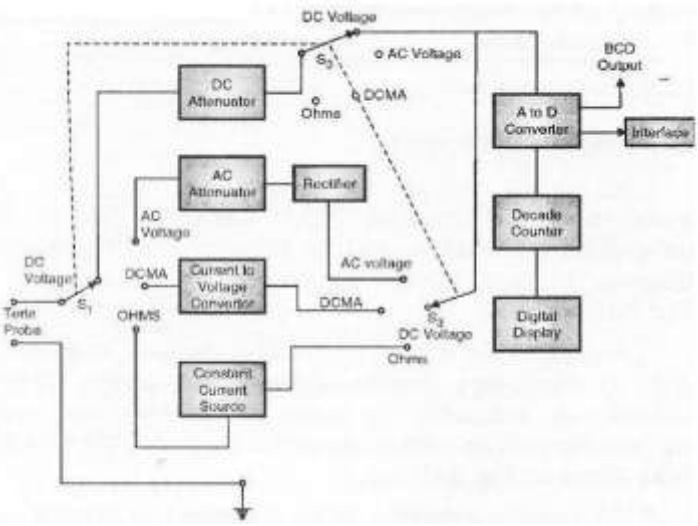
In this Q meter input voltage E is Q times the voltage appears across the capacitor. Hence E=Q Ec so ,the voltmeter is calibrated for finding the value of Q factor.

	d)	**What is LCR meter? Draw digital LCR –Q meter block diagram.** **Ans:** An LCR meter is a type of electronic test equipment used to measure the inductance (L), capacitance (C), and resistance (R) of an electronic component. **Block diagram digital LCR –Q meter**	**(Explanation 1M, Block Diagram 3M)**



e) Draw block diagram of DMM. State its advantages. **(Block Diagram- 2M, Any 2 Advantages - 2M)**

Ans:

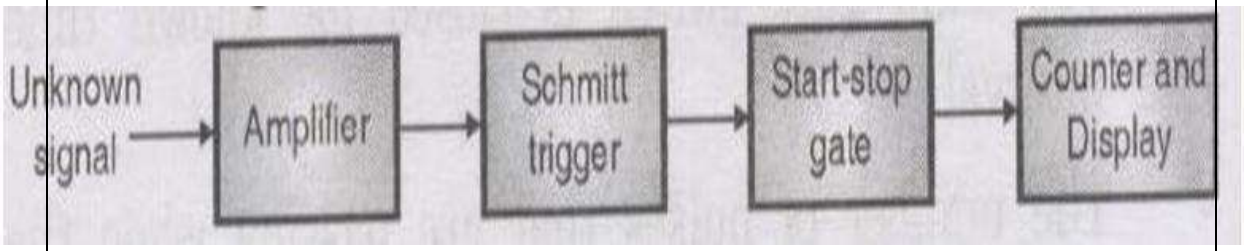


Advantages of DMM:

1. DMM provides numerical readouts that **eliminate observational errors**. Thus providing better **readability**.
2. DMM offers better **accuracy** and **versatility** as compared to analogue multimeters.
3. DMM has a **greater speed** of taking readings as compared to analogue instruments.
4. The output of DMM can be fed to memory devices for further computations.
5. The decreased size of DMM **increases** the portability

f) Draw block diagram of digital frequency meter in time mode and describe its operation. **(Block Diagram 2M, Operation 2M)**

Ans



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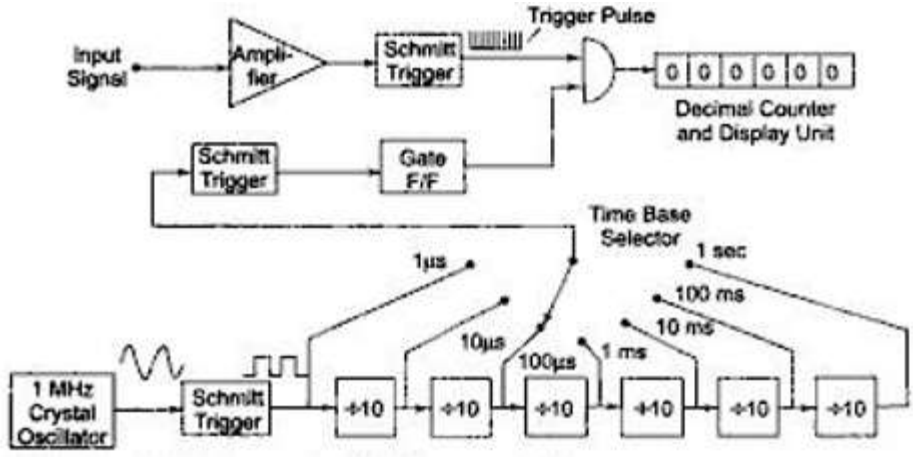

Operation:

The input signal is amplified and converted to a square wave by a Schmitt Trigger circuit. In this diagram the square wave is differentiated and clipped to produce a train of pulses each pulse separated by the period of the input signal. The time base selector output is obtained from an oscillator and is similarly converted into positive pulses,

The first pulse activates the gate control F/F. This gate control F/F provides an enable signal to the AND gate. The trigger pulses of the input signal are allowed to pass through the gate for a selected time period and counted. The second pulse from the decade frequency divider changes the state of the control

		F/F and removes the enable signal from the AND gate, thereby closing it. The decimal counter and display unit output correspond to the number of input pulses.	