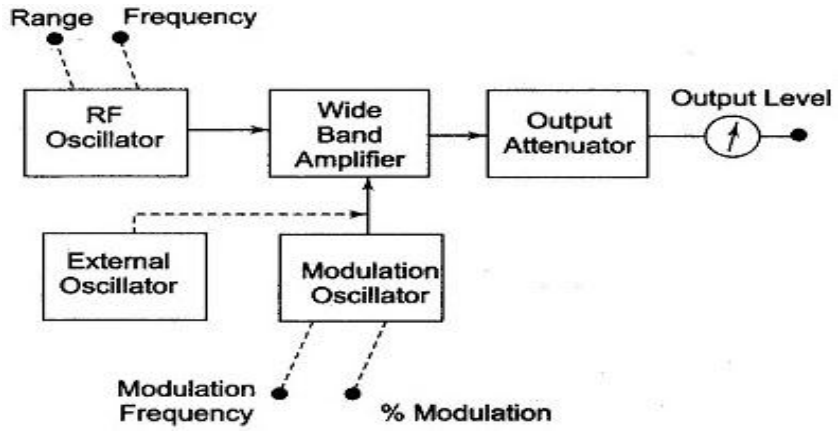
WINTER– 2018 EXAMINATION

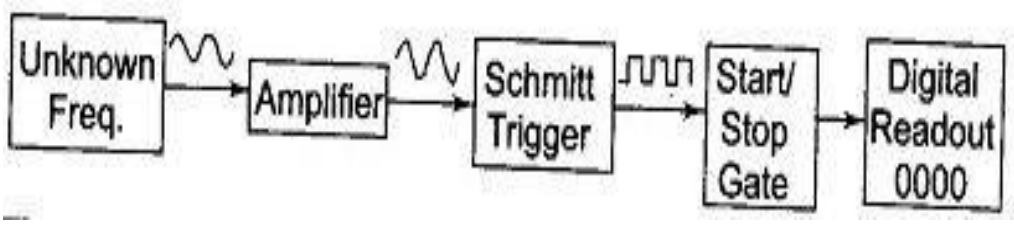
Model Answer **Subject Code:** 22331

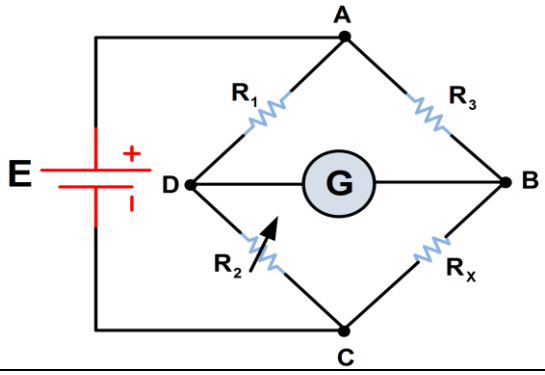
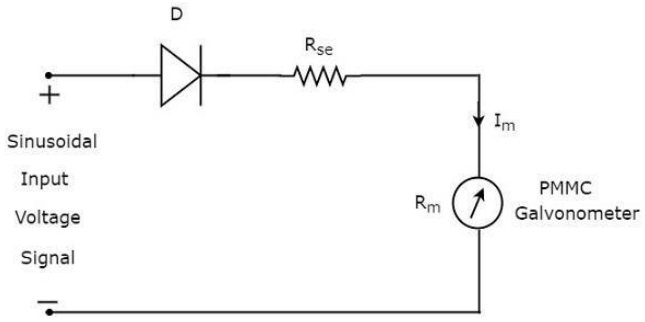
Important Instructions to examiners:

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.		**Attempt any FIVE of the following:**	10 M
	(a)	**Define the term of "Accuracy"** **Ans:** Accuracy is the ability of the instrument to measure the accurate value**.** In other words, it is the closeness of the measured value to a standard or true value.	2M
	(b)	**Write feature of PMMC instrument.** **Ans:** • Consumes less power • Great accuracy. • High torque to weight ratio	2M(any two)
	(c)	**State application of logic analyzer.** **Ans:** • Digital systems. • Computer systems • Logic circuits. • Testing complex digital	2M(any two)
	(d)	**Sketch the block diagram of signal generator.** **Ans:** 	2M

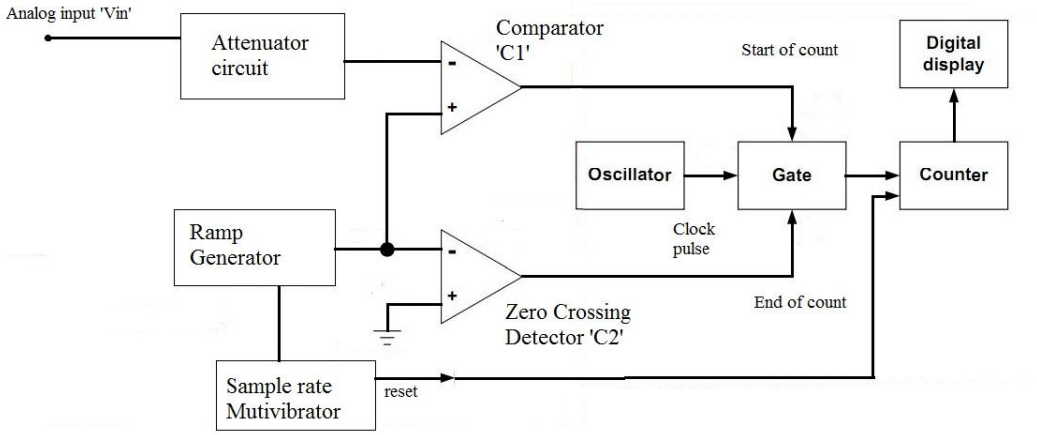
	(e)	**List application of CRO.** **Ans:** • Voltage measurement • Current measurement • Examination of waveform • Measurement of phase and frequency	**2M(any two)**
	(f)	**Define the tern null as it applies to bridge measurement.** **Ans:** Null measurements balance voltages so that there is no current flowing through the measuring device and, therefore, no alteration of the circuit being measured. Null measurements are generally more accurate but are also more complex than the use of standard voltmeters and ammeters, and they still have limits to their precision.	**2M**
	(g)	**State specification of digital instruments.** **Ans:** • DC Volts Ranges 200 mV-1000 V • DC Current Ranges 200 μA - 200 mA • Resolution 100 mW • Audible Indication 75 W ± 25 W • Response Time 100 ms • Overload Protection 1000 V DC or 750 V AC	**2M(any two)**
2.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	(a)	**Describe the different types of errors occurs in measurement.** **Ans:** Generally errors are classified into three types: systematic errors, random errors and blunders. **1) Gross Errors** **2) Random Errors** **3) Systematic Errors** • **Instrumental Errors** • **Environmental Errors** • **Observational Errors** 1) **Gross Errors** Gross errors are caused by mistake in using instruments or meters, calculating measurement and recording data results. This may be the reason for gross errors in the reported data, and such errors may end up in calculation of the final results, thus deviating results. 2) **Random Errors** Random errors are caused by the sudden change in experimental conditions and noise and tiredness in the working persons. These errors are either positive or negative. **3) Systematic Errors** • **Instrumental Errors** Instrumental errors occur due to wrong construction of the measuring instruments. These errors may occur due to hysteresis or friction. These types of errors include loading effect and misuse of the instruments. • **Environmental Errors** The environmental errors occur due to some external conditions of the instrument. External conditions mainly include pressure, temperature, humidity or due to magnetic fields. In order to reduce the environmental errors	**4M**

		• **Observational Errors** As the name suggests, these types of errors occurs due to wrong observations or reading in the instruments particularly in case of energy meter reading.	
	(b)	**Explain the role of the series resistance connected in PMMC movement.** Ans: A PMMC Instrument can be used as voltmeter by just connecting a series resistance with the moving coil. This series resistance is called Voltmeter Multiplier. This combination of moving coil and multiplier is connected across the point whose voltage is to be measured. There are two main function of voltmeter multiplier are 1) It limits the current through the PMMC moving coil to a value less than full scale deflection current and thus prevents moving coil from being damaged. 2) It minimizes the flow of current through the voltmeter and thus do not alter the circuit current whose voltage is to be measured. Ideally the resistance of voltmeter should be infinite.	**4M**
	(c)	**Sketch and describe block diagram of digital frequency meter.** **Ans:**  The basic block diagram of basic digital frequency meter (DFM) is shown in above figure. The signal whose frequency we have to be measured is first to be amplified through amplifier. The output of amplifier is applied to the Schmitt trigger. The Schmitt trigger is convert input signal into a square wave which has a fast rise and fall time. The square wave is then differentiated and clipped. Each pulse is proportional to each cycle of unknown signal. Now the output from Schmitt trigger is applied to a start and stop gate. The input pulses are allowed to pass through it, when the gate is open. The counter starts to count these pulses. The gate is closed the output pulses are not allowed to pass through the gate. The counter stops the counting. When the gate is open the number of pulse are counted by the counter. The interval between start and stop condition is the frequency of unknown signal which has to be measured. F = N/t Where, F = Unknown frequency. N = Number of counts. t = Time interval between start and stop condition of the gate.	**2M** **2M**

	(d)	**Describe the operation of whetstone bridge.** **Ans:** A Wheatstone bridge is widely used to measure the electrical resistance. This circuit is built with two known resistors, one unknown resistor and one variable resistor connected in the form of bridge. When the variable resistor is adjusted, then the current in the galvanometer becomes zero, the ratio of two two unknown resistors is equal to the ratio of value of unknown resistance and adjusted value of variable resistance. By using a Wheatstone Bridge the unknown electrical resistance value can easily measure.  	**2M** **2M**
3.		**Attempt any THREE of the following:**	**12 M**
	(a)	**Sketch and describe operation of half wave rectifier type AC Voltmeter.** **Ans:**  Half-wave Rectifier Voltmeter The d'Arsonval meter movement only responds to the average or dc value of the current through the moving coil. In order to measure alternating voltage with d'Arsonval meter, the unidirectional current flow. If a diode D1 is added to the dc voltmeter circuit, then a circuit that is capable of measuring ac voltage is achieved. Therefore, the AC voltmeter produces an output voltage, which is equal to **0.45** times the rms value of the sinusoidal (AC) input voltage signal alternating signal needs to be rectified first by using diode rectifier to produce	**2M** **2M**
	(b)	**Explain with sketch operation of ramp type DVM.** **Ans:** This is given to an input comparator which will compare two signals and generates the output. One input to the input comparator is from the input and another input is from the ramp. This input voltage and ramp signal are compared and output is given. If the ramp signal is more than input voltage there will be no output but if the input voltage is greater than the ramp signal then a is generated which will open the gate. Now when the gate gets opened, clock will send clock pulses which are counted by the counter and displayed on the screen. The comparator will compare the ramp signal and ground and output is given.	**2M**

This output will stop the flow of purchase from clock

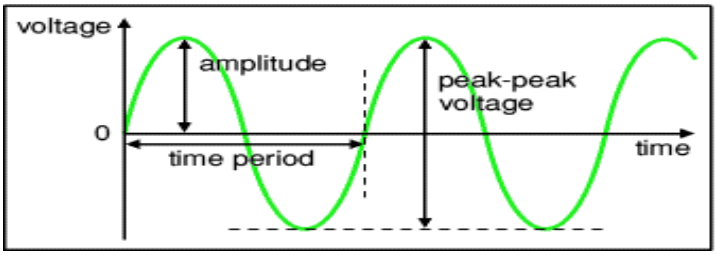
Block Diagram - Ramp type DVM



2M

(c) Explain with sketch time period measurement by CRO.

Ans:



2M

Horizontal sweep is turned ON and the display appealing on the screen is adjusted by varying different control knobs provided on the front panel of CRO, till the signal is suitably displayed on the screen. After obtaining the display of good deflection, count the number of horizontal division for a complete cycle. From the counted horizontal divisions, the time period is computed as,

T=m*n

Where

m=Number of division in one complete cycle

n=Setting of time base =Time/Division

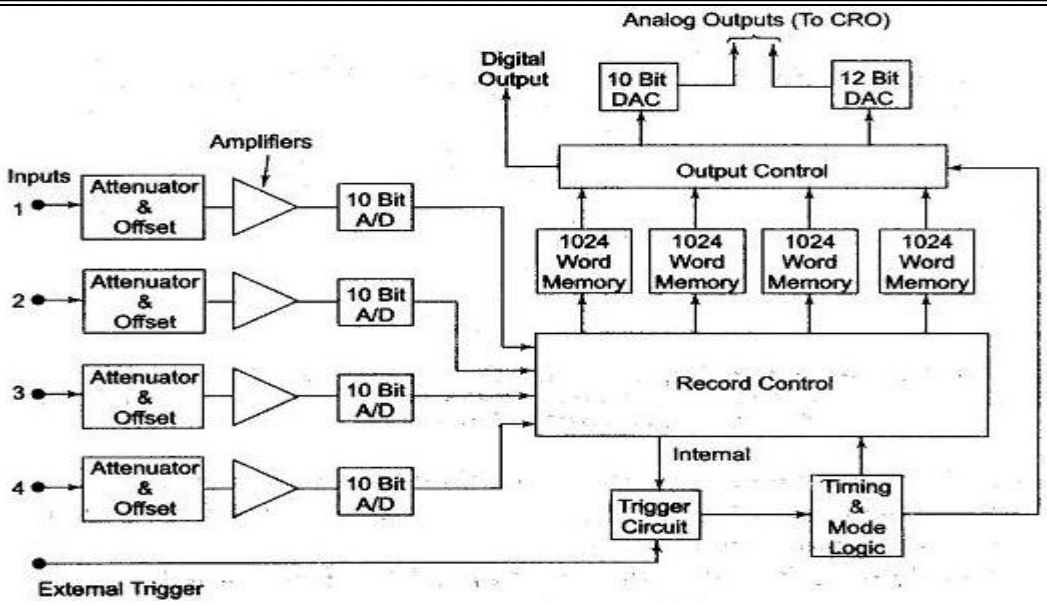
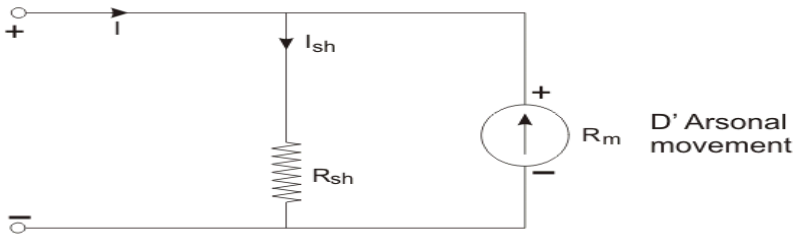
2M

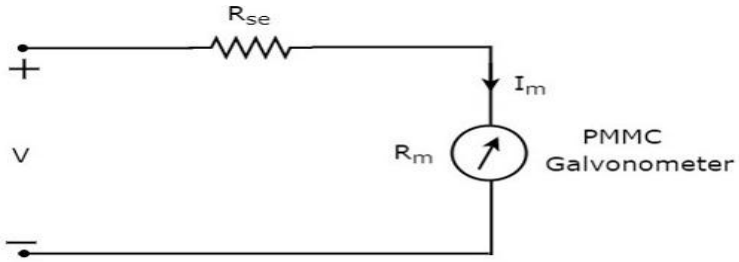
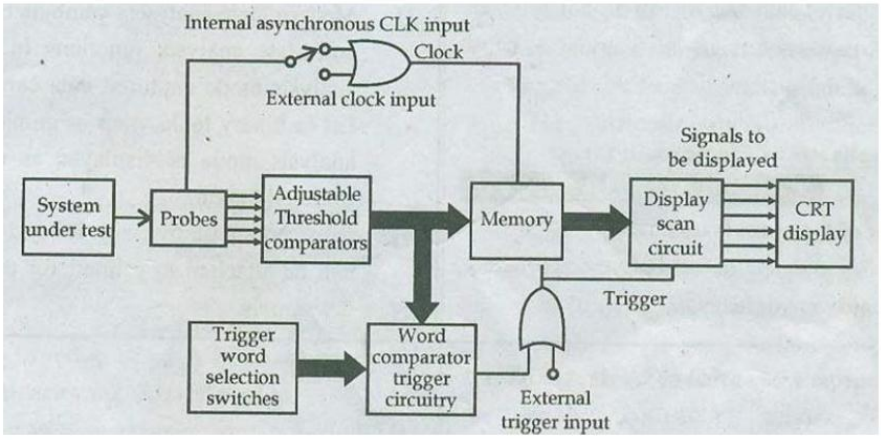
(d) Sketch and describe operation of DSO with block diagram.

Ans:

The input is amplified and attenuated with input amplifiers. The output of the input signal amplifiers feeds an analog to digital converter (ADC). There are numbers of ADC available. But the selection of ADC is depends on the speed of converters, because the conversation of analog to digital signal should be in fast rate. A digital storage oscilloscope digitizes the input signal, so that all subsequent signals are digital. The storage occurs in electronic digital memory. The input signal is digitized and stored in memory in digital form. In this state it is capable of being analyzed to produce a variety of different information. To view the display on the CRT, the data from memory is reconstructed in analog form.

2M

			**2M**
4.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	(a)	**Convert PMMC movement into DC ammeter of the range 0 to 50 mA.** **Ans:** Let, R_s = Shunt resistance Rm = Internal resistance of movement I = total load or circuit current to be measured $$R_{sh} = \frac{I_m R_m}{I - I_m}$$ Consider $I_{m=}$ 1_mA and R_m=100Ω R_s=(1_mA*100)/50_mA-1_mA R_s=(1_mA*100)/49_mA **R_s=2.04Ω**	**4M**
	(b)	**Sketch and label equivalent circuit diagram of practical ammeter and voltmeter.** Ans: **practical ammeter**  I = total current flowing in the circuit in Amp. I_{sh} is the current through the shunt resistor in Amp. R_m is the ammeter resistance in Ohm.	**2M**

		Practical voltmeter.  Rs is series multipliers Im is the full scale deflection of the movement Rm is the internal resistance of the movement	**2M**
	(c)	**Sketch and explain block diagram of logic analyzer.** **Ans:**  A logic analyzer can be triggered on a complicated sequence of digital events, then capture a large amount of digital data from the system under test (SUT).When logic analysers first came into use, it was common to attach several hundred "clips" to a digital system. Later, specialized connectors came into use. Once the probes are connected, the user programs the analyzer with the names of each signal, and can group several signals together for easier manipulation. Next, a capture mode is chosen, either "timing" mode, where the input signals are sampled at regular intervals based on an internal or external clock source, or "state" mode, where one or more of the signals are defined as "clocks", and data are taken on the rising or falling edges of these clocks, optionally using other signals to qualify these clocks. After the mode is chosen, a trigger condition must be set. A trigger condition can range from simple to the very complex At this point, the user sets the analyzer to "run" mode, either triggering once, or repeatedly triggering. Once the data are captured, they can be displayed several ways, from the simple) to the complex	**2M** **2M**
	(d)	**Determine value of Rx in Wheatstone bridge if R1=400Ω, R2=5KΩ, R3=2KΩ.** **Ans**: R1=400Ω, R2=5KΩ, R3=2KΩ. Rx is unknown resistor $$R_x = \frac{R_2 R_3}{R_1}$$ Rx=(5KΩ*2KΩ)/400 **Rx=25KΩ** **Therefore unknown resistance is 25KΩ.**	**4M**

(e) Compare Dual slope DVM and SAR type DVM. (4 points) — **4M(any four)**

Ans:

Sr no	Dual slope DVM	SAR type DVM
1	It is highly accurate	It is moderately accurate
2	Cost is high	It is inexpensive
3	Two comparator is used	One comparator is used
4	Poor resolution	Good resolution
5	Slow speed	High speed
6	Less Error	More error

5. Attempt any TWO of the following: — **12 M**

a) State the need of calibration and explain the procedure to calibrate the instrument. — **3M**

Ans:

Need of calibration:

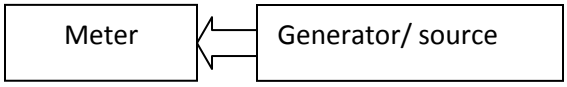
Every measuring device degrades over time due to normal wear and tear. These changes can be caused by various reasons such as electric or mechanical shock or a hazardous manufacturing environment. In those situations, calibration is required to perform on those instruments to enhance the accuracy of the measuring device. Accurate measuring devices increase product quality. Here are the five reasons, why calibrating instruments is important:

- Making sure that the instrument is making consistent measurements and displaying the correct readings.
- Establishing the instrument's reliability
- Maintaining adherence to industry standards, government regulations, and/ or quality assurance norms like the current good manufacturing practice.
- Determining the precision, deviation, and reliability of the measurements

Procedure to calibration instrument: — **3M**

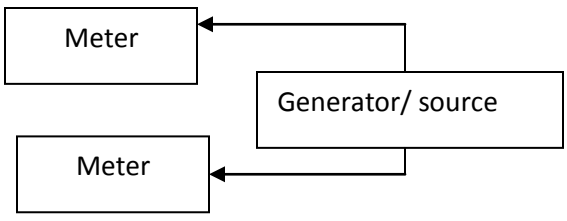
A calibration can take advantage of a wide range of different principles. By measuring different properties of the object under calibration it is possible to perform a calibration. This can result in different calibration methods for the same measurand, often also on the same object under calibration. It is possible to perform; **direct** or **indirect** calibrations depending on which property of the object under calibration are to be determined.

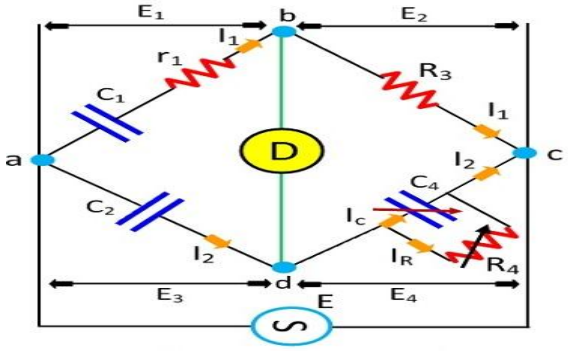
Direct method: Calibration of the shunt via measurement of the resistance value.



Test instrument standard instrument

Indirect method: Calibration of the shunt via measurement of the currents under applied voltage the resulting different magnitude are used to calculate the resistance based on ohm's law.



	(b)	**Using Schering bridge, describe the procedure to measure the unknown value of capacitance.** Ans: **Schering Bridge** The Schering bridge use for measuring the capacitance of the capacitor, dissipation factor, properties of an insulator, capacitor bushing, insulating oil and other insulating materials. It is one of the most commonly used AC bridge. The Schering bridge works on the principle of balancing the load on its arm. Let, C_1 – capacitor whose capacitance is to be determined, r_1 – a series resistance, representing the loss of the capacitor C_1. C_2 – a standard capacitor (The term standard capacitor means the capacitor is free from loss) R_3 – a non-inductive resistance C_4 – a variable capacitor. R_4 – a variable non-inductive resistance parallel with variable capacitor C_4.	**3M**
		 	**3M**
		When the bridge is in the balanced condition, zero current passes through the detector, which shows that the potential across the detector is zero. At balance condition $Z_1/Z_2 = Z_3/Z_4$ $Z_1Z_4 = Z_2Z_3$ So, $$\left(r_1 + \frac{1}{jwC_1}\right)\left(\frac{R_4}{1 + j\omega C_4R_4}\right) = \frac{1}{j\omega C_2}.R_3$$ $$\left(r_1 + \frac{1}{jwC_1}\right)R_4 = \frac{R_3}{jwC_2}(1 + j\omega C_4R_4)$$ $$r_1R_4 - \frac{jR_4}{\omega C_1} = -j\frac{R_3}{\omega C_1} + \frac{R_3R_4C_4}{C_2}$$ Equating the real and imaginary equations, we get $$r_1 = \frac{R_3C_4}{C_2} \ldots\ldots\ldots equ(1)$$ $$C_1 = C_2\left(R_4/R_3\right) \ldots\ldots\ldots equ(2)$$ The equation (1) and (2) are the balanced equation, and it is free from the frequency.	

	(c)	**Calculate the frequency of vertical input for on oscilloscope which displays the following Lissajous figure.(Horizontal input frequency is 10KHz)** **(a)** **(b)**  **Ans:** (a) (b) **Soln.** We know that $\frac{f_y}{f_x} = \frac{\text{number of horizontal tangents}}{\text{number of vertical tangents}}$ $f_x = 10$ kHz In Fig.(a) No. of horizontal tangency is = 3 No. of vertical tangency is = 1 $f_y = (3/1) \times f_x$ $= 3 \times 10$ kHz $\therefore$ $f_y = 30$ kHz **Ans.** In Fig.(b) Here , No. of horizontal tangency is = 1 No. of vertical tangency is = 4 $f_y = (1/4) \times f_x$ $= (1/4) \times 10$ kHz $\therefore$ $f_y = 2.5$ kHz **Ans.**	**3M** **3M**
6.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	(a)	**The lowest range on a 41/2 digit is 10v full scale. What is the sensitivity of this meter?** **Ans:** If number of full digit then resolution R Resolution R $=1/10^n$ **Resolution R $=1/10^4=0.0001$** Where the number of full digit is n=4 Sensitivity $S=(f_s)_{min}*R$ Sensitivity S=(10*0.0001 Where lowest full scale deflection $(f_s)_{min}=10$ Resolution R=0.0001 **Sensitivity S=0.001**	**3M** **3M**

	(b)	**Describe the procedure how phase is measured by Lissajous pattern on CRO.** **Ans**: **Measurement of Phase Difference** A Lissajous figure is displayed on the screen when sinusoidal signals are applied to both horizontal & vertical deflection plates of CRO. Hence, apply the sinusoidal signals, which have same amplitude and frequency to both horizontal and vertical deflection plates of CRO.For few Lissajous figures based on their shape, we can directly tell the phase difference between the two sinusoidal signals. • If the Lissajous figure is a straight line with an inclination of 45∘45∘ with positive x-axis, then the phase difference between the two sinusoidal signals will be 0∘0∘. That means, there is no phase difference between those two sinusoidal signals. • If the Lissajous figure is a straight line with an inclination of 135∘135∘with positive x-axis, then the phase difference between the two sinusoidal signals will be 180∘180∘. That means, those two sinusoidal signals are out of phase. • If the Lissajous figure is in circular shape, then the phase difference between the two sinusoidal signals will be 90∘90∘ or 270∘270∘. • We can calculate the phase difference between the two sinusoidal signals by using formulae, when the Lissajous figures are of elliptical shape. • If the major axis of an elliptical shape Lissajous figure having an inclination angle lies between 0∘0∘ and 90∘90∘ with positive x-axis, then the phase difference between the two sinusoidal signals will be. • $\phi=\sin-1(x1x2)=\sin-1(y1y2)$ • If the major axis of an elliptical shape Lissajous figure having an inclination angle lies between 90∘90∘ and 180∘180∘ with positive x-axis, then the phase difference between the two sinusoidal signals will be. • $\phi=180-\sin-1(x1x2)=180-\sin-1(y1y2)$ Where, x1 is the distance from the origin to the point on x-axis, where the elliptical shape Lissajous figure intersects x2 is the distance from the origin to the vertical tangent of elliptical shape Lissajous figure y1 is the distance from the origin to the point on y-axis, where the elliptical shape Lissajous figure intersects y2 is the distance from the origin to the horizontal tangent of elliptical shape Lissajous figure	**6M**
	(c)	**A dc voltmeter uses 50μA and having an internal resistance of 400Ω.Calculate the value of multiplier on ranges :(i) 10V (ii) 15V (iii) 20V.** **Ans:** Given data: $I_m=50\mu A$ and $R_m=400\Omega$ $$V = I_m (R_s + R_m)$$ $$R_s = \frac{V - I_m R_m}{I_m} = \frac{V}{I_m} - R_m$$ $$R_s = \frac{V}{I_m} - R_m$$	

Case 1:For range 0-10v

$$R_s = \frac{V}{I_m} - R_m$$

2M

$R_s=(10/50*10^{-6})-400$
$R_s=(0.2*10^{6})-400$
R_s=199.6KΩ

Case 2:For range 0-15v

$$R_s = \frac{V}{I_m} - R_m$$

2M

$R_s=(15/50*10^{-6})-400$
$R_s=(0.3*10^{6})-400$
R_s=299.6KΩ

Case 3:For range 0-20v

$$R_s = \frac{V}{I_m} - R_m$$

2M

$R_s=(20/50*10^{-6})-400$
$R_s=(0.2*10^{6})-400$
R_s=399.6KΩ