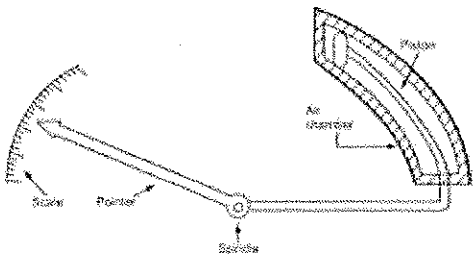
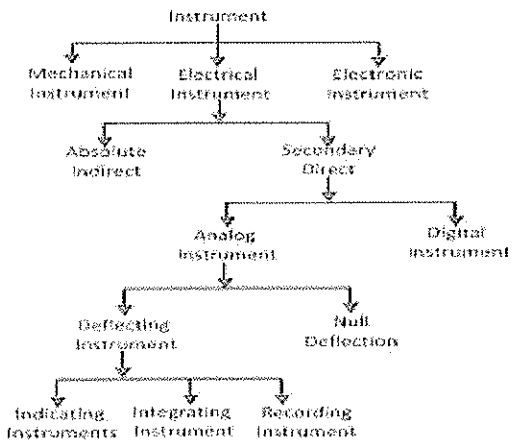
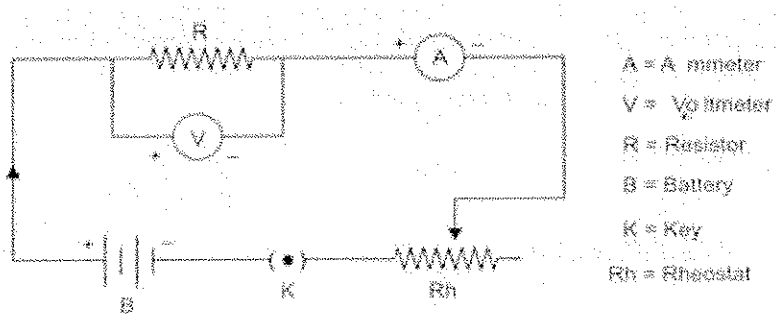
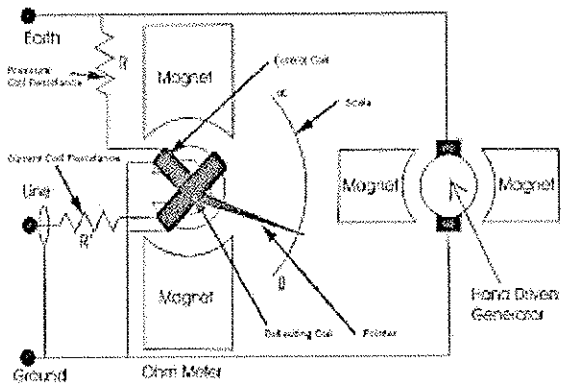
Scoring Indicators

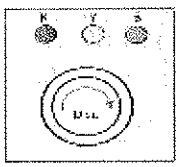
COURSE NAME : **Electrical and Electronic Measuring Instruments**

COURSE CODE : 3034 **QID :** 2110220138

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			9
I.1	Energy meter	1	1	
I.2	Permanent Magnet moving coil	1	1	
I.3	Insulation of the cable may break down causing a flow of current from the core of the cable to the lead sheath or to the earth.	1	1	
I.4	Kilo Watt hour	1	1	
I.5	Schering Bridge.	1	1	
I.6	• A synchroscope is used to determine the correct instant of closing a switch that connects the alternator to a power system bus bar.	1	1	
I.7	Produces a sharply focused beam of electrons which is accelerated to high velocity.	1	1	
I.8	LVDT	1	1	
I.9	Thermocouple, Thermistor	0.5*2	1	

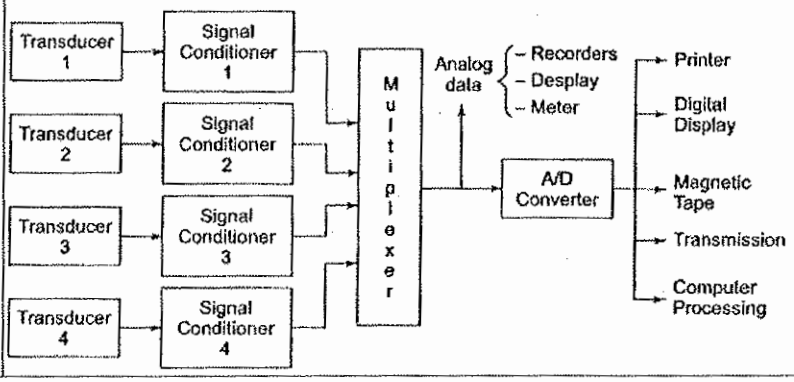
	PART B			24
II.1	**Air Friction Damping** *Explanation 2 marks* *Diagram 1 Mark*  •It consists of a light aluminum piston that is attached to the moving system. •This piston moves in a fixed air chamber which is closed at one end. •When there are oscillations the piston moves into and out of an air chamber. •When the piston moves into the chamber, the air inside is compressed and the pressure of air thus built up, opposes the motion of the piston and hence the whole of the moving system. •When the piston moves out of the air chamber, the pressure in the closed space falls, and the pressure on the open side of the piston is greater than on the other side. Thus there is again opposition to the motion.	2+1	3	
II.2	**Classification of measuring instruments.** *Write any THREE classifications* *3* 1 mark =3 marks*  	3*1	3	

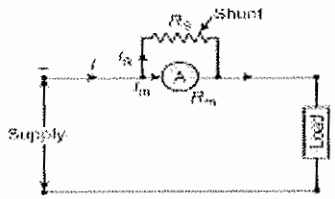
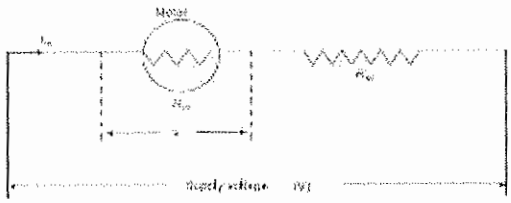
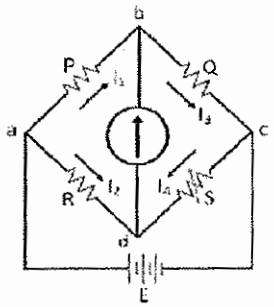
II.3	**Classification of resistance** *Write 3 classification (3*1mark=3marks)* Low (below 1Ω) medium (1Ω to 0.1MΩ) or 100 kΩ High (0.1MΩ and above)	3*1	3	
II.4	**Voltmeter ammeter method** *circuit diagram(2)* *Explanation(1)*  This method is based on Ohms law R= V/I = (Voltmeter reading)/(Ammeter reading)	2+1	3	
II.5	**Insulation tester** *Diagram 2 marks* *Labelling 1 mark*  		3	

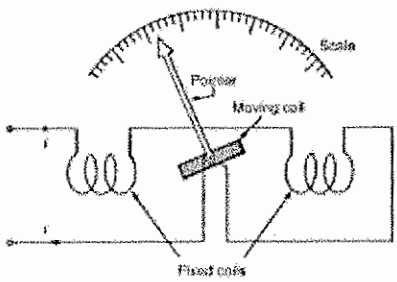
II.6	**Rotating type phase sequence indicators** *Explanation 2 marks* *Diagram 1 mark* Rotating type phase sequence indicators show the direction of the phase sequence by rotating the disc placed at the center of the instrument. It has three terminals which are connected to the terminals of the measuring devices. The working principle of the rotating phase sequence indicator is similar to that of the induction motor. The coils of the induction motor are star connected. The phase sequence of the power supply is RYB. When the supply is given to the motor coils, rotating magnetic fields induce in the coils. This rotating magnetic field induces the eddy EMF in the aluminium disc. 	2+1	3	
II.7	**Smart Energy Meters** It is an advanced metering technology involving placing intelligent meters to read, process and feedback the data to customers. It measures energy consumption, remotely switches the supply to customers and remotely controls the maximum electricity consumption. Smart metering system uses the advanced metering infrastructure system technology for better performance. These are capable of communicating in both directions. They can transmit the data to the utilities like energy consumption, parameter values, alarms, etc and also can receive information from utilities such as automatic meter reading system, reconnect/disconnect instructions, upgrading of meter software's and other important messages	3	3	

11.8	**Distingush between thermocouple and thermistor** *Any 3 points 3*1=3*		3*1	3

	Thermocouple	Thermistor
Definition	The thermocouple is a type of device used for measuring the temperature	Thermistor is the thermal resistor whose resistance changes with the temperature
Sensing Parameter	Voltage generates at the junction	Resistance
Material	Copper, iron, Constantan, Chromel, Alloys of metals like Chrome, chromium and nickel, platinum and rhodium, tungsten and rhenium, rhodium and iridium	Manganese, nickel or cobalt oxides, semiconductor material
Accuracy	High	Low
Temperature Range	-50°C to 250°C	-200°C to 1250°C
Cost	Expensive (because of external power source and devices on circuit.)	Cheap
Uses	Industries and home appliances	Industries and home appliances

II.9	**CHARACTERISTICS OF TRANSDUCERS** Any 3 ponts 3*1=3 1. Linearity Its input vs output characteristics should be linear and it should produce these characteristics in balanced way. 2. Ruggedness A transducer should be capable of withstanding overload and some safety arrangements must be provided with it for overload protection. 3. Repeatability The device should reproduce the same output signal when the same input signal is applied again and again under unchanged environmental conditions, e.g., temperature, pressure, humidity, etc. 4. High Reliability and Stability The transducer should give minimum error in measurement for temperature variations, vibrations and other various changes in surroundings. 5. High Output Signal Quality The quality of output signal should be good, i.e., the ratio of the signal to the noise should be high and the amplitude of the output signal should be enough. 6. No Hysteresis It should not give any hysteresis during measurement while input signal is varied from its low value to high value and vice versa. 7. Residual Reformation There should not be any deformation on removal of input signal after long period of use	*3*1*	3	
II.10	**Data acquisition system** *Block diagram 3marks*  	3	3	

	PART C			42
III	**Range Extension of Ammeter** *Circuit Diagram 2 mark* *Equations 2 mark* *steps 2 mark* *Final Answer 1 marks*  Im *Rm =Ish*Rsh Rsh=Im*Rm/Ish =0.22Ω Multiplying power of shunt=I/Im=10	2+2+2+1	7	
IV	*Circuit Diagram 2 mark* *Equations 2 mark* *steps 2 mark* *Final Answer 2 marks*  m=V/Vm=250/100 mV=2500 Rsc=Rm(m-1)=10*9999=99.99*10^3 Ω	2+2+2+1	7	
V	**Wheat stone's bridge** *Circuit 3 marks* *Derivation 4 marks*  	3+4	7	

	$I_1P = I_2R \ldots\ldots\ldots equ(1)$ At balanced condition $I_1 = I_3 = \frac{E}{P+Q}$ $I_2 = I_4 = \frac{E}{R+S}$ $\frac{P}{P+Q} = \frac{R}{R+S}$ $P(R+S) = R(P+Q)$ $PR + PS = RP + RQ$ $PS = RQ \ldots\ldots\ldots equ(2)$ $R = \frac{P}{Q} \times S \ldots\ldots\ldots equ(3)$			
VI	**Construction of Electrodynamometer type wattmeter** *Diagram 3 marks* *Explanation 4 marks*  **Fixed Coils :** It is basically an air-cored coil with a large area of cross-section and fewer turns. The fixed coils are divided into two sections and a moving coil is placed between them. These two coils are connected in series with line and hence carry the full	3+4	7	

line current. The main function of the fixed coil is to produce the required flux. The field coils are laminated and varnished as they carry heavy current and they are also known as current coils.

Moving Coil :

The moving coil is placed between the two fixed coils and made to rotate with the help of a spindle. A pointer is attached to the spindle that moves with the moving coil over the scale. The coil is wounded on a metallic former and connected across the line. It is also known as the voltage coil or pressure coil.The resistance of the voltage coil can be increased by connecting a resistance in series with it.

Springs :

springs provide the necessary controlling torque to control the deflection of the pointer.

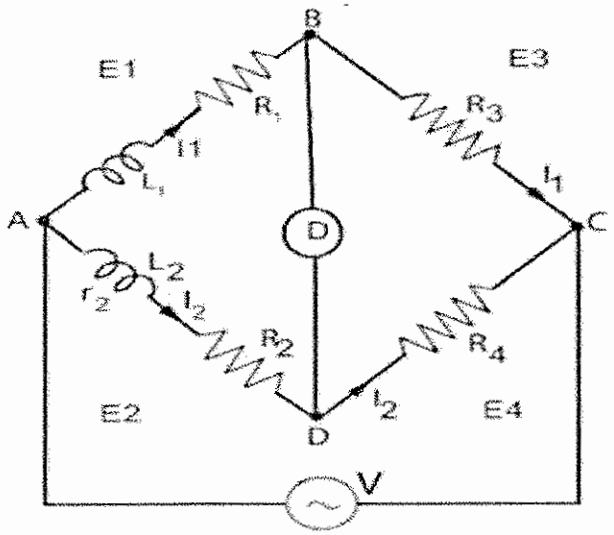
Damping :

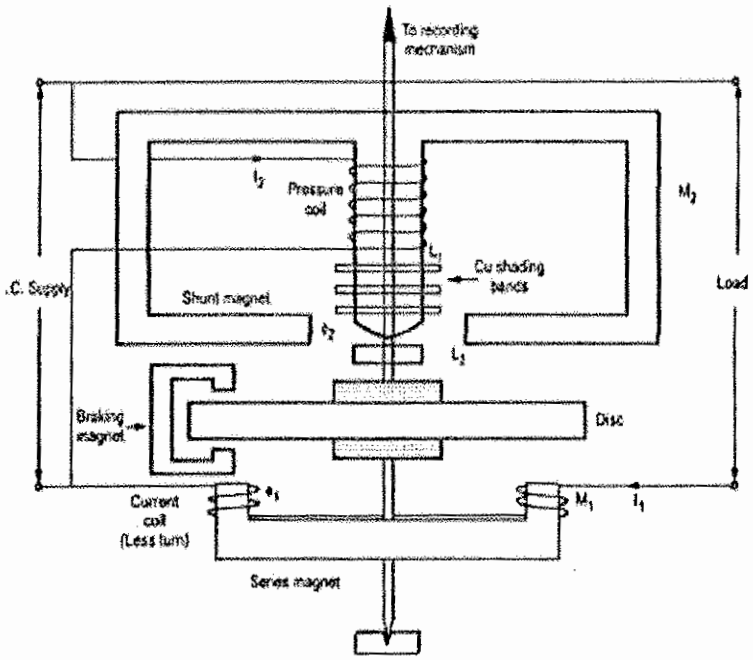
This type of instrument is provided with air friction damping

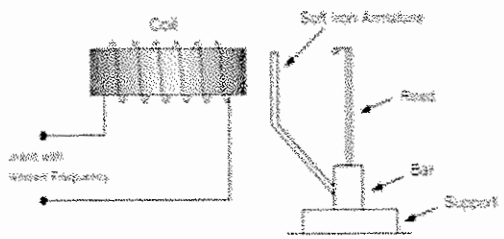
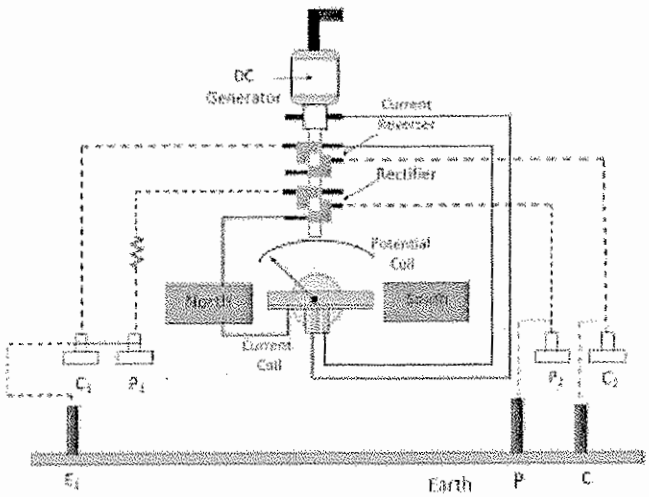
Shielding :

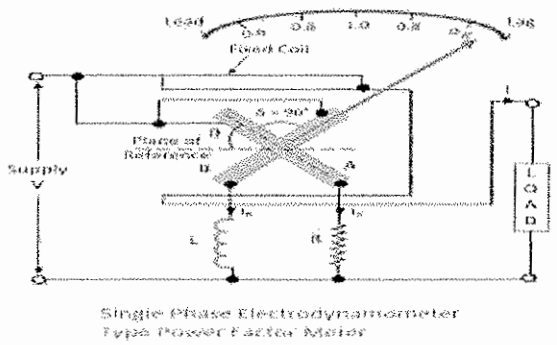
The field produced by this instrument is very weak and hence may get affected easily by the stray magnetic field. Hence, in order to overcome this drawback shielding is done in the form of casing of high permeability.

Scale and Pointer

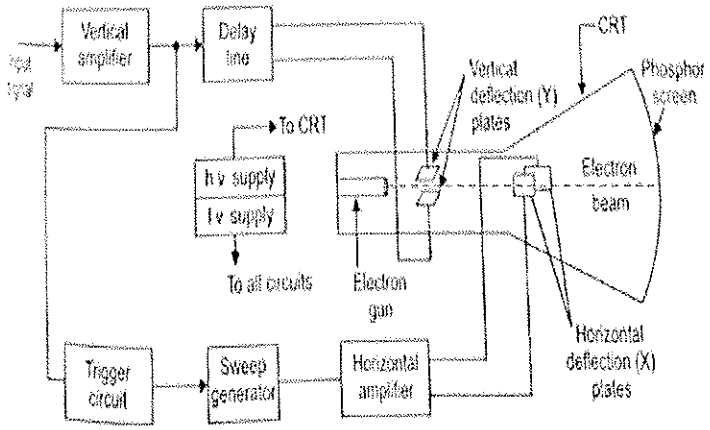
VII	**Maxwell's inductance bridge** *Circuit 3 marks* *Derivation 4 marks*  This bridge circuit measures inductance with a standard variable inductor • L1=Unknown inductance • R1=Unknown resistance • L2=known Variable inductance • R2=known Variable resistance connected in series withL2 • R3,R4=Known non inductive resistors • E is the AC supply voltage and D is the detector • The bridge is balanced by varying R2 and L2 At balanced condition Z1*Z4=Z2*Z3----------(1) • Z1=R1+jwL1, Z2=R2+jwL2, Z3=R3 and Z4=R4 • (R1+jwL1)*R4=(R2+jwL2)R3 (from equ(1)) • R1*R4+jwL1*R4=R2*R3+jwL2*R3----------(2) • Equating real and imaginary parts of eq(2) we get	5+ 2	7	

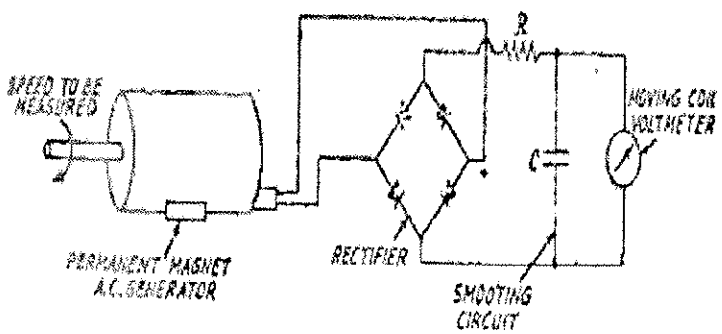
	• R1*R4=R2*R3 and wL1*R4=wL2*R3----------(3) • **R1=R2*R3/R4** • **L1=L2*R3/R4** • The unknown quantities can be measured from the above equation			
VIII	**<u>Induction type Energy meter Construction</u>** *Diagram 3 marks* *Explanation 4 marks*  1.Driving system 2.Moving system 3.Braking system 4.Registering system	3+4	7	

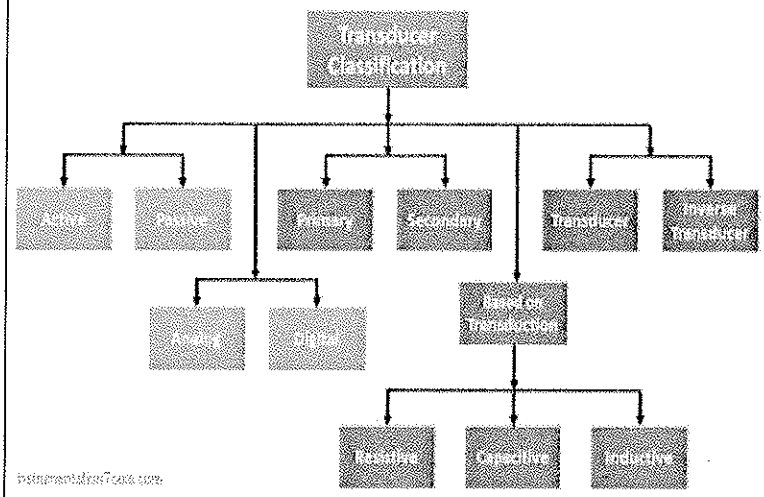
IX	**Reed Type Frequency meter** *Explanation 4 marks* *Diagram 3 marks*  In this type of meter, many reeds are mounted on a common support, with their free ends visible on the meter face. Each reed has its own natural frequency of vibration. When an internal electromagnet is excited by the current of unknown frequency, an alternating magnetic field is produced. If the frequency of the field corresponds to the vibration frequency of the reed, that particular reeds vibrate with considerable amplitude. If two adjacent reeds vibrate with the same amplitude, the unknown frequency is halfway between those indicated by the two vibrating reeds. The reed –type meter is useful only at low frequencies and only over a limited range of frequencies.	4+ 3	7	
X	 • The instrument used for measuring the resistance of the earth is known as earth tester or earth megger • All the equipment of the power system is connected to the	4+3	7	

	earth through the earth electrode • It's a modification of insulation megger • The earth tester uses the hand driven generator. • The rotational current reverser and the rectifier are the two main parts of the earth tester(difference from insulation megger) • Both these features consist of commutator segments and brushes • The earth tester consist of pressure coil and current coil • The current reverser and the rectifier are mounted on the shaft of the DC generator • It has four terminals P1,P2,C2,C1 • The two terminal P1 and C1 shorted and connected to earth electrode • The other two terminals P2 and C2 connected to two spikes P and C • The indication of earth megger depend upon the voltage across pressure coil and current through current coil • The deflection of earth tester directly indicate the earth resistance • Although earth tester is a PMMC instrument can operate in DC only but by including current reverser and rectifier it is possible to make AC flowing through the soil • Sending AC current through soil have some advantage 1. Eliminates back emf produced in the soil due to electrolytic effect of soil			
XI	**<u>Single phase power factor meter.</u>** *Diagram 3 marks* *Explanation 4 marks*  Single Phase Electrodynamometer Type Power Factor Meter	3+4	7	

	• Power factor meter circuit include two coils namely pressure coil and current coil • Pressure coil is connected across the load (Moving coil) • Current coil(fixed coil) is connected in series with the load and it carries load current or a definite fraction of load current • Pressure coil is splits into two parts namely inductive and non-inductive part or pure resistive part • There is no requirement of controlling system because at equilibrium there exist two opposite forces which balance the movement of pointer without any requirement of controlling force. • The magnetic field produced by current coil(fixed coil)depend upon the current flowing through it • The meter has two identical pressure coils A and B. • Both the coils are pivoted on the spindle • The pressure coil A has non inductive resistance R which is connected in series with the coil • The pressure coil B has highly inductive coil L which is connected in series with the coil • The two coils A and B connected across the load • The value of R and L adjusted so that the current flowing through it is the same(R=wL) • The connection of the moving coil is made through silver or gold ligaments which are extremely flexible • The meter has two deflecting torque one acting on coil A, and the other on coil B(Ta and Tb) • The windings are so arranged that Ta and Tb are opposite in directions. When the instrument is connected to a load whose power factor is to be measured at some point,the pointer will come to rest(when Ta=Tb)			

XI r	**Block Diagram of CRO** *Block Diagram 4 marks* *Explanation 3 Marks*  The **function** of each block of CRO is mentioned below. • **Vertical Amplifier** – It amplifies the input signal, which is to be displayed on the screen of CRT. • **Delay Line** – It provides some amount of delay to the signal, which is obtained at the output of the vertical amplifier. This delayed signal is then applied to the vertical deflection plates of CRT. • **Trigger Circuit** – It produces a triggering signal in order to synchronize both horizontal and vertical deflections of an electron beam. • **Time base Generator** – It produces a sawtooth signal, which is useful for horizontal deflection of the electron beam. • **Horizontal Amplifier** – It amplifies the sawtooth signal and then connects it to the horizontal deflection plates of CRT. • **Power supply** – It produces both high and low voltages. The negative high voltage and positive low	4+3	7	

	voltage are applied to CRT and other circuits respectively. • **Cathode Ray Tube (CRT)** – It is the major important block of CRO and mainly consists of four parts. Those are electron gun, vertical deflection plates, horizontal deflection plates and a fluorescent screen.			
XIII	**AC Tachometer** *Diagram 3 marks* *Explanation 4 marks* The AC tachogenerator is used to measure the speed only in one direction. In AC tachogenerator the armature is provided with an AC winding, either single phase or three phase windings. When the rotor is stationary and primary winding excited by an AC input voltage, the induced voltage in secondary is zero. Due to relative position of two winding being placed at 90^0 to each other. As the rotor rotates, a voltage is induced in the secondary winding whose magnitude is proportional to the rotor speed. The emf induced in quadrature coil is directly proportional to the rotor speed and is in phase with applied voltage to the refrence coil.  	4+3	7	

XIV	**Classification of transducers** 	7		