MODEL ANSWER

SUMMER– 17 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 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 terms active and passive transducer.**	**2M**
	Ans:	Active transducer is a transducer which do not required power supply for converting one form of energy to another. It is also called as 'Self generating transducers' Passive transducer is a which requires power supply for converting one form of energy to another. It is also called as 'externally powered transducers'.	**(1M each)**
	(b)	**Explain zero and span drift.**	**2M**
	Ans:	**Zero Drift:** If the whole calibration gradually shifts due to slippage, permanent set, or due to undue warming up of electronic tube circuits, then it is called as zero drift. **Span drift or sensitivity drift:** If there is proportional change in the indication all along the upward scale, the drifts is called span drift or sensitivity drift	**(1M each)**
	(c)	**State function of delay line in CRO.**	**2M**
	Ans:	**Function of Delay line:**	**2M**

	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.	
(d)	**List four units of temperature measurement**	**2M**
Ans:	Several scales and units exist for measuring temperature, the most common being 1. Celsius (denoted °C), 2. Fahrenheit (denoted °F), 3. Kelvin (denoted K), 4. Rankine (denoted by ^{0}R)	**(½M each units)**
(e)	**State any four applications 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 to test AF circuit for different distortion. 4) It is used to check faulty components. 5) It is used to check signals at radio and TV receiver. 6) It is used to check radiation pattern generated by antenna	**(2M for any four Applications)**
(f)	**Define wave analyzer. State any two wave analyzers.**	**2M**
Ans:	**Waveform analyzer**: - It is the instrument used to measure the amplitude of each harmonic or fundamental. This is the simplest form of analysis in the frequency domain & can be performed with a set of tuned filters & a voltmeter. 1. Logic Analyzer 2. Spectrum Analyzer	**(1M Definition 1M for two types)**
(g)	**Define resistive transducer. State any two examples.**	**2M**
Ans:	Definition: Resistive transducers are those in which the resistance changes due to a change in some physical phenomenon. Examples: 1. Linear Potentiometer 2. Angular Potentiometer.	**(1M Definition, 1M example)**
(h)	**Explain the principle of piezoelectric transducer.**	**2M**
Ans:	**<u>Principle of piezoelectric transducer:</u>** 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. **<u>OR</u>** 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	**2M**
B)	**Attempt any TWO :**	**8M**

	(a)	**Explain analog and digital transducer with the help of suitable examples..**	**4M**
	Ans:	**Analog transducers** converts input signal into output signal, which is a continuous function of time Examples : THERMISTOR ,strain gauge, LVDT , thermocouple etc. **Digital transducers** converts input signal into the output signal in the form of pulses e.g. it gives discrete output such as 0 and 1 Examples: Rotary Encoder, digital tachometer, limit switches.	**(2M Explanation , 2M Examples.)**
	(b)	**If moving coil voltmeter given 30^0 displacement for 3 V input voltage. Calculate the sensitivity of voltmeter. If minimum measurable displacement is 1^0 calculate its resolution.**	**4M**
	Ans:	***Note: If a student attempted this question,Marks can be given.***	

Assume

for

0 Volt input — 0° displacement
3 volts input — 30° displacement.

$$\text{Sensitivity} = \eta = \frac{\text{change in output}}{\text{change in input}}$$

$$= \frac{30^\circ - 0^\circ}{3 - 0}$$

$$= 10^\circ/\text{volts}.$$

$$= 10 \times \frac{\pi}{180} \frac{\text{rad}}{\text{volts}}.$$

$$= 0.174 \frac{\text{rad}}{\text{volts}}.$$

2M

Resolution: Resolution is the smallest change in input which can be detected by instrument.

Given → 1° displacement is the smallest displacement on the meter.

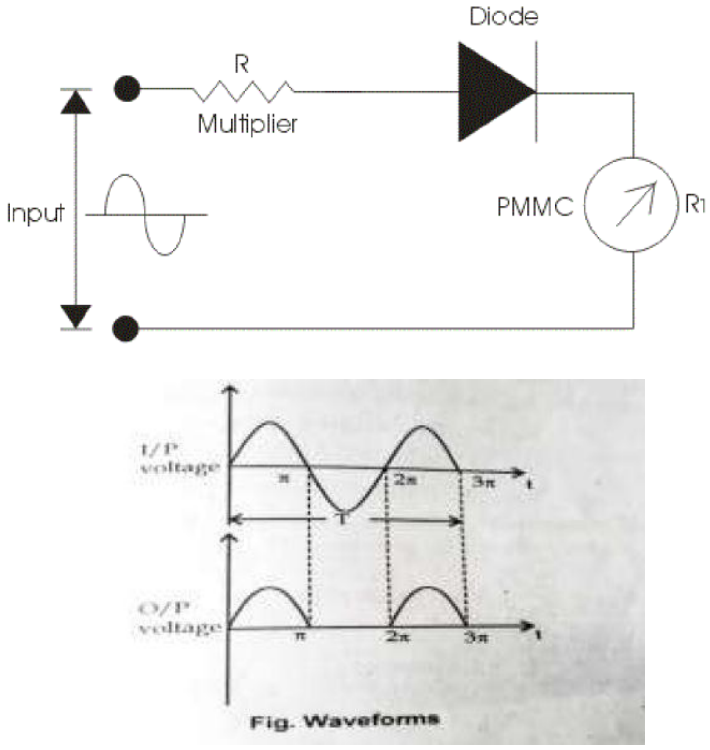
So if for 3 v input — 30° displacement
then for 1° displacement,

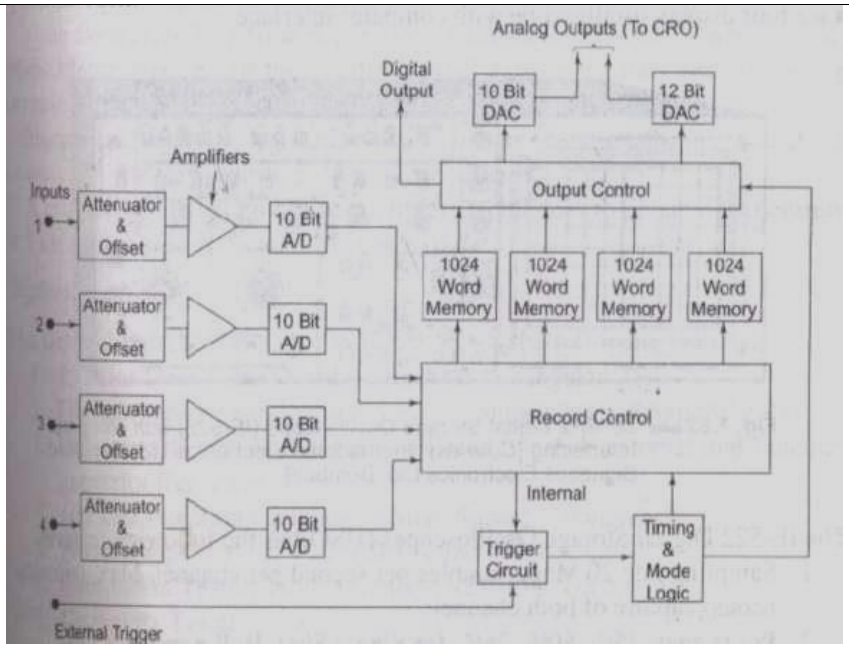
30° — 3 V.
1° — x.

$$\frac{1^\circ \times 3\,V}{30^\circ} = \frac{3}{30} = 0.1\,V$$

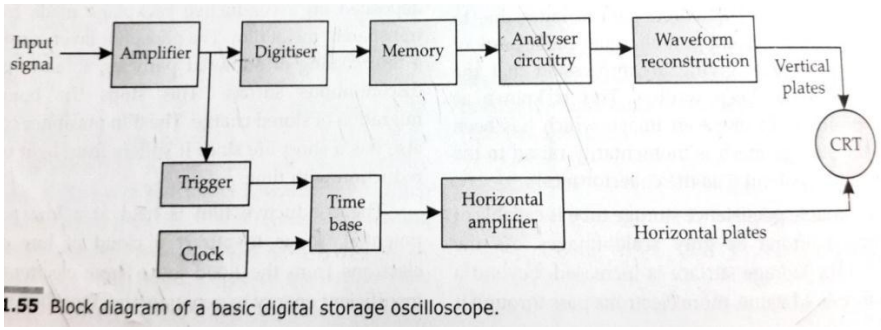
Resolution is 0.1 V.

2M

	(c)	**Draw the neat labeled diagram of half wave AC voltmeter. Explain its working.**	**4M**
	Ans:	**Diagram:**  Fig. Waveforms **Explanation:** The circuit given in which the rectifying element (diode) is connected in series with Sinusoidal voltage source, PMMC, and multiplier resistor. The Function of Multiplier is to limit the current drawn by the PMMC to ovoid it from damage. The diode conducts during positive half cycle and does not conduct during negative half cycle. The average current through the meter will be given by the expression. $\mathbf{Iav = V_{av} / 2R = 0.45 * [V_{rms}/R]}$	**2M** **2M**
Q 2		**Attempt any FOUR:**	**16M**
	(a)	**Draw a block diagram of DSO.**	**4M**
	Ans:	**Diagram:**	**4M**

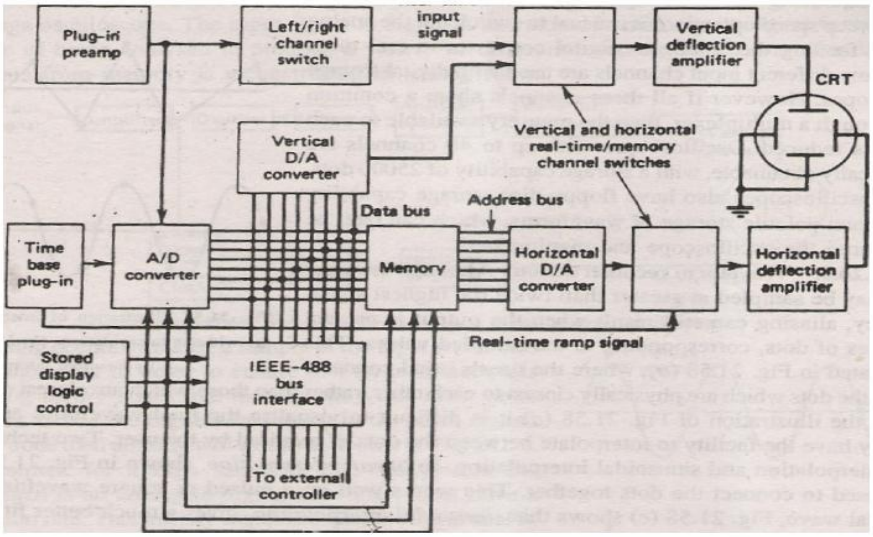


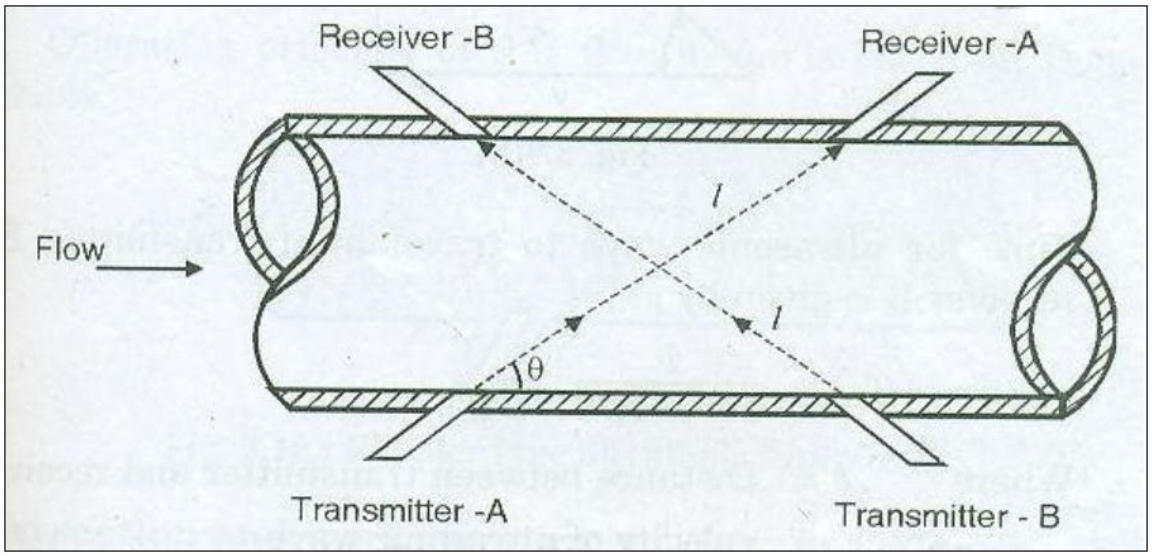
OR



1.55 Block diagram of a basic digital storage oscilloscope.

OR



(b)	**Explain principle of time difference type ultrasonic flowmeter with neat labelled diagram.**	**4M**
Ans:	**Diagram:**  	**2M**
	Explanation:- 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 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 $TA=\ell/(c+ v \cos \Theta)$ Time for ultrasonic wave to travel from transmitter B to receiver B is given by, $TB=\ell/ (c- v \cos \Theta)$	**2M**
(c)	**Distinguish between RTD and thermocouple on the basis of following factors:** **(i) Principle of operation** **(ii) Operating range** **(iii)Linearity** **(iv)Materials used.**	**4M**
Ans:		

Parameter	RTD	Thermocouple
1. Principle of operation	The resistance of certain metal changes with temperature change.	When two dissimilar metals are connected to each other to form two junctions and these junctions are exposed to different temperatures then current flows through the metals, an emf generates which is proportional to the difference in temperature at the junctions.
2. Operating Range	-200^0C to 650^0C.	-270^0C to 2800^0C.
3. Linearity	Linear	Non linear in emf vs temp characteristics
4. Materials Used	Platinum, nickel and copper	Copper, constantan, chromel, alumel, rhodium, iron etc.

(4M for four points).

(d)	**A permanent magnet moving coil instrument has a coil of dimensions 15 mm × 12 mm. The flux density in the air gap is 1.8×10^{-3}Wb/m^2 and the spring constant is 0.14×10^{-6} Nm/rad. Determine the number of turns required to procedure an angular deflection of 90^0 when a current of 5 mA is flowing through the coil.**	**4M**

Ans:

Data :-

$A = 15\ mm \times 12\ MM$

$A = 180\ mm^2$

$A = 180 \times 10^{-6}\ m^2$

$B = 1.8 \times 10^{-3}\ wb/m^2$

$K = 0.14 \times 10^{-6}\ Nm/rad.$

$\theta = 90^\circ$

$= 90 \times \frac{\pi}{180}$

$\theta = 1.57\ rad.$

$I = 5\ mA$

$= 5 \times 10^{-3}\ A$

The deflecting torque is given by

$T_d = B \times A \times I \times N$ **1M**

$K\theta = BAIN$

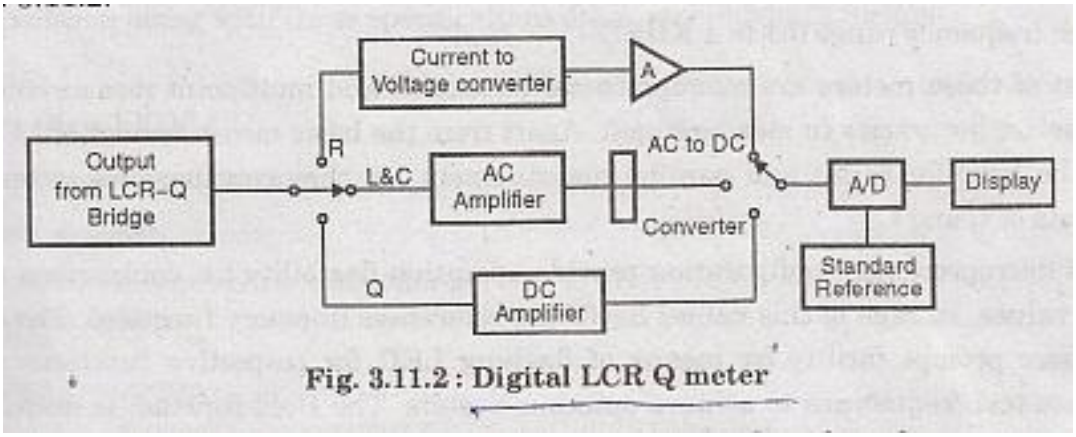
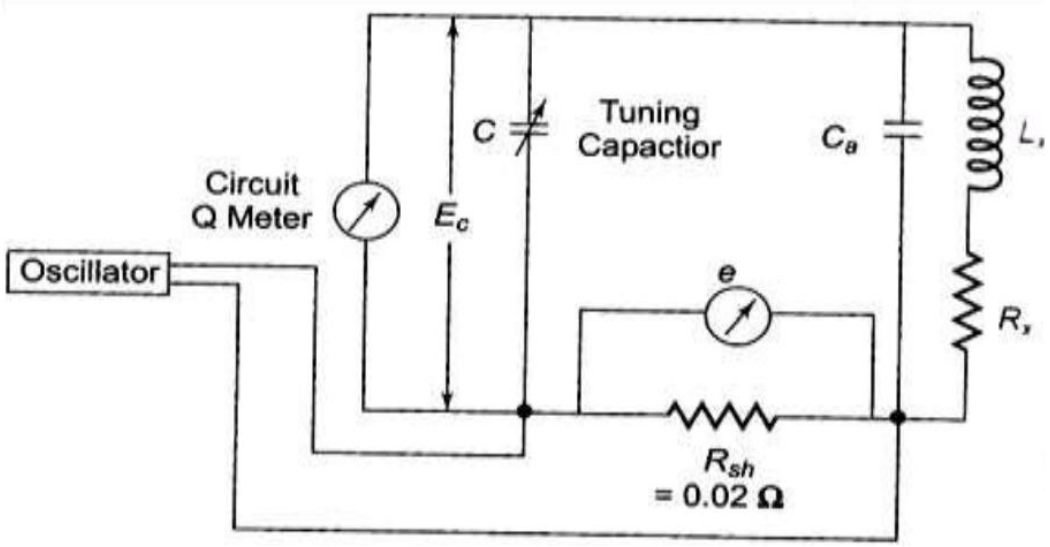
$N = \frac{K\theta}{B \cdot A \cdot I}$ **1M**

$= \frac{0.14 \times 10^{-6} \times 1.57}{1.8 \times 10^{-3} \times 180 \times 10^{-6} \times 5 \times 10^{-3}}$

$\boxed{N = 136}$ (Approx) **2M**

Number of turns required = 136 (Approximately)

(e)	**List four signal generators. Also state one function of each.**	**4M**
Ans:	1. **Standard signal generator:** Used as power source for the measurement of gain, signal to noise ratio(S/N), bandwidth 2. **AF sine and square wave generator:** This provides sine wave or square wave output. 3**. Function generator:** It produces different waveforms of adjustable frequency 4. **Sweepgenerator:** It provides sinusoidal output voltage whose freqency varies smoothly and continuously over and entire frequency range. **Video Pattern generator:** It provides video signals directly and with RF modulation on standard TV channels for alignment, testing and servicing of TV receivers.	**4M**

	(f)	**Draw a block diagram of LCR-Q meter. State its principle.**	**4M**
	Ans:	**Diagram :**  Fig. 3.11.2 : Digital LCR Q meter **OR**  **Principle:** LCR meter is an electronic test machine used to measure inductance (L) , Capacitance (C) , & Resistor (R) of a component sensor or other device that's operation depends upon capacitance, inductance , & resistance.	**3M** **1M**
Q. 3		**Attempt any FOUR:**	**16M**
	(a)	**List any four specifications of analog voltmeter and ammeter each.**	**4M**
	Ans:	**Specifications of analog voltmeter: (any four)** **1.** Form Factor 2. Measurement type 3. Phase 4. AC voltage range 5. DC voltage range	**(½M each)**

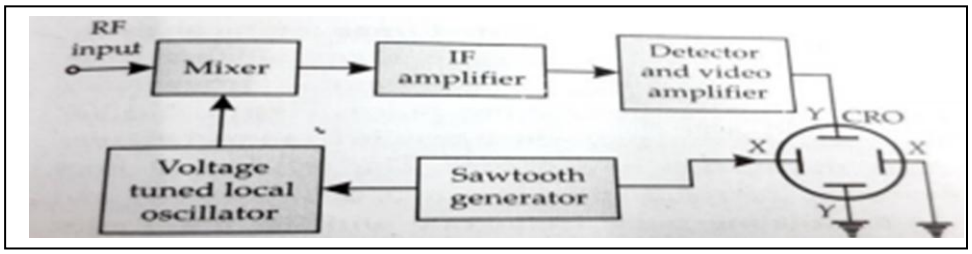
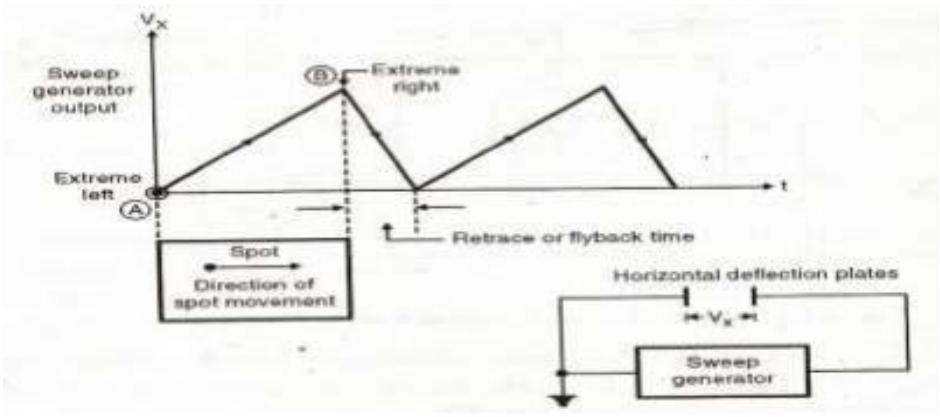
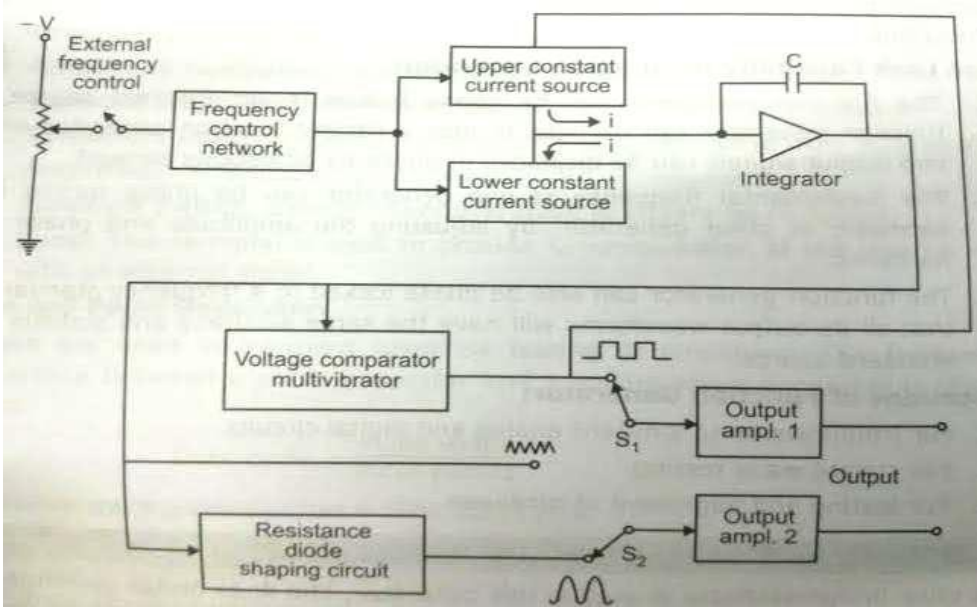
	6. Maximum channels **Specifications of analog ammeter: (any four)** 1. Form Factor 2. Measurement type 3. AC current range 4. DC current range 5. Operating temperature	**(½M each)**
(b)	**Draw a block diagram of spectrum analyzer. Explain its working**	**4M**
Ans:	**Bock diagram of spectrum analyzer:**  **Working**: • Referring to the block diagram of the basic spectrum analyzer, the saw tooth generator provides the saw tooth voltage which drives the horizontal axis element of the scope and this saw tooth voltage is the frequency controlled element of the voltage tuned oscillator. • As the oscillator sweeps from f min to f max of its frequency band at a linear recurring rate, it beats with the frequency component of the input signal and produce an IF, whenever a frequency component is met during its sweep. • The frequency component and voltage tuned oscillator frequency beats together to produce a difference frequency, i.e. IF. The IF corresponding to the component is amplified and detected if necessary and then applied to the vertical plates of the CRO producing a display of amplitude versus frequency. Spectrum analyzers are widely used in radar, oceanography and biomedical fields.	**2M** **2M**
(c)	**State advantages of digital instruments over analog.**	**4M**
Ans:	**Advantages of digital instruments over analog.(Any four)** 1. Output is in digital form. 2. Power required is less as compared to analog instruments. 3. Accuracy is more. 4. Resolution is more. 5. Free from observational errors.	**4M**
(d)	**Describe the waveform generation technique in CRO.**	**4M**
Ans:		

		Diagram: 	**2M**
		• A saw tooth waveform is applied to the right plate of the horizontal deflection plate while the left is connected to ground. • This sawtooth waveform is generated by a special until inside the oscilloscope called as the "sweep generator". • Let us assume that the voltage applied between the vertical deflection plates is zero that is no input signal is not being applied. • A saw tooth waveform is applied between the horizontal deflection plates. At instant 'A' the saw tooth voltage is zero and the electron beam is on the extreme left of the screen. As the voltage Vx increases the potential on the right plate start increasing. An electrostatic field is developed the field strength of which increases with increase in Vx. Due to this the electron beam is pulled towards the right hand side of the screen. • As the sawtooth voltage Vx increase linearly with time, the field also increase and the beam travels at a uniform speed from left to right. • As the sawtooth voltage reaches the peak point (B). The beam will reach extreme right end of the screen. • The time taken by the voltage Vx to rise from 0 to peak which corresponds to the time taken by the sport to move from left to right is called "Trace Time". • Then the voltage Vx reduces suddenly from its peak value to zero, The electrostatic filed collapses and electron beam is return back to the extreme left side of the screen. This is called as flyback or retrace . • The beam is blanked out during the retrace time so that the retrace is not visible on the screen.	**2M**
(e)		**State advantages and disadvantages of electromagnetic flowmeter (two each).**	**4M**
Ans:		**Advantages: (Any two)** **1.** There is no obstacle in the path. 2. Output is independent of viscosity, pressure and temperature. 3. Can be used as bidirectional flowmeter.	**(1M each)**

		4. It is available in large pipe size. 5. It can handle slurries and greasy materials. **<u>Disadvantages:(Any two)</u>** 1. Cost is high 2. Used only for conductive liquids 3. It must be explosion proof when installed in hazardous area.	**(1M each)**
	(f)	**Explain time and frequency measurement with the help of CRO.**	**4M**
	Ans:	**Time measurement using CRO:** It is the distance between two identical points on successive cycles of the waveform. In order to measure time first align the reference point on a graticule line using horizontal position control. Time period = Number of horizontal division * (time/div) **Frequency measurement using CRO:** The frequency is proportional to the time Frequency = 1 / Time period	**2M** **2M**
Q. 4		**Attempt any FOUR:**	**16M**
	(a)	**Draw block diagram of function generator.**	**4M**
	Ans:	**<u>Block diagram of function generator:</u>**  	**4M**
	(b)	**Differentiate between logic analyzer and wave analyzer .(any four points).**	**4M**

Ans:

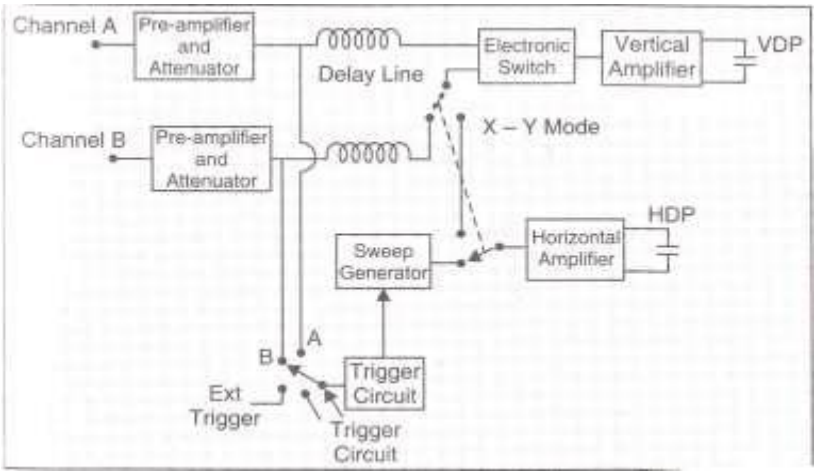
Logic analyzer	Wave analyzer
It is an electronic instrument that capture and displays multiple signals from a digital system or digital circuit	It is an instrument to measure relative amplitudes of single frequency components in a complex waveforms.
Types 1. logic timing analyzer 2.logic state analyzer	Types 1. Basic Wave analyzer 2. Frequency selective wave analyzer 3. Heterodyne wave analyzer
Function Troubleshooting of digital systems	Function Frequency domain analysis of various systems.
Working domain Digital	Working domain frequency
Application: In the field of microprocessor based system development	Application: Used for measuring the relative amlitudes of single frequency components in a complex or distorted waveform

(Any 4 points:1M each)

(c) **Draw a block diagram of single beam dual trace CRO. Explain alternate and chop mode** **4M**

Ans: **2M**

Block diagram of Dual trace CRO:



Working:

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.

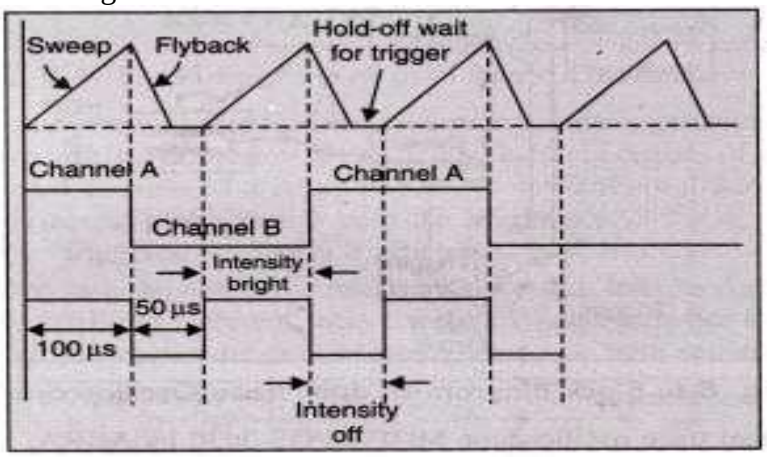
The switching takes place at the start of each new sweep of the sweep generator

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

(Consider explanation, alternate mode 1M,and chop mode 1M)

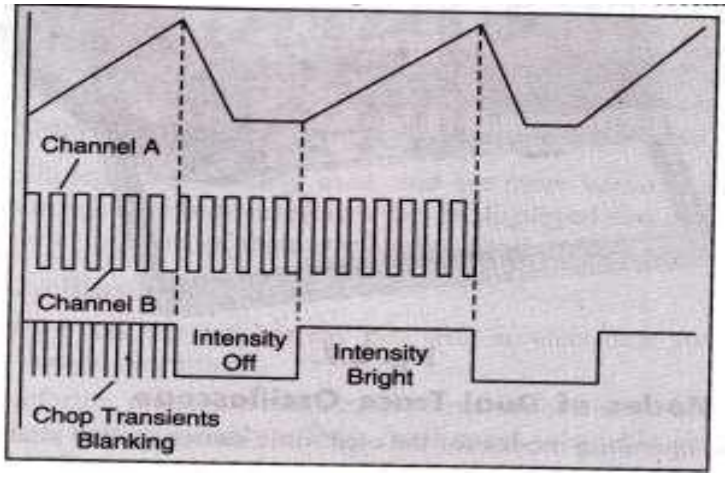
place before the electronic switch. This arrangement maintains the correct phase relationship between signal A and B.



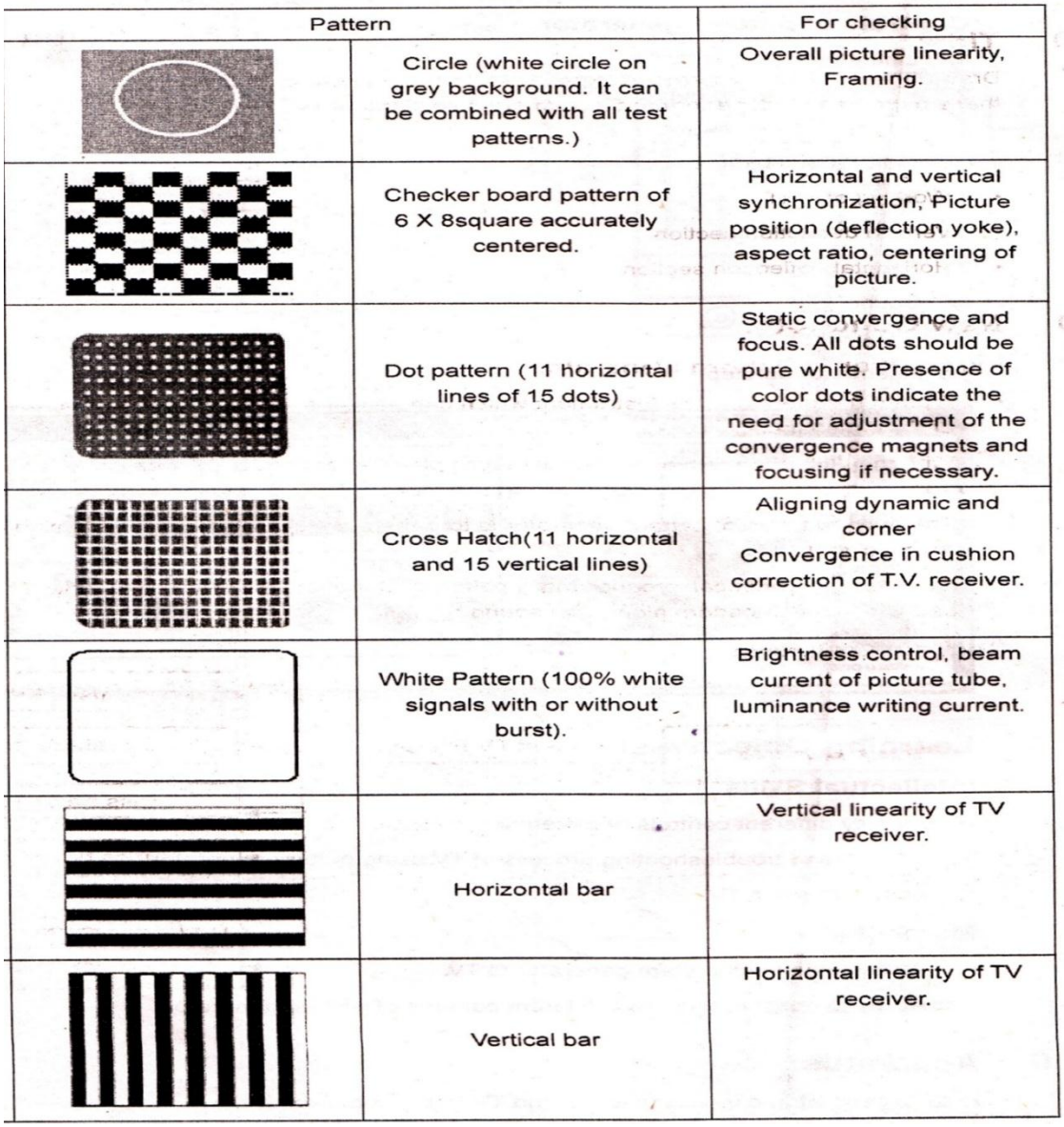
Chop mode:

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.

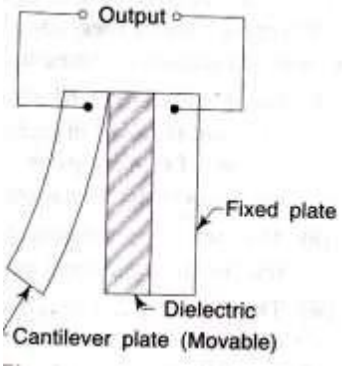
If the chopping rate is slow, the continuity of the display is lost and it is better to use the alternate mode of operation.

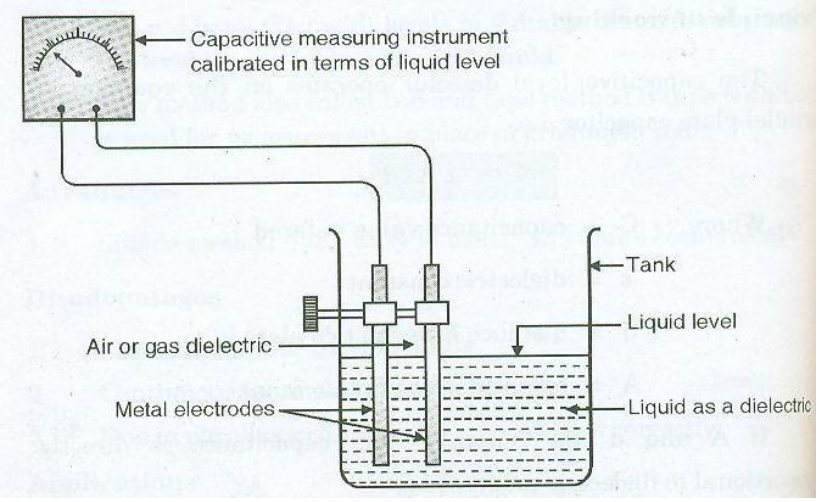


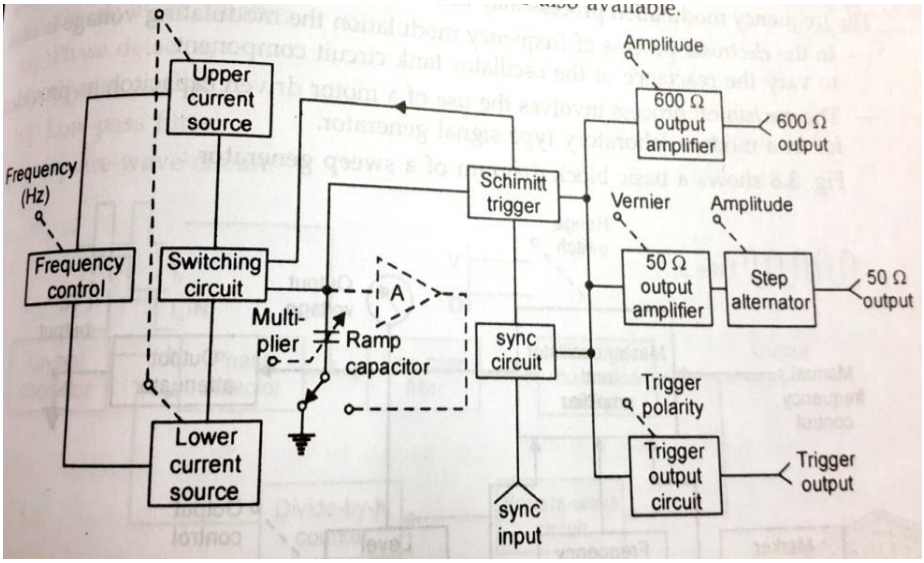
(d)	**Draw test patterns generated by pattern generator. State importance of test pattern.**	**4M**
Ans:		

			**(Any 4,1M each)**

Pattern		For checking
	Circle (white circle on grey background. It can be combined with all test patterns.)	Overall picture linearity, Framing.
	Checker board pattern of 6 X 8square accurately centered.	Horizontal and vertical synchronization, Picture position (deflection yoke), aspect ratio, centering of picture.
	Dot pattern (11 horizontal lines of 15 dots)	Static convergence and focus. All dots should be pure white. Presence of color dots indicate the need for adjustment of the convergence magnets and focusing if necessary.
	Cross Hatch(11 horizontal and 15 vertical lines)	Aligning dynamic and corner Convergence in cushion correction of T.V. receiver.
	White Pattern (100% white signals with or without burst).	Brightness control, beam current of picture tube, luminance writing current.
	Horizontal bar	Vertical linearity of TV receiver.
	Vertical bar	Horizontal linearity of TV receiver.

(e)	**Suggest a transducer to measure tank level. Explain with neat labelled diagram.**	**4M**
Ans:	**<u>Diagram:</u> <u>Capacitive transducer</u>** 	**2M**

		OR  **Explanation:** The movable plate works as a cantilever plate, decreasing the distance between the two plate. 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.	**2M**
	(f)	**State any four applications of LVDT.**	**4M**
	Ans:	1. Used to measure linear displacement 2. Useful in force, pressure and weight measurement as a secondary transducer 3. Useful for measurement and control of thickness of metal sheet. 4. Used for measurement of tension in a cord	**(1M each)**
Q.5		**Attempt any FOUR :**	**16M**
	(a)	**Thermocouple is best suitable temperature transducer for higher temperature range upto 2000 ^{0}C. Illustrate**	**4M**
	Ans:	• Thermocouple is two dissimilar metals joining end to end which generate the potential difference between these two ends as result of temperature or Thermocouples generates a voltage directly dependent on temperature. • The metals chosen in such way that they can withstand against higher temperatures and rapid variation in temperature highly responsive, sensitive. • Generally R-type i.e. platinum -rhodium combination metals are used to measure temperature up to 2000 degree Celsius. R- Type has a slightly higher output, improved stability and high accuracy over S type. Also **Series of thermocouples called as thermopile** is used for sensing higher temperature range. • And they are widely used in industrial applications because they work reliably at	**(1M for each point)**

		very high temperatures and are less expensive than RTD's. hence thermocouple is best suitable for higher temperature range up to 2000 ^{0}C ***Note: Consider relevant answer***	
	(b)	**State applications of spectrum analyzer.**	**4M**
	Ans:	1) Amplitude Modulation 2) Frequency Modulation 3) Pulse Modulation 4) Noise Measurement 5) Measurement of harmonic distortion 6) Used to measure Antenna pattern 7) Can be used in Biomedical, radars and Oceanography. 8) Used to analyze the air and water pollution. 9) Testing of RF interface. 10) Used to measure modulation index of FM deviation.	**(Any 4,Each-1M)**
	(c)	**Draw a block of pulse generator. Explain function of upper and lower current source.**	**4M**
	Ans:	**Diagram:**  **Explanation:** Function of Upper and Lower Current source: The upper current source, supplying a constant current to the ramp capacitor charges this capacitor at a constant rate and the ramp voltage increases linearly, when the positive slope of the ramp voltage reaches the upper limit set by internal circuit component the Schmitt trigger (a bi-stable multivibrator) changes state. The trigger circuit output goes negative reversing the condition of the current control switch and the capacitor starts discharging. The discharge rate is linear, controlled by the lower current source.	**2M** **2M**
	(d)	**Differentiate J, K, R and S thermocouples on the basis of material used and temperature range.**	**4M**

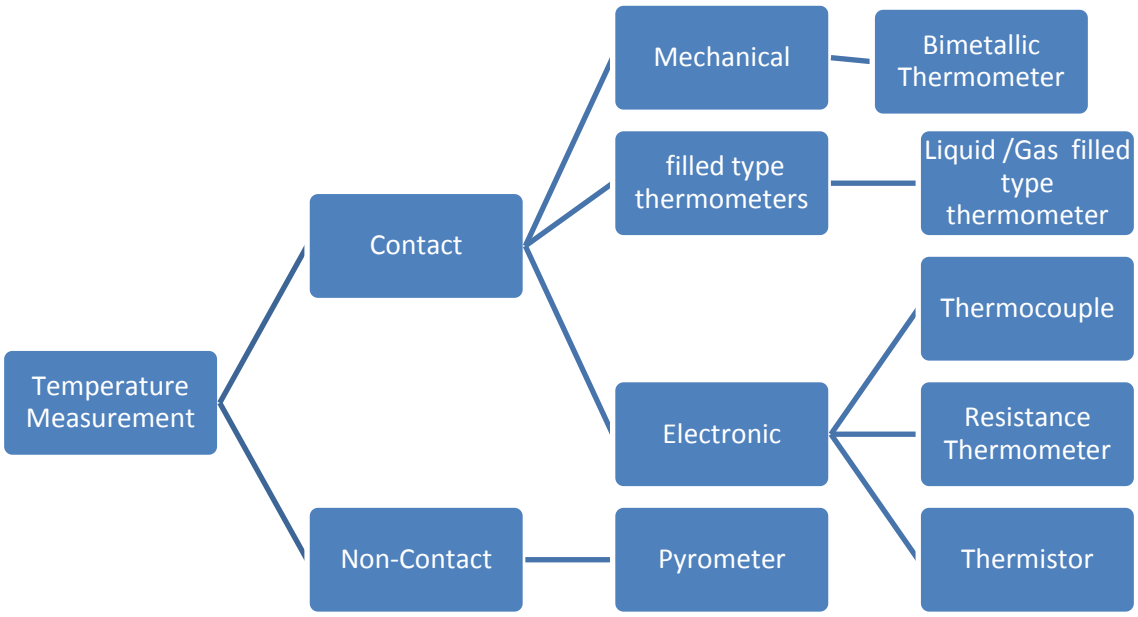
Ans:

Sr. No.	Type of transducer	Material used	Temperature range in (degree. Celsius)
1	J	Iron-Constantan	-180 to +850
2	K	Chromel-Alumel	-200 to +1300
3	S	Platinum-Platinum/ 10% Rhodium	-0 to +1400
4	R	Platinum-Platinum/ 13% Rhodium	-0 to +1600

(1M for each type)

(e) State classification of temperature transducer. **4M**

Ans: **4M**



OR

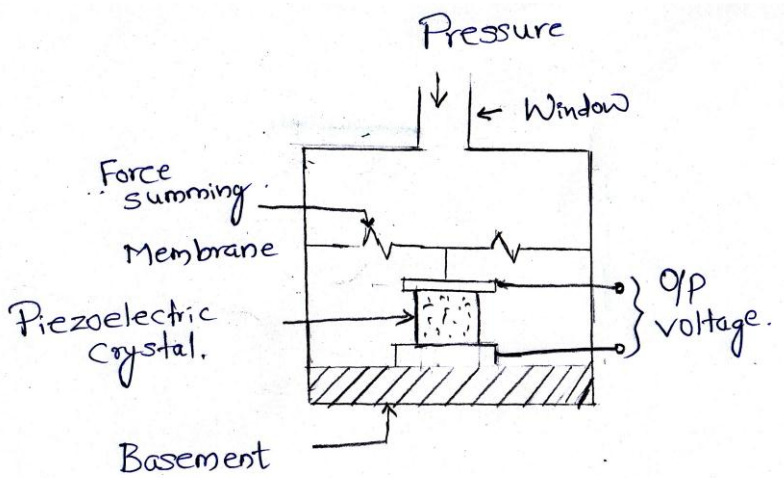
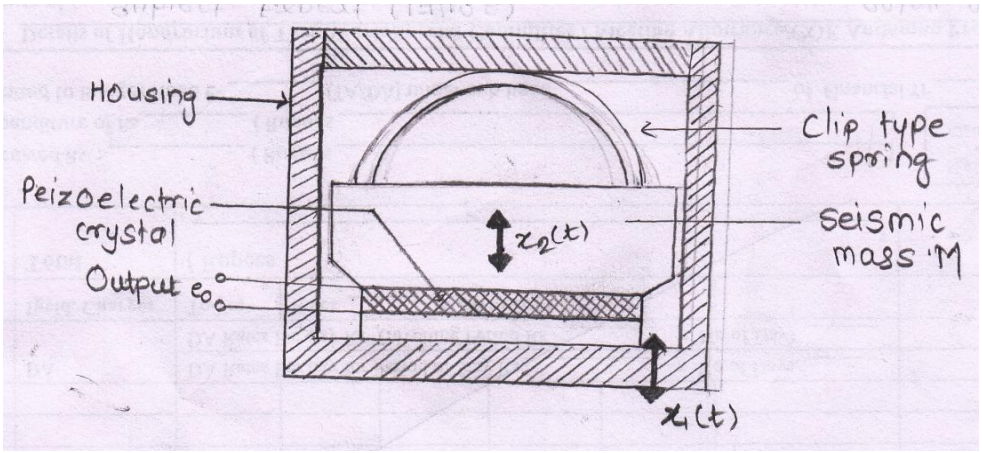
Classification of temperature (measuring) transducers:-

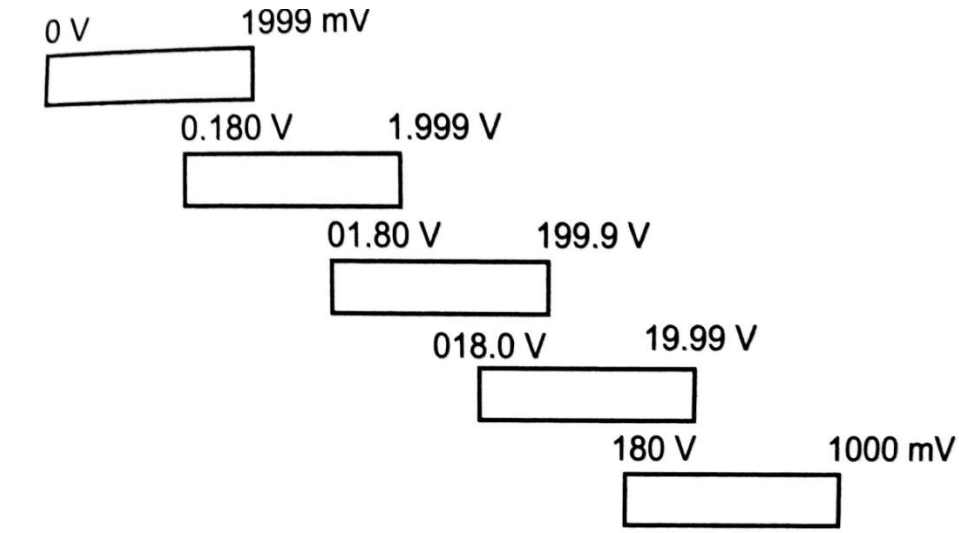
Electrical Transducer is divided into three parts-

a) RTD (Resistance temperature detector)

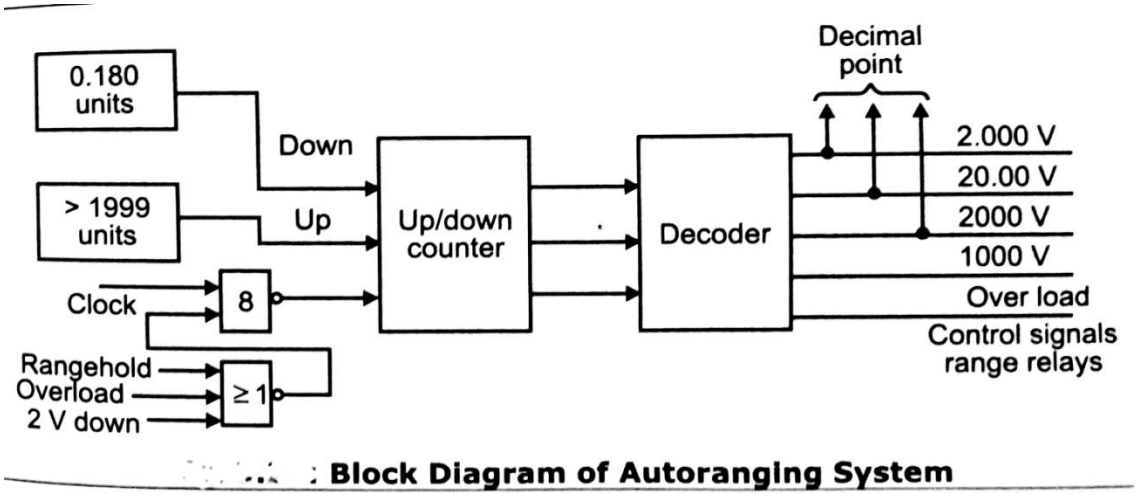
b) Thermisters-1. NTC (Negative temperature coefficient)
2. PTC (Positive temperature coefficient)

c) Thermocouple-1. J
2. K
3. R
4. S

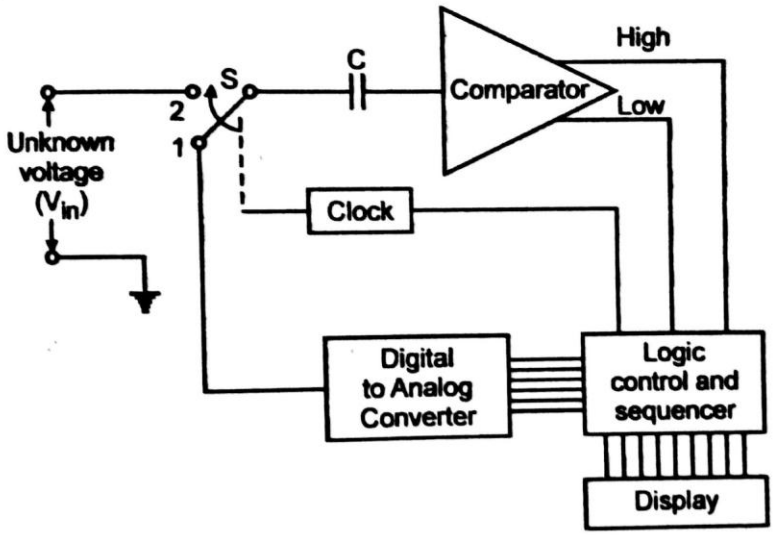
	5. T	
(f)	**With beat labelled diagram, explain piezoelectric transducer for vibration measurement.**	**4M**
Ans:	1. For vibration measurement it is necessary to use Seismic transducer along with Piezo-Electric Accelerometer where the seismic mass has tendency to remain fixed in its spatial position so that the vibrational motion is registered as a relative displacement between mass and housing frame. This displacement is sensed and indicated by an appropriate transducer. 2.The following figure shows that the piezo-electric crystal is spring loaded with seismic mass in contact with the crystal.  **OR**  3. When subjected to an acceleration, the seismic mass stresses the crystal to a force F=ma, resulting in a voltage generated across the crystal. 4. This force generates an output voltage which is proportional to the acceleration. By applying a varying acceleration to the mass crystal assembly, the crystal experiences a varying force.	**(Diagram:2 M Explanation : 2M)**

		As F=ma This force generates varying charge, Q=dF=dma ***Note: Any relevant diagram with explanation can be considered.***	
Q.6		**Attempt any FOUR:**	**16M**
	(a)	**Illustrate the concept of autoranging in DMM.**	**4M**
	Ans:	**<u>Diagram:</u>**  **Overlapping Ranges in Automatic Ranging Instrument** **<u>Explanation:</u>** 1. The Auto ranging or automatic ranging has a purpose that reading must be obtained with the optimum resolution always. Thus, 167mv should be shown as 167.0 and not as 0.167. 2. To understand this, consider a 31/2 digit display i.e.one which is capable of giving a reading up to 1999. This means that a value greater than this maximum will have to be reduced by a factor of 10 before it can appear on the display. Thus, 207mv will be shown as 0207. 3. At the same time, a value less than 0200 can be shown with one decade more resolution, showing 194mv as 194.0. 4. To put this in other words, if the display is less than 0200, the instrument should automatically be switched to a range which is more sensitive. But as soon as 1999 is reached it should move into the next sensitive range. 5. In practice, the lower limit is taken to be well below 0200.as an example, 0180 may be taken to be this lower value. Otherwise, if there is slight fluctuations around 200, the readings may produce a confusing quick change like 199.8, 0200,0201, 199.9 etc. 6. By making sure that there is an overlap in the ranges we make sure that all values are	**2M** **2M**

represented with small ranges. The above values would then become 0199,0200,0201,0199.
7. The values round 0180 also get a stable display like 1797,1800, 1803.
8. The Design of Auto ranging system consisting of control pulses for down and up ranging are obtained from counters in ADC circuits.
9. The auto ranging up/down counter reacts to these control signals and delivers the control signals to range relays as well as decimal points.
10.It may happen that user may need range hold and not auto ranging every time. When "Range hold" signal is activated by user, the up/down signals are disabled automatically.

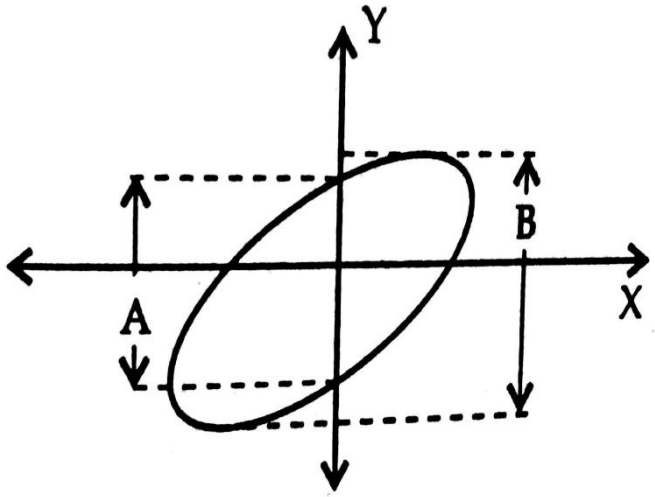


: Block Diagram of Autoranging System

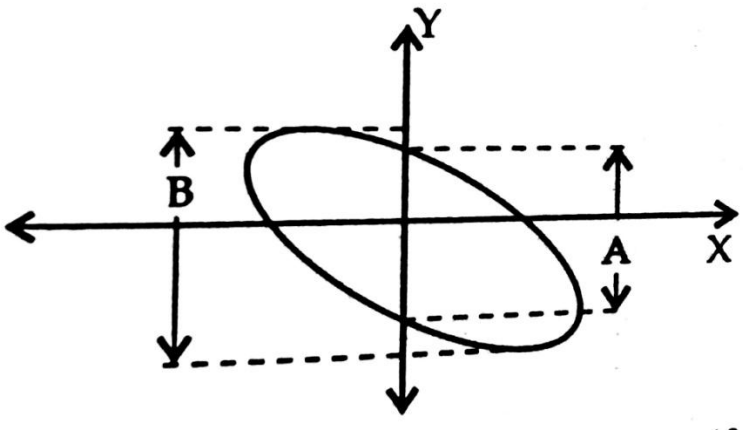
(b)	**Explain SAR type DVM with neat diagram.**		**4M**
Ans:	**Diagram:**		**2M**

Note: any relevant diagram can be considered

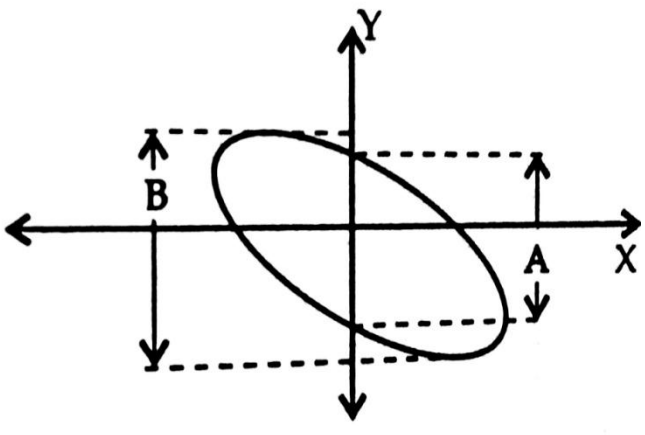
		Explanation: 1.Succesive approximation type DVM (SAR) is special type of analog to digital converter where the comparator compares output of DAC with unknown input and provides high or low logic which generates the sequence of binary digits, this process is continue until out of DAC becomes equal to unknown voltage. 2. This technique is also called as Binary regression. 3. Initially D to A converter is reset. 4. In the beginning of measurement cycle, start pulse is applied to the multivibrator. (Start/stop). 5. Assuming 8 bit control register, and switch S is at position 1 the sequence code generated by DAC with set higher bit(10000000) is applied to capacitor. 6. The capacitor charge with analog voltage produced by DAC. 7. So during next interval the switch S shifts to position 2. 8. An unknown voltage is applied to capacitor and the capacitor either charge or discharge. 9. If input voltage is greater than voltage store across capacitor then the forward current flows input the comparator and high signal is generated. 10. If input voltage is less than voltage store across capacitor then apposite current flows which discharge the capacitor and low signal is generated. 11.At the generation of high signal the control circuit advances one count by shifting 1 to second digit (for example 10000000 to 11000000) 12. while during the generation of low the control circuit reset MSB to 0 and set next lower bit to 1 (for example 10000000 to 01000000) 13. The measurement cycle thus proceeds through a series of successive approximation cycles. 14. Finally when counter reaches its last count, the measurement cycle stops and the digital output of control register represent the final approximation of the unknown input voltage.	**2M**
	(c)	**Describe phase measurement using Lissajous pattern on CRO.**	**4M**
	Ans:	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 tothe 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, $\Theta = \sin^{-1}(A/B)$	**(1M for each case and diagram)**



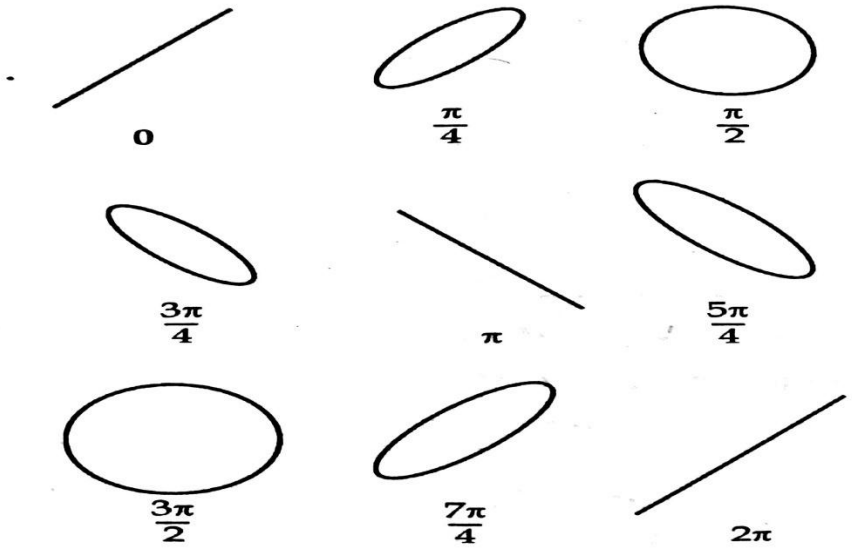
A. The Lissajous pattern will be an ellipse if the sine waves of equal frequency but phase shift between 00 and 900 are applied to the two channels of CRO. The Lissajous pattern will be as shown below-



B. For the phase difference above 900 and less than 1800, the ellipse appears as shown



C. Different Lissajous figure for phase difference 00, 450, 900, 1350, 1800, 2250, 2700,150, 3600 are shown below respectively.



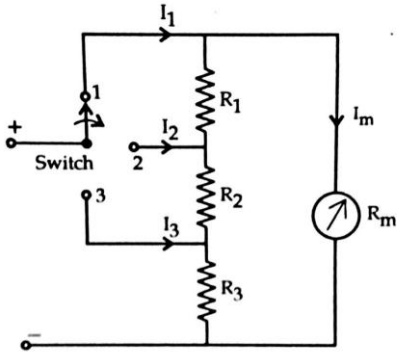
(d) **State SI units of following quantities :**
(i) Thermodynamic temperature
(ii)Luminous intensity
(iii)Amount of substance
(iv)Plane angle — **4M**

Ans: — **(1M for each quantity)**

Sr. No	Name of Quantity	SI unit
1.	Thermodynamic temperature	Kelvin
2.	Luminous intensity	Candela
3.	Amount of substance	Mole
4.	Plane angle	Radian

(e) **Draw universal shunt type multirange Ammeter. Derive equation for all three positions.** — **4M**

Ans: **<u>Diagram:</u>** — **2M**



2M

Explanation:

Position 1= When switch (s) is at position 1, the resistors R1 , R2 and R3 is in series. This series combination of resistor is in parallel with meter resistance Rm.
Therefore, (I1 - Im) (R1 + R2 + R3) = Im. Rm ---------- (1)

Position 2= When switch (s) is at position 2, the combination of R2 and R3 parallel with combination of R1 and Rm.
Therefore, (I2 - Im) (R2 + R3) = Im(R1 + Rm) ---------- (2)

Position 3= When switch (s) is at position 3, the resistance R3 is in parallel with combination of R1 , R2 and Rm.
Therefore, (I3 - Im) R3 = = Im(R1 + R2 + Rm) ---------- (3)

(f) **The following table gives a set of 7 measurement. Calculate the precision of third measurements.** **4M**

Sr. No.	**Measurements X_n**
1.	**12**
2.	**18**
3.	**15**
4.	**14**
5.	**13**
6.	**15**
7.	**17**

Ans:

The average Value for the set of measurements is - given by,

$$\overline{X_n} = \frac{\text{Sum of the 7 measurement Values.}}{7}$$

$$= \frac{(12+18+15+14+13+15+17)}{7}$$

$$= \frac{104}{7}$$

$$\overline{X_n} = 14.857$$

$$\text{Precision} = 1 - \left| \frac{X_n - \overline{X_n}}{\overline{X_n}} \right|$$

for the 3rd reading

$$\text{Precision} = 1 - \left| \frac{15 - 14.857}{14.857} \right|$$

$$= 1 - 0.00962$$

Precision of 3rd reading = 0.9903

(2M to calculate average value and 2M for final value)