MODEL ANSWER

SUMMER– 18 EXAMINATION

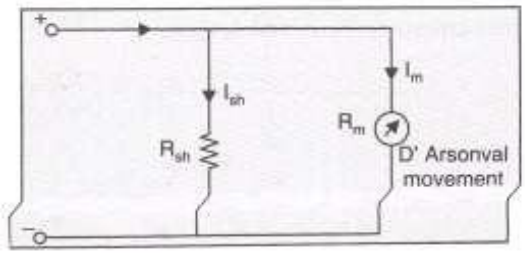
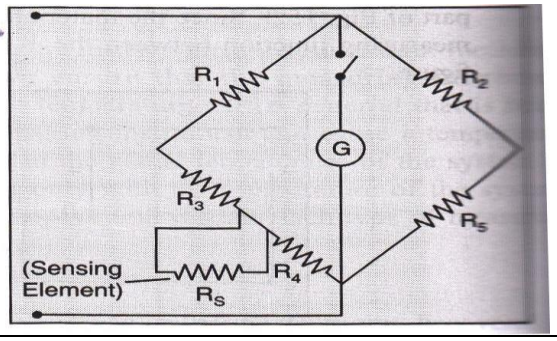
Subject Title:-Electronic Instrumentation **Subject Code:-** **17435**

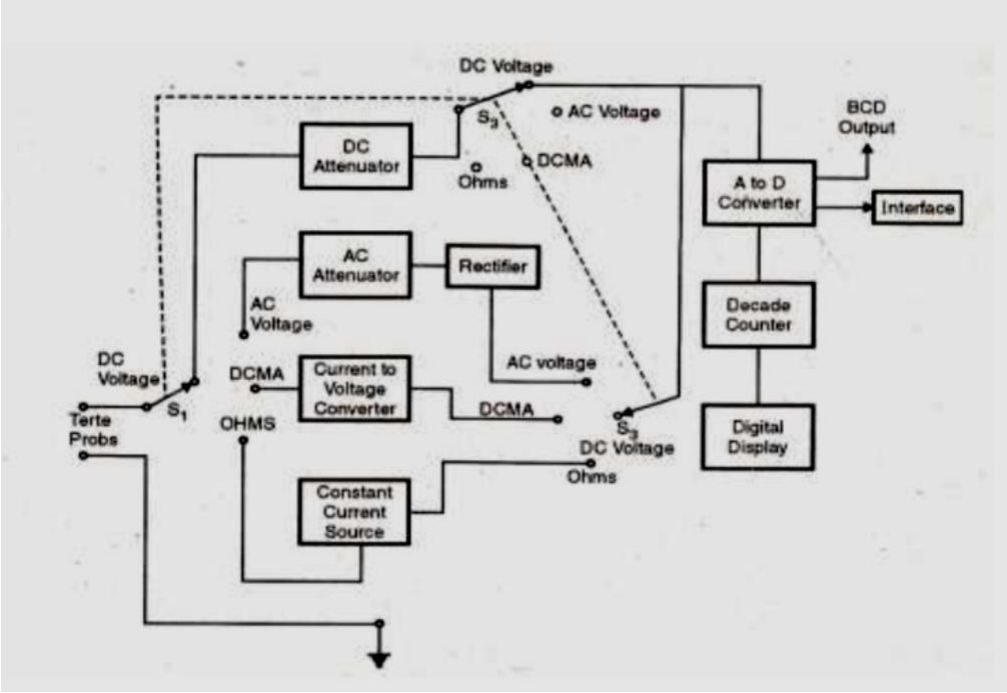
Important Instructions to examiners:

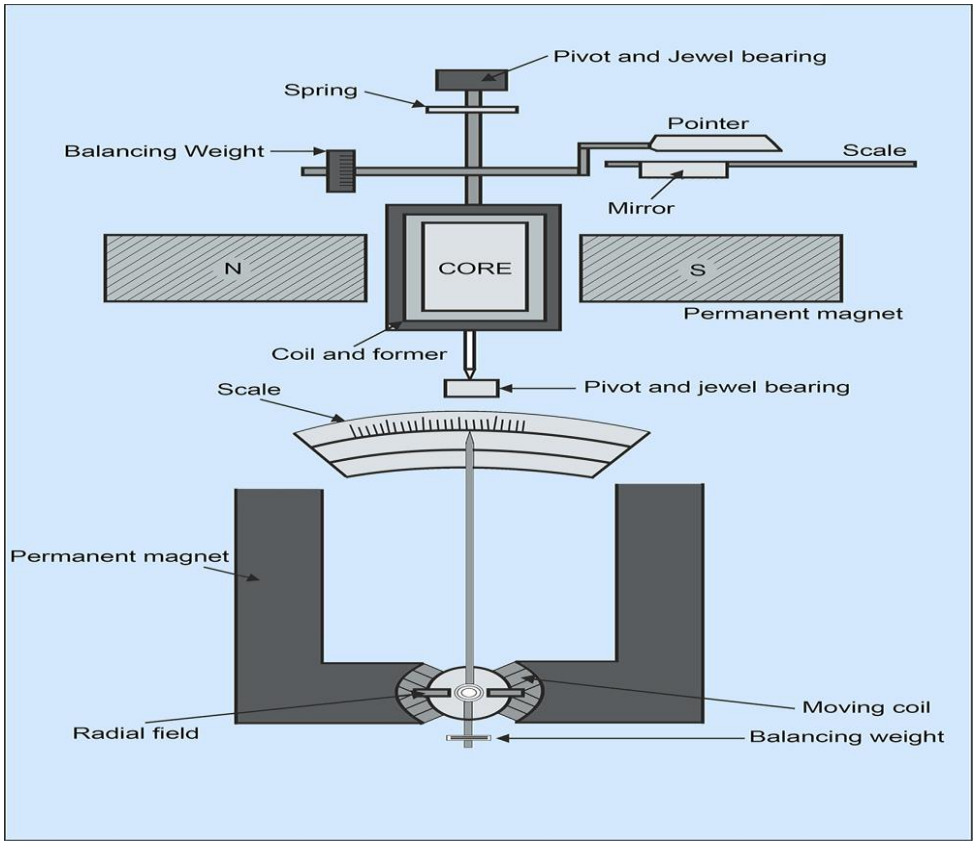
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

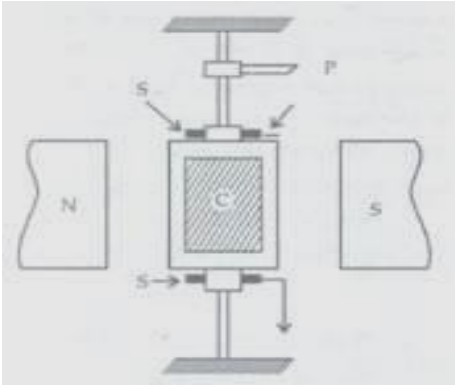
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	A)	**Attempt any SIX :**	**12 Marks**
	a)	**List out dynamic characteristics of instruments.**	**2 Marks**
	Ans:	1. Speed of Response 2. Lag 3. Fidelity 4. Dynamic Error	**½ Mark each**
	b)	**Define : (i) Resolution (ii) Dead zone**	**2 Marks**
	Ans:	**Resolution** The smallest change in a measured variable to which an instrument will respond. **Dead Zone** It is the largest change of input quantity for which there is no output.	**1 Mark** **1 Mark**
	c)	**State the function of Delay line in CRO.**	**2 Marks**
	Ans:	The delay line is used in CRO to delay the signal for some time in the vertical deflection section. As horizontal channel consists of trigger circuit and time base generator, this causes more time for the signal to reach the horizontal deflection plates than the vertical deflection plates. Hence, Delay line is required for synchronization of the signals reaching both the deflection plates in a CRT.	**2 Marks**
	d)	**Give one example each for : (i) Resistive transducer (ii) Inductive transducer.**	**2 Marks**
	Ans:	**Resistive transducer (any one)** 1. Linear potentiometers **2.** Angular(Rotary) potentiometers **Inductive transducer (any one)** 1. LVDT (Linear variable differential transformer) 2. RVDT (Rotary variable differential transformer)	**1 Mark** **1 Mark**

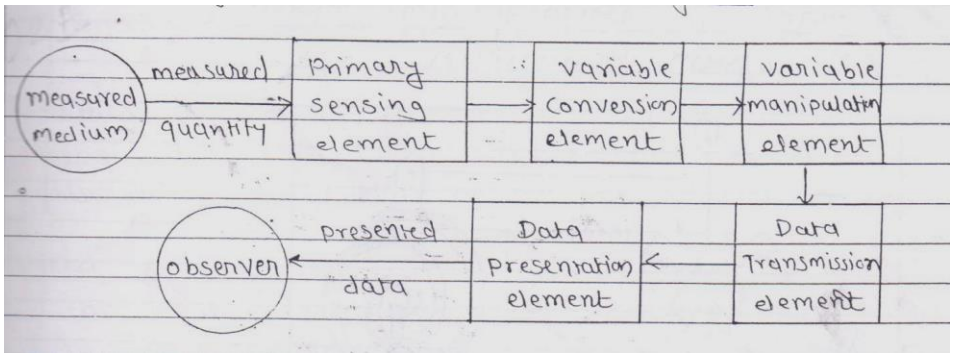
	e)	**Define temperature. Name any two temperature measuring units.**	**2 Marks**
	Ans:	**Temperature:-**It is a degree of hotness or coldness of a body or an environment on a definite scale**.** **Temperature units (any two)** 1. Celsius (denoted °C), 2. Fahrenheit (denoted °F), 3. Kelvin (denoted °K), 4. Rankine (denoted by °R)	**1 Mark** **Any two- ½ Mark each**
	f)	**Name the types of wave analyzer.**	**2 Marks**
	Ans:	**Types of wave analyzer (**Any two) 1. Basic Wave analyzer 2. Frequency selective wave analyzer 3. Heterodyne wave analyzer	**1 mark each**
	g)	**State any two advantages and two disadvantages of digital instruments.**	**2 Marks**
	Ans:	**Advantages (any two)** 1. Output is in digital form.. 2. The digital instrument requires less power. 3. The accuracy of digital instruments is more. 4. The resolution of digital instruments is more. 5. The readings are clearly indicated in decimal number. **Disadvantages (any two)** 1. They are costly. 2. Some are complex.	**½ Mark each**
	h)	**State the principle of PMMC instruments.**	**2 Marks**
	Ans:	The electromagnetic torque developed or the amount of rotation is directly proportional to the amount of current flowing through the coil.	**2 Mark**
	B)	**Attempt any TWO :**	**8 Marks**
	a)	**Describe the working principle of Piezoelectric transducer. State any two applications.**	
	Ans:	**Principle of piezoelectric transducer:** Certain solid materials (crystals) when deformed generate electric charges within them. This effect is reversible; i.e., if a charge is applied, then material mechanically deforms. **OR** The transducers that work on the principle of piezoelectric effect to measure changes in displacement, force, pressure, strain and acceleration converting them to Electric charge are termed as Piezoelectric Transducers. This transducer produces electric voltage when there is application of mechanical stress or forces along certain planes. **Applications (Any two)** **1.** Used in High frequency accelerometer.	**2 Marks** **1 mark each**

		2. Used in industrial cleansing apparatus. **3.** Used in water detection system i.e. SONAR. **4.** Used in measurement of surface roughness in accelerometers and vibration pickups.	
	b)	**The expected value of voltage across resistor is 50 V. But the measured value if 49 V. Calculate (i) absolute error (ii) % (percentage) error.**	**4 Marks**
	Ans:	i) Absolute error = Measured value –True Value = 49 - 50 = -1 ii) Percentage (%) error =Absolute error / True value*100 =1/50*100 = 2%	**1 Mark** **1 Mark** **1 Mark** **1 Mark**
	c)	**Draw the circuit of basic DC Ammeter. Derive equation for shunt resistance.**	**4 Marks**
	Ans:	**Circuit of basic DC Ammeter**  **Equation:** Where, Rm=Internal resistance Rsh= Resistance of the shunt Im= Full scale deflection current Ish= Shunt current I=current to be measured Vshunt= Vmovement IshRsh=ImRm Rsh=(Im/Ish)Rm	**2 Marks** **2 Marks**
Q 2		**Attempt any FOUR :**	**16 Marks**
	a)	**Write the working principle of RTD. State how the temperature change is measured using RTD.**	**4 Marks**
	Ans:	**Working principle:** RTD (resistance temperature detector) is a temperature sensor that operates on the measurement principle that a material's electrical resistance changes with temperature.  	**2 Marks**

		Working: RTD,(R_T) is connected in one of the arms of Wheatstone's bridge which is initially kept in the balance condition. The balance condition of the bridge is $R_2 / R_1 = R_5 / (R_3+R_4+R_T)$ As R_T changes with change in temperature, the bridge gets unbalanced and galvanometer shows deflection. It is calculated as : $R_T = R_O (1+ \alpha(\Delta t))$	
	b)	**Draw the block diagram of digital multimeter and explain its working.**	**4 Marks**
	Ans:	**Block diagram of digital multimeter**  **Explanation:** • In order to measure unknown current, current to voltage. (I to V) converter is used. An unknown current is applied to op-amp. I/P impedance of op-amp is very high. So current passing through it is negligible. Thus Iin = Ifb. This feedback current pass through resistance. This will cause a voltage. drop across the resistance. This voltage 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 used. The current from this constant current source is allowed to pass through unknown resistance. Thus proportional voltage. is obtained. This voltage is directly proportional to unknown resistance. • To measure AC voltage, a rectifier & filter is used. The rectifier converts AC into DC signal & this DC signal is applied to A to D converter & to digital display.	**2 Marks** **2 Marks**

	c)	**Define error. List the sources of error in measurement system.**	**4 Marks**
	Ans:	**Definition of Error**:- An error is the deviation of the true value from the desired value. **Sources of error:-** • **Gross Errors:-**The gross error occurs due to the human mistakes in reading or using theinstruments. • **Systematic errors**:- These are sub divided as :- 1) **Instrumental errors** :- These errors occurs due to inherent shortcomings in the instruments, misuse of instruments and loading effects of the instruments 2) **Observational error**:- These are due to carelessness of the operator 3) **Environmental error**:- This includes condition in the area surrounding the instrument such as the effect of changes in temperature, humidity, barometric pressure or magnetic or electrostatic field . • **Random error:-** These are due to unknown causes and occur even when all the systematic errors have been accounted for. **Note**:- (Considered only the classification of errors not the explanation).	**1 Mark** **3 Marks**
	d)	**Draw the constructional diagram of PMMC instrument. State the torque equation.**	**4 Marks**
	Ans:	**Constructional diagram of PMMC instrument:**  **OR**	**2 Marks**

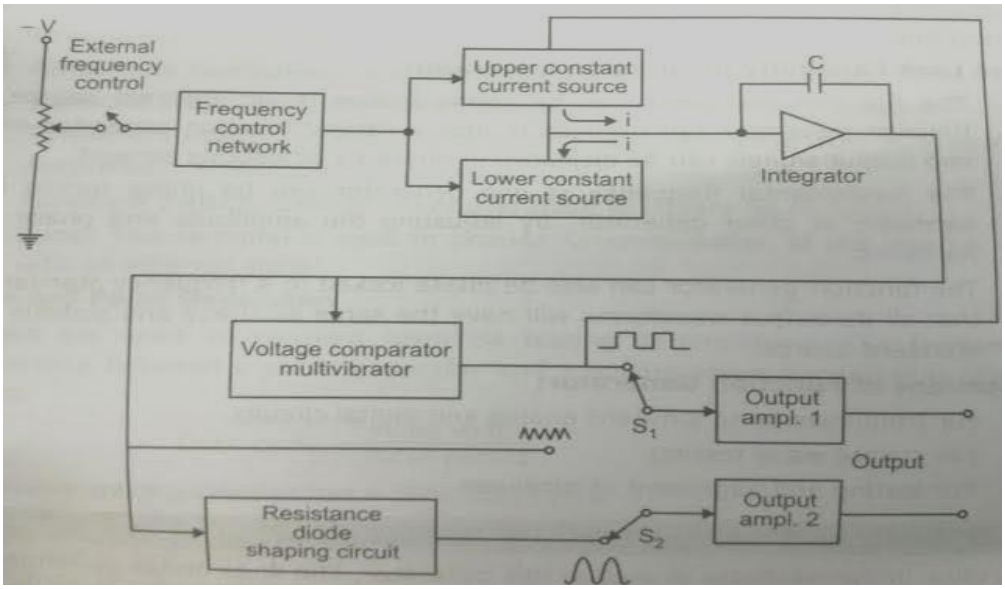
		 **Torque Equation for PMMC** The equation for the developed torque of the PMMC can be obtained from the basic law of electromagnetic torque. The deflecting torque is given by, **Td = NBAI** Where, **Td** = deflecting torque in N-m **B** = flux density in air gap, Wb/m2 **N** = Number of turns of the coils **A** = effective area of coil m2 **I** = current in the moving coil, amperes Therefore, **Td = GI** Where, G = NBA = constant The controlling torque is provided by the springs and is proportional to the angular deflection of the pointer. **Tc = KØ** Where, **Tc** = Controlling Torque **K** = Spring Constant Nm/rad or Nm/deg **Ø** = angular deflection For the final steady state position, **Td = Tc** Therefore **GI = KØ** So, Ø = (G/K)I or I = (K/G) Ø Thus the deflection is directly proportional to the current passing through the coil. The pointer deflection can therefore be used to measure current.	**2 Marks**
	e)	**Draw the block diagram of instrumentation system. Explain each block in brief.**	**4 Marks**
	Ans:	**Block diagram of instrumentation system**	**2 Marks diagram**



2 Marks Explanation

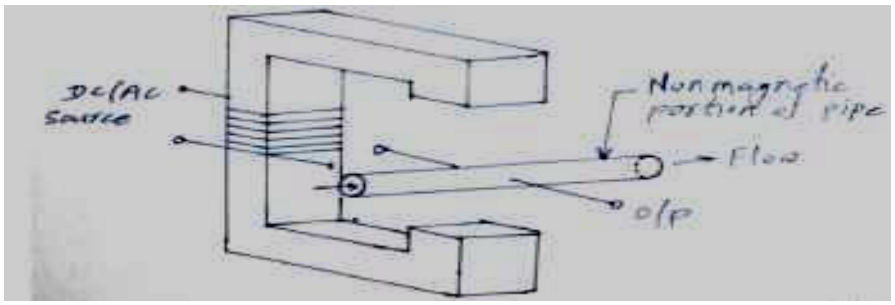
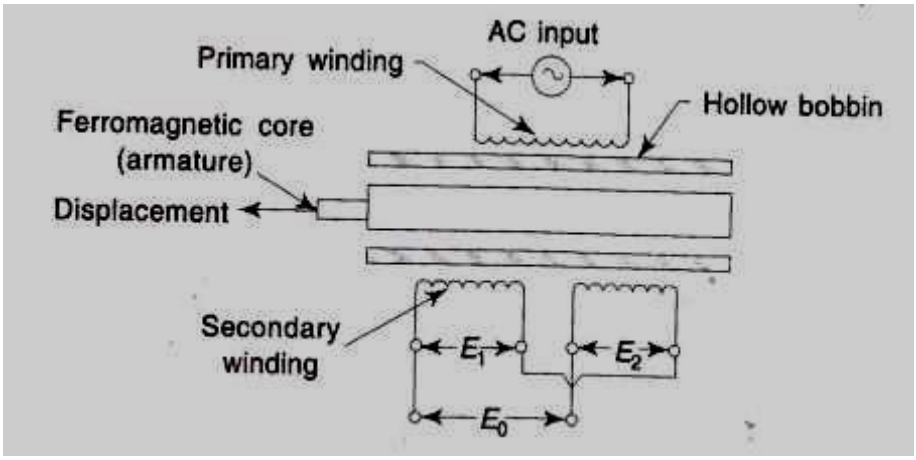
Primary sensing Element:-
It receives energy from the measured medium and produces o/p depending on the value of the measured quantity.
Variable conversion element:-
It converts the o/p signals of the primary sensing element into a more suitable variable or condition useful to the function of the instrument.
Variable manipulation element:-
It manipulates the signals represented by some physical varible, to perform the intended task of an instrument.
Data-transmission element:-
It transmits the data from one element to the other.
Data presentation element :-
It performs the translation function , such as thesimple indication of a pointer moving ona scale.

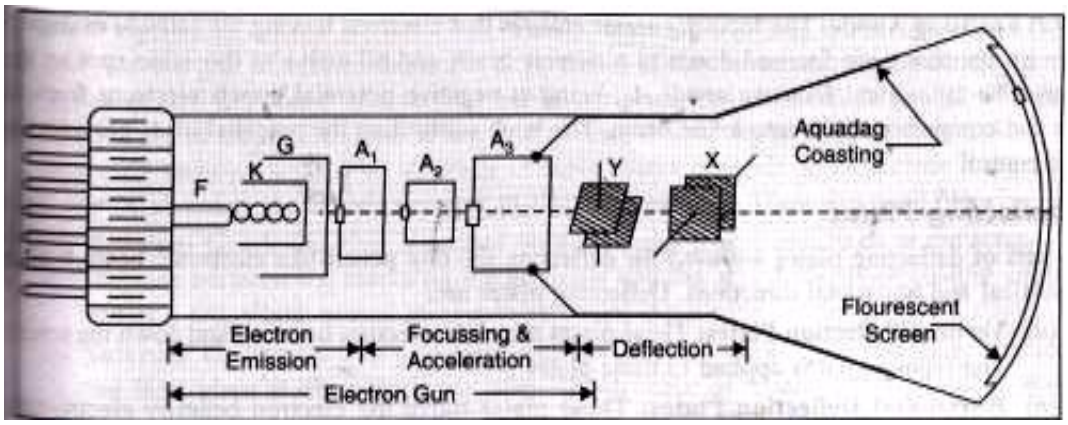
f)	**Draw the block diagram of function generator. State any four applications.**	**4 Marks**
Ans:	**Block diagram of function generator**	**2 Marks**

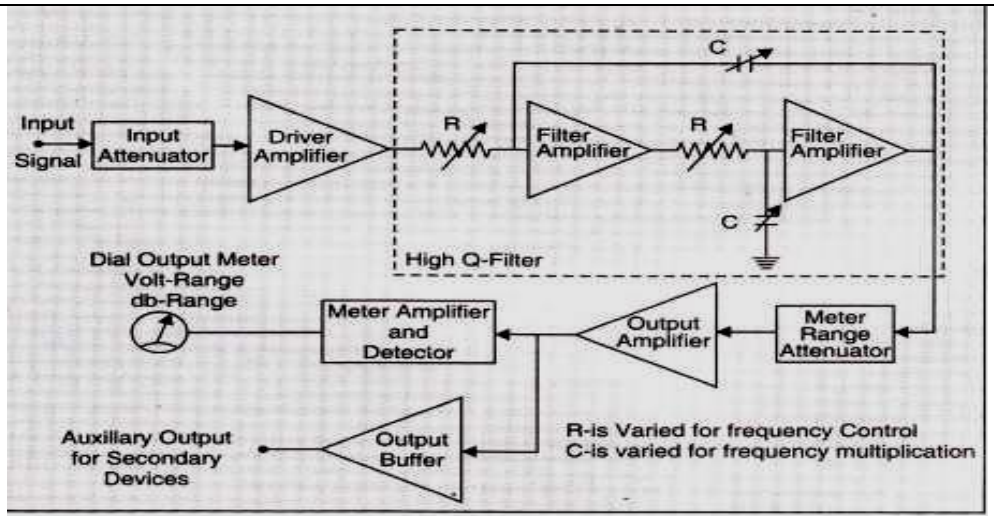


½ Mark each

Applications of Function Generator: (any four)

		1. For troubleshooting different analog & digital circuits. 2. For square wave testing. 3. For triangular wave testing. 4. For testing & alignment.	
Q. 3		**Attempt any FOUR :**	**16 Marks**
	a)	**Draw the diagram of electromagnetic flow meter and explain its working.**	**4 Marks**
	Ans:	**Diagram of electromagnetic flow meter:**  **Working:-** The operation of this type of flow meter is based on Faraday's law of electromagneticinduction. The law state that whenever the conductor moves through a magnetic field, an emf is induced in the conductor proportional to the relative velocity between the conductor & the magnetic field. It consists of a pipe, short section of which is subjected to a transverse magnetic field. The conductive fluid is passed through this pipe. As fluid passes, its motion relative to field produces an emf proportional to velocity according to Faraday's law. This output emf is collected by the electrodes (kept at points of maximum potentialdifference) and is given to external circuitry.	**2 Marks** **2 Marks**
	b)	**Draw the diagram of LVDT. Explain how it is used to measure displacement.**	**4 Marks**
	Ans:	**Diagram of LVDT:**  **Working**: When the core is in the neutral position, voltage induced in the secondary windings are equal and opposite and the net output is negligible. As the core is moved in one direction from the neutral position the differential	**2 Marks** **2 Marks**

		voltage, i.e. the difference of the secondary voltage, will increase while maintaining an in phase relationship with the voltage from the source. Now the core is moved in the other direction from the neutral position, the differential voltage will again increase but will be 180^0 out of phase with the voltage from the input source. By comparing the magnitude and phase of the voltage with the input source, the amount and direction movement of the core and hence of displacement may be determined.	
	c)	**Write working principle of CRT in a single trace CRO with diagram.**	**4 Marks**
	Ans:	**Diagram of CRT:**  **Working**: Electrons are emitted from the indirectly heated cathode, these electrons pass through a small hole in the (control grid). The intensity of electron beam depends upon the number of electron emitted from the cathode. The grid with its negative bias controls the number of electrons emitted from the cathode and hence the intensity is controlled by the grid. 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.After leaving the focusing anode the electron beam passes through vertical and horizontal deflection plates and then goes on to the fluorescents screen. Fluorescent screen of the CRT is coated with a phosphor. At the point where the electron beam strikes the screen, phosphor emits a spot of visible light. If the electron beam is repeatedly moved across the screen an image will be displayed on scope screen due to persistence of phosphor.	**2 Marks** **2 Marks**
	d)	**Draw the block diagram of frequency selective wave analyzer and state the function of each block.**	**4 Marks**
	Ans:	**Block diagram** :	**2 Marks**

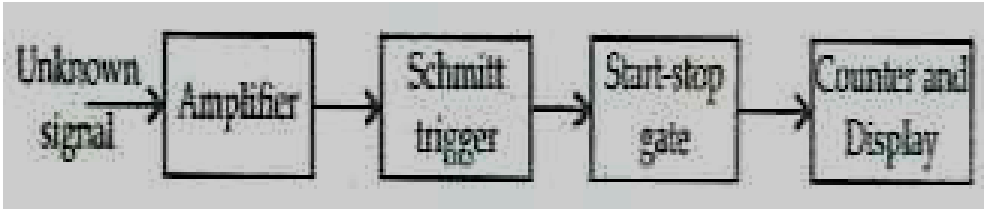


Functions:

- The wave analyzer consist of a very a narrow pass-band filter section that can be tuned to a particular frequency.
- The complex wave to be analyzed is passed through an adjustable attenuator which serves as a range multiplier and permits a large range of signal amplitudes to be analyzed without loading the amplifier.
- The output of the attenuator is then fed to a selective amplifier, which amplifies the selected frequency.
- The driver amplifier applies the attenuated input signal to a high Q active filter. This high-Q filter is a low pass filter which allows the frequency which is selected to pass and reject all others.
- The magnitude of the selected frequency is indicated by the meter and the filter section identifies the frequency of the component.
- The capacitors are used for range changing and the potentiometer is used to change the frequency within the selected pass-band, hence this wave analyzer is also called a frequency selective voltmeter.
- The selected signal output from the final amplifier stage is applied to the meter circuit & un-tuned buffer amplifier.
- The main function of the buffer amplifier is to drive the output devices.
-

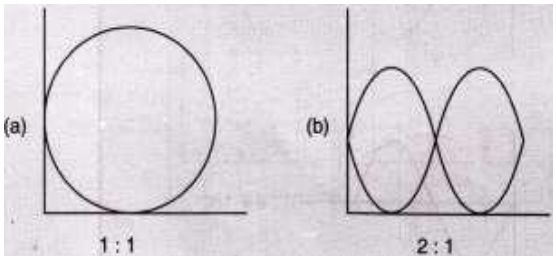
2 Marks

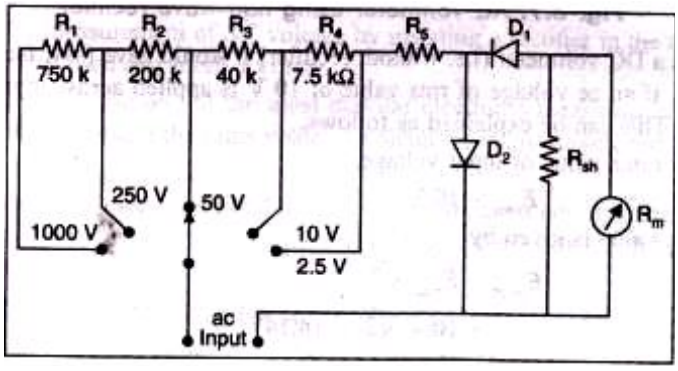
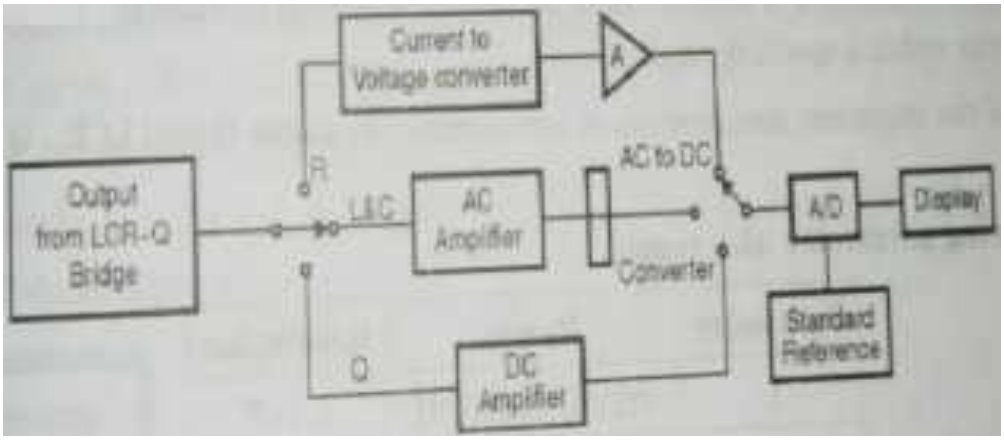
e)	**Describe the working principle of Digital Frequency Meter with diagram.**	**4 Marks**
Ans:	**Diagram of Digital Frequency Meter:**	**2 Marks**

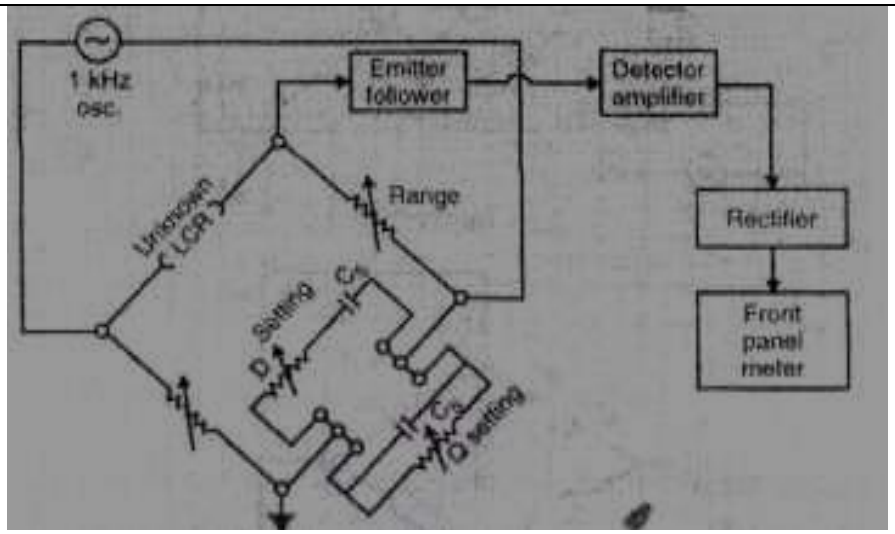


Working:

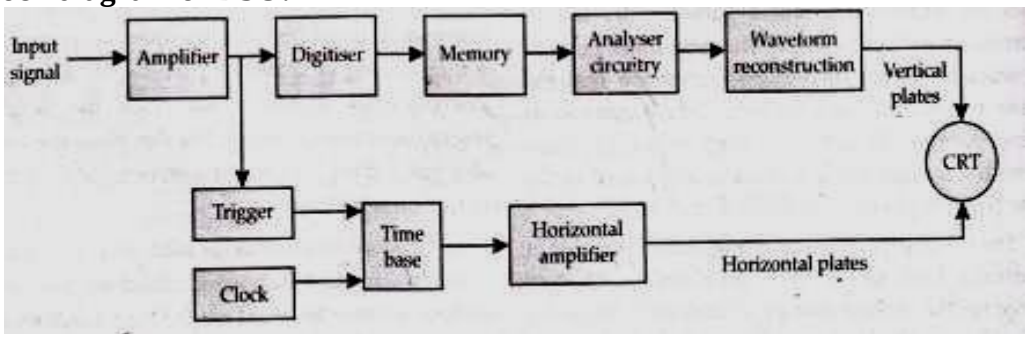
Amplifier: The signal whose frequency is to be measured is first amplified. The

		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 the gate is open are counted by the counter. If this interval between start and stop condition is known, the frequency of unknown signal can be measured as,. $F = N/t$ Where, F= Unknown frequency N= Number of counts displayed by the counter. t= Time interval between start and stop condition of the gate.	
	f)	**Describe the method of frequency measurement using Lissagous pattern.**	**4 Marks**
	Ans:	**Explanation:-** • In this method of measurement a standard frequency is applied to one set of deflection plates of the CRT tube while the unknown frequency is simultaneously applied to the other set of plates. The resulting pattern depend on the integral & phase relationship between two frequencies • Keep frequency fh constant and vary frequency fv , noting that the pattern. spins inalternate directions and change shape. The pattern will stand still whenever fv and fh are in an integral ratio. • The fv = fh pattern stands still and is a single circle or ellipse.(As per fig a) • When fv=2fh a two loop horizontal pattern is obtained. .(As per fig b)  • To determine the frequency from any Lissagous figure, count the number of horizontal loops in the pattern, divide it by the number of vertical loops and multiply this quantity by fn (known frequency). fv=(fraction)× fh Fraction= (No. of loops touches to horizontal tangent) /(no of loops touches to vertical tangent)	**4 Marks**
Q. 4		**Attempt any FOUR :**	**16 Marks**
	a)	**Explain multi range analog AC voltmeter with neat diagram.**	**4 Marks**

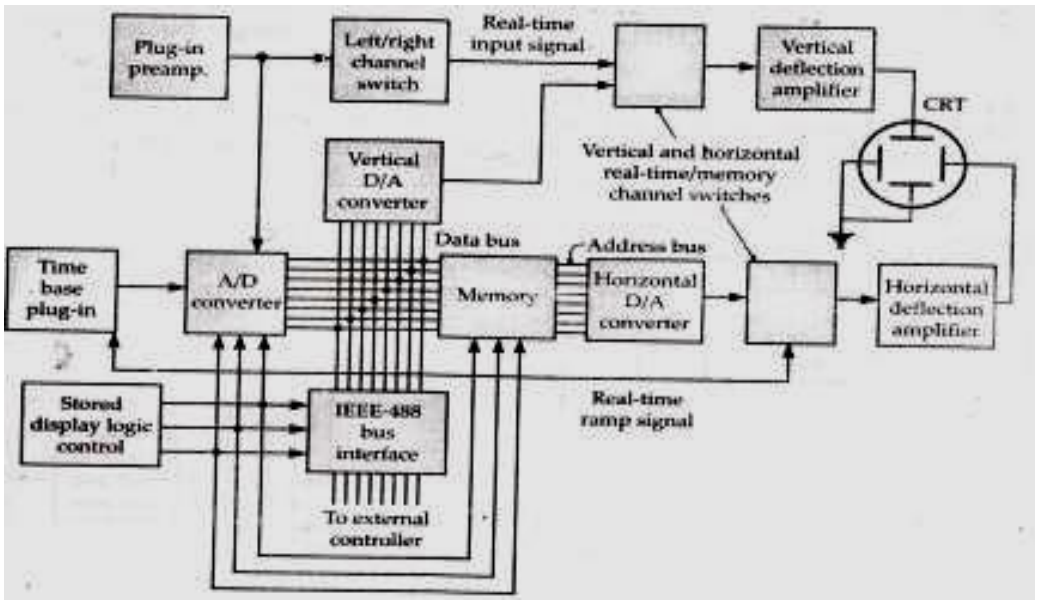
	Ans:	**Diagram of multi range analog AC voltmeter**	**2 Marks**
			
		Explanation:-The PMMC meter movement is used for measurement of AC voltage by using a rectifier in the measuring circuit. For measuring AC voltage of different ranges multi range AC voltmeter is designed. A rectifier is used with series of multiplier resistance R_1, R_2, R_3, R_4 & R_5. Due to different multiplier resistances various voltage ranges are achieved. The resistance R_5 acts as basic multiplier resistance and Diode D_1 & D_2 are used for full wave rectification.	**2 Marks**
	b)	**State any two function of LCR-Q meter. Draw its block diagram.**	**4 Marks**
	Ans:	**Function of LCR-Q meter:- (any two)** • Inductance measurement • Capacitance measurement • Resistance measurement	**Any two- 1 Mark each**
		Block diagram: 	**2 Mark**
		OR	



	c)	**Draw the labeled block diagram of DSO. List any two applications.**	**4 Marks**
	Ans:	**Block diagram of DSO:**	**2 Marks**



OR



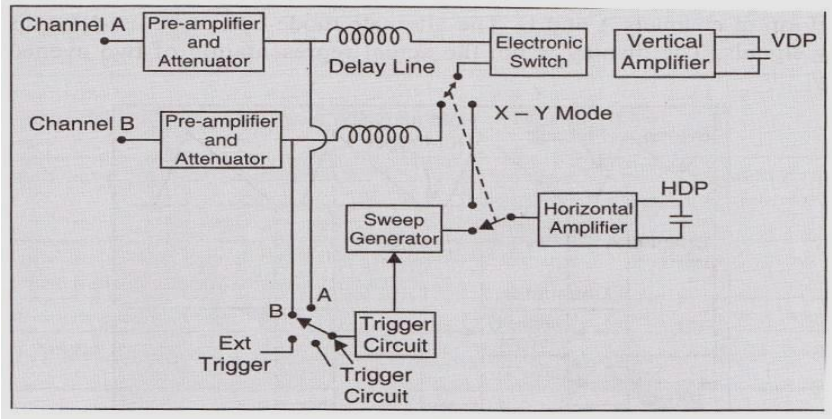
Applications: (any two)

1. Used to measure ac as well dc voltages and currents.
2. Used to save signals, so that it can be compared or processed.

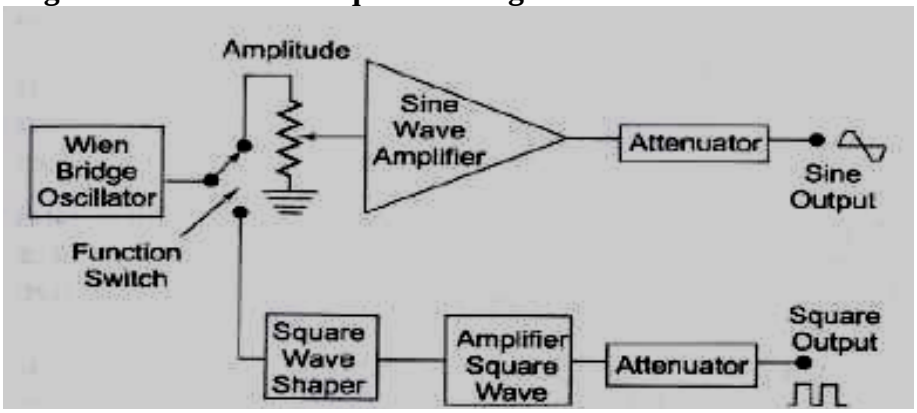
		3. Used to observe B-H curves, P-V diagrams. 4. Used to observe V-I characteristics of diodes, transistors. 5. Used to display cardiograms in medical field. 6. Used to measure inductance, capacitance. **7.** The signals can be integrated or differentiated.	**1 Mark each**
	d)	**What are the main functional blocks of logic analyzer ? State the function of each block briefly.**	**4 Marks**
	Ans:	**Functional blocks of logic analyzer:** 1. Data gathering unit 2. Information processing and storage unit 3. Display unit. • **The data gathering unit has** ➢ A pod slots for carrying data from the digital system under test to the logic analyzer. ➢ A key pad used for entering commands. • **Information processing storage unit**:- Records all the data from data gathering unit with respect to clock signal. This clock signal determines whether the data is 'high' or 'low' w.r.t defined threshold voltages. This info stored in memory available for detailing to display unit. • **The display unit** is a cathode ray tube (CRT) that displays the command menu for the operator and also displays the output data.	**1 Mark** **1 Mark** **1 Mark** **1 Mark**
	e)	**Differentiate between active and passive transducer. (any four points)**	**4 Marks**
	Ans:		**1 Mark each**

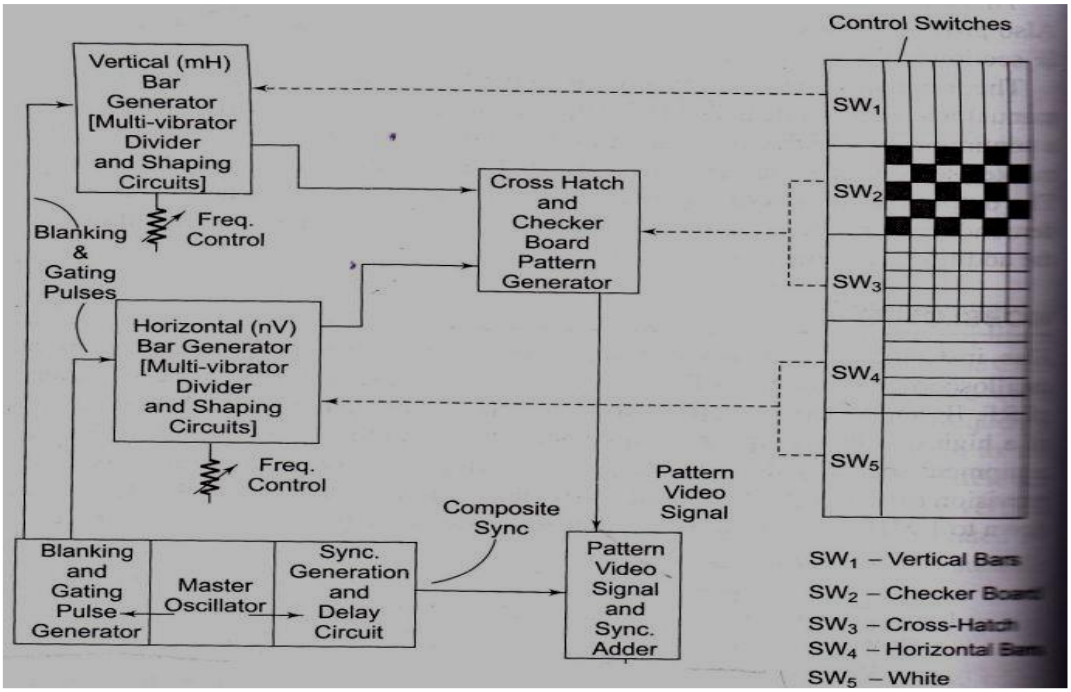
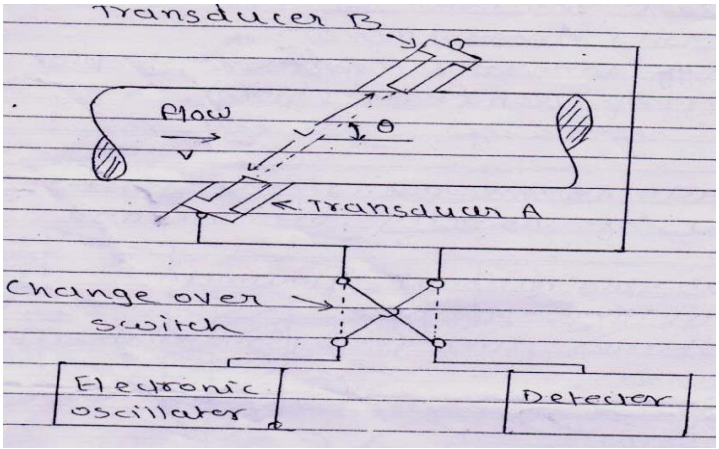
Sr. No.	Active Transducers	Passive transducers
1.	Do not require external power supply for its operation.	Requires external power supply for its operation.
2.	It is also called as 'Self generating Transducers'.	It is also called as 'Externally powered Transducers'.
3.	Operate under energy conversion principle.	Operate under energy controlling Principle.
4.	e.g. Thermocouples, Piezoelectric transducer etc.	e.g. Thermistors ,Strain gauges etc.

	f)	**Describe : (i) Seeback effect (ii) Peltier effect**	**4 Marks**
	Ans:	**Seeback effect :** Seeback effect states that whenever two dissimilar metals are connected together to form two junctions, out of which, one junction is subjected to high temperature and another junction is subjected to low temperature ,then e.m.f is induced in this loop proportional to the temperature difference between two junctions. **Peltier effect :** Peltier effect state that when two dissimilar metals form a closed loop, if the current is forced to flow through the closed loop then one junction will be heated and other	**2 Mark** **2 Mark**

<table>
<tr><td></td><td></td><td>will become cool.</td><td></td></tr>
<tr><td>Q.5</td><td></td><td>Attempt any FOUR :</td><td>16 Marks</td></tr>
<tr><td></td><td>a)</td><td>List any four specifications of analog DC ammeter and analog DC voltmeter.</td><td>4 Marks</td></tr>
<tr><td></td><td>Ans:</td><td>Specifications of analog ammeter: (any four)
1. Form Factor
2. Measurement type
3. AC current range
4. DC current range
5. Operating temperature
Specifications of analog voltmeter: (any four)
1. Form Factor
2. Measurement type
3. Phase
4. AC voltage range
5. DC voltage range
6. Maximum channels</td><td>½ Mark each</td></tr>
<tr><td></td><td>b)</td><td>Compare analog and digital multimeter on the basis of (i) Resolution (ii) Accuracy (iii) Function (iv) Power consumption.</td><td>4 Marks</td></tr>
<tr><td></td><td>Ans:</td><td><table>
<tr><th>Parameters</th><th>Analog multi meter</th><th>Digital multi meter</th></tr>
<tr><td>Resolution</td><td>Less</td><td>More</td></tr>
<tr><td>Accuracy</td><td>Less</td><td>More</td></tr>
<tr><td>Function</td><td>Less functions are available as compared digital multi meter</td><td>More functions are available as comparedto analog multi meter</td></tr>
<tr><td>Power consumption</td><td>Power consumption is less</td><td>Power consumption is negligible</td></tr>
</table></td><td>1 Mark each</td></tr>
<tr><td></td><td>c)</td><td>Draw the block diagram of single beam dual trace CRO. Explain its operation.</td><td>4 Marks</td></tr>
<tr><td></td><td>Ans:</td><td>Block diagram of single beam dual trace CRO
 

Working:</td><td>2 Marks</td></tr>
</table>

		In this CRO a single beam is split into two to produce two images. A mode control system (s1) enables the electronic switch to operate in two modes Alternate and chop mode and x-y mode. **Alternate mode:** • When the switch (s1) is in alternate position, the electronic switch feeds each signal alternatively to the vertical amplifier. • The electronic switch alternately connects the main vertical amplifier to channels A and B and adds a different dc component to each signal • This dc component directs the beam alternately to the upper or lower half of the screen. • The switching takes place at the start of each new sweep of the sweep generator. • The switching rate of the electronic switch rate, so that the CRT spot traces the channel A signal on one sweep and the succeeding sweep. • The sweep trigger signal is available from channels A or B and the trigger pick-off takes place before the electronic switch. This arrangement maintains the correct phase relationship between signal A and B. **Chop mode:** • When the switch (s1) is in the chop mode position .the electronic switch is free 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. E.g. 1 MS segments of each waveform are to the CRT display. • If the chopping rate is slow, the continuity of the display is lost and it is better to use the alternate mode of operation.	**2 Marks Working**
	d)	**Draw the block diagram of AF sine and square wave generator and explain its operation.**	**4 Marks**
	Ans:	**Block diagram of AF sine and square wave generator:**  • The frequency of the oscillations of Wein Bridge oscillator can change by	**2 Marks**

		varying the capacitance in the oscillator. • The output of the oscillator goes to a function switch which directs the oscillator output to either sine wave amplifier or to the square wave shaper. • The attenuator varies the amplitude of the output which is taken through a push-pull amplifier. Schmitt Trigger is used as wave shaping circuit that provides square waveform.	**2 Marks**
	e)	**Draw labeled block diagram of video pattern generator.**	**4 Marks**
	Ans:	**Block diagram of video pattern generator.**  	**4 Marks**
	f)	**Explain time difference type ultrasonic flow meter with diagram.**	**4 Marks**
	Ans:	 **Explanation:-**	**2 Mark diagram**

- The operating principle of this flow meter is based on the apparent change in the velocity of propagation of ultrasonic wave pulses in a fluid with a change in velocity of fluid flow.
- This flow meter consists of two transmitters and two receivers. These are separated by distance 'ℓ ' and mounted.
- Transmitter A transmits the waves pulsed of short duration in the direction of receiver A, this favor the wave as it is in direction of low.
- Transmitter B transmits the wave pulsed of short duration in the direction of receiver B, this do not favor the wave as it is opposite to the direction of low.
- The velocity of ultrasonic waves is increased or decreased by the fluid velocity depending upon the direction of fluid.
- The detector measures the transit time from upstream to downstream and vice versa. The time for ultrasonic wave to travel from transmitter A to receiver A is given by

2 Mark explanation

$TA=\ell/(c+ v \cos \Theta)$

Time for ultrasonic wave to travel from transmitter B to receiver B is given by,

$TB=\ell/ (c- v \cos \Theta)$

Where ℓ= distance between transmitter and receiver
C= velocity of ultrasonic wave
Θ= angle of path with respect to pipe axis.
V= velocity of fluid flowing through pipe.

The difference in time between TA and TB is given by,

$\Delta T = TA - TB$

$\Delta T =(\ell/ (c+ v \cos \Theta)) – (\ell/ (c- v \cos\Theta))$

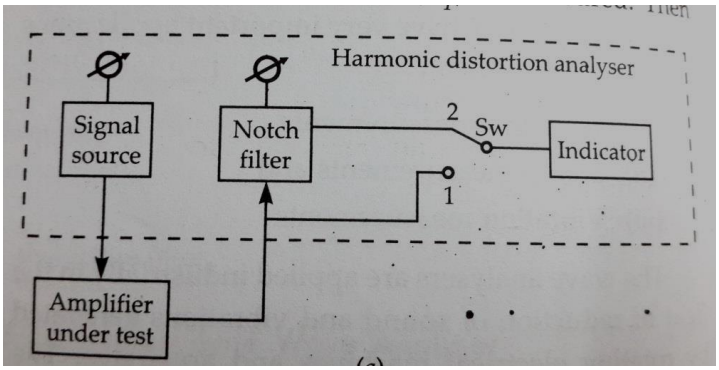
$\Delta T = \ell/ 2v \cos \Theta$

Therefore $v= \ell/ (2\Delta T \cos\Theta)$

The measurement is independent of velocity of ultrasonic wave (c)

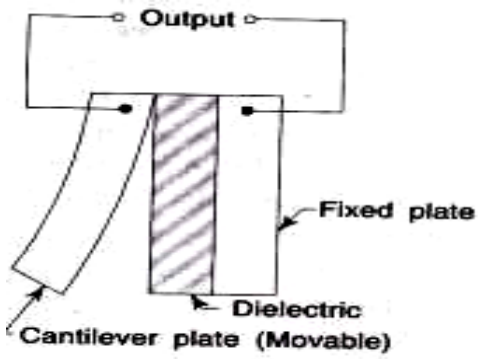
By measuring the difference in reception frequency, and knowing the value of Θ and ℓ, the velocity of fluid can be calculated.

Q.6		**Attempt any FOUR :**			**16 Marks**
	a)	**Differentiate between logic analyzer and spectrum analyzer.**			**4 Marks**
	Ans:	**Parameter**	**Logic Analyzer**	**Spectrum Analyzer**	**Any four- 1 Mark each**
		Waveforms observed	At a time number of waveforms can be observed. (up to 64 waveforms can be observed)	At a time only a single waveform can be observed	
		Compatibility	They are compatible with different logic families like TTL,CMOS, NMOS.	They are not compatible with different logic families.	
		Types	1.logic timing analyzer 2.logic state analyzer	1.scanning type 2.Non-scanning type.	
		Function	Troubleshooting of digital systems	Frequency domain analysis of various systems.	
		Application	IC testing, Hardware/Software troubleshooting.	Measurement of antenna pattern, Biomedical, Radar	

		(Any four Parameters)	
	b)	**Draw the block diagram of harmonic distortion analyzer and state the function of each block.**	**4 Marks**
	Ans:	**Block diagram of harmonic distortion analyzer:**  • The signal has very low distortion and this can be checked by reading its o/p distortion by connecting directly into analyzer • The signal from source is fed to the amplifier under test. This generates harmonics and original fundamental frequency. • The original fundamental frequency is removed by notch filter. The switch is first placed in position 1 and total content of fundamental & harmonics (E_T) is measured. Then the switch is moved to position 2 to measure just the harmonics (E_H). The value of THD total harmonic distortion is then found $THD = E_H / E_T \times 100$	**2 Marks** **2 Marks**
	c)	**Define : (i) accuracy (ii) precision (iii) Drift (iv) Sensitivity**	**4 Marks**
	Ans:	**Accuracy**: It is the degree of closeness with which an instrument reading approaches the true value of the quantity being measured. **Precision**: A measure of the consistency or repeatability of measurement, i.e. successive reading do not differ. **Drift**: The actual change in the measured value when the same characteristic is measured under the same conditions, same operator at different points in time. **Sensitivity**: Sensitivity is the ratio of change in output of an instrument to the change in input.	**1 Mark each defination**
	d)	**Differentiate between single beam dual trace CR0 and dual beam CRO. (based on any four factors)**	**4 Marks**
	Ans:		**1 Marks each**

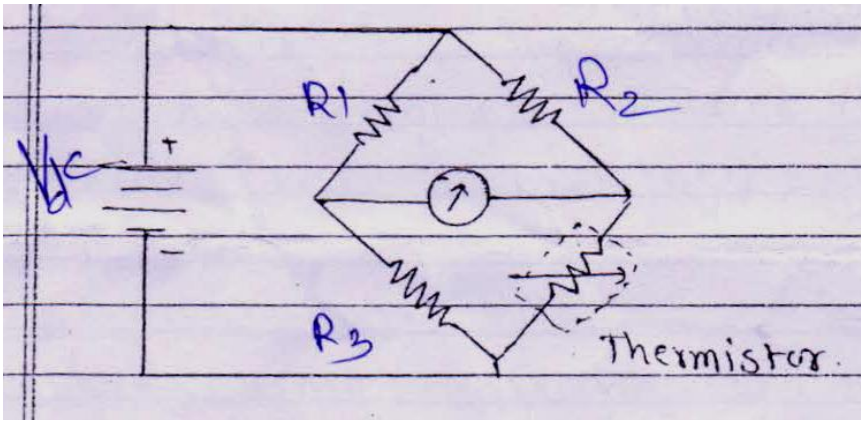
single beam dual trace CRO	**Dual beam dual trace CRO**
It has one cathode ray gun and one beam	It has two completely separate electron beams
It has one set of vertical deflection plates	It has two sets of vertical deflection plates.

Electronic switch switches the two signals to vertical amplifier.	Because of separate beam electronic switch is not required.
Only one vertical amplifier is used.	Two separate vertical amplifiers are used.
Intensity of the beam is high	Intensity of the beam is less

e)	**Describe the working principle of capacitive transducer with diagram.**	**4 Marks**
Ans:	The capacitive transducer works on the principle of variable capacitances. The capacitance value of a the capacitive transducer changes because of many reasons like overlapping of plates, change in distance between the plates and dielectric constant. $C = \varepsilon A / d$ Where , C – capacitance of the capacitor in Farads A – overlapping area of plates in m^2 d – the distance between two plates in meter ε – permittivity of the medium **Explanation:** The following example of capacitive transducer makes use of the principle of change in distance between the plates causing the variation in capacitance. (Note: Here any other suitable diagram may also be drawn and explained or capacitive transducers working on the other principles may also be explained with suitable diagrams)  The movable plate works as a cantilever plate, decreasing the distance between the two plates. Due to this decrease in distance the capacitance of a capacitor increases. The air between the two plates works as a dielectric medium. The capacitance of an air dielectric capacitor does not vary linearly with change in distance between the plates. For the linearity can be the closely approximated by keeping the change in the distance small or by having a medium of high dielectric constant in the space between the two plates. This type of capacitive transducer may be used to measure displacements.	**2 Marks Diagram** **2 Marks Explanation**
f)	**Describe the working principle of thermistor. State its advantages and disadvantages. (one each)**	**4 Marks**
Ans:	• Thermistor is a temperature transducer in which, the change in temperature	**2 marks working**

causes change in resistance of the thermistor.

- Thermistors are available in two types i.e PTC (Positive temperature co-efficient of resistance) and NTC (Negative temperature co-efficient of resistance).
- To measure temperature with a thermistor, it is placed in an environment whose temperature is to be measured.
- Generally the thermistor is placed in one arm of a Wheatstone's bridge circuit as shown in fig.
- At balance condition , when there is no change in temperature , the galvanometer indicates zero.
- As the temperature increases or decreases, the resistance of thermistor changes due to which the bridge circuit becomes unbalanced.
- Thus galvanometer shows deflection proportional to change in temperature .This system can be calibrated to show the reading in temperature scale.



Advantages of thermistor : (any 1)

1. Small size and fast response
2. Suitable for narrow spans
3. Cost is low
4. Stability of the instrument increases with age
5. They are adaptable to various electrical read out
6. Good response at lower temperature range.

Disadvantage of thermistor: (any 1)

1. Temperature verses resistance curve is non- liner
2. They are not suitable for wide temperature spans
3. Problems rise due to interchangeability of individual elements.
4. Stability is doubtful at higher temperature.
5. Limited for process application.

Advantages 1 Marks

Disadvantages 1 Marks