Model Question Paper I

ELECTRICAL AND ELECTRONICS MEASURING INSTRUMENTS

Time: 3 Hour *Max.Marks: 75*

PART A

I .Answer **all** questions in one word or one sentence. Each question carries 1 mark.

1	Give one example for absolute instrument	M 1.01	R
2	List out necessary torques of an indicating instrument.	M 1.02	R
3	Give reason why ordinary electrodynamometer wattmeter is not suitable for measurement of power in low power circuits.	M 2.04	U
4	Name the type of damping used in electrodynamometer type wattmeter	M 2.04	R
5	Define ground fault in underground cables.	M 2.02	R
6	Write the purpose of electron gun assembly in CRO	M 3.04	R
7	State the range of power factor.	M 3.01	R
8	Define transducers.	M 4.01	R
9	Which transducer is used for the measurement of displacement?	M 4.02	U

PART B

II. Answer any **eight** questions from the following, each question carries 3 marks.

1	Classify measuring instruments.	M 1.01	U
2	Compare Moving Iron and Moving coil instruments	M 1.03	A
3	Explain voltmeter ammeter method of resistance measurement .	M 2.01	U
4	Classify the resistances on the basis of ohmic value.	M 2.01	U
5	Describe the working principle of DSO.	M 3.04	R

6	List the advantages of digital meters.	M 3.03	R
7	Describe rotating type phase sequence indicators.	M 3.01	R
8	List any three features of Thermistors	M 4.02	R
9	Draw the block diagram of Data acquisition system	M 4.04	R
10	Write short note on thermocouple .	M 4.02	R

PART C

Answer ALL questions. Each question carries 7 marks.

III	An ammeter having full scale deflection of 0 to 50 A and internal resistance of 2Ω.Find out the value of shunt resistance required to extend the range of meter to 50A.	M 1.04	A
	OR		
IV	A moving coil voltmeter reading up to 20 mV has a resistance of 2 ohms. How this instrument can be adopted to read voltage up to 300 volts.	M 1.04	A
V	Explain the working of Maxwell's inductance bridge.	M 2.03	U
	OR		
VI	With a neat diagram explain the measurement of medium resistance by Wheat stone's bridge.	M 2.01	U
VII	Explain the construction of a dynamometer type wattmeter with a neat sketch.	M 2.04	U
	OR		
VIII	Explain the construction of a single phase induction type energy meter.	M 2.04	U

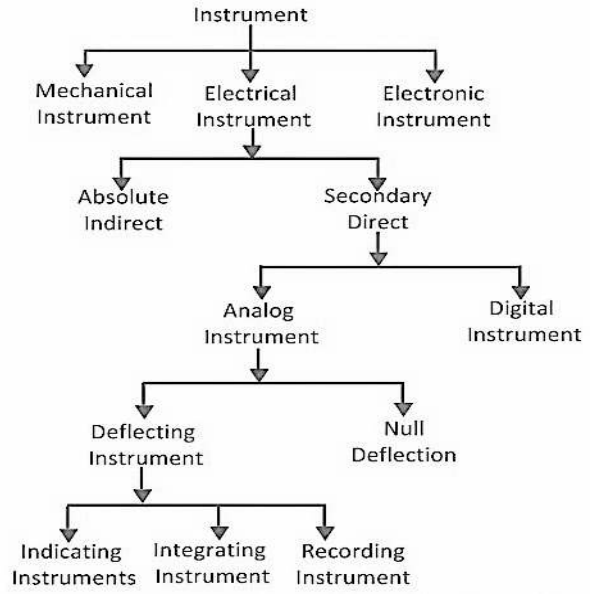
IX	Illustrate the working of reed type frequency meter.	M 3.01	U
	OR		
X	Summarize the working of Weston synchroscope with neat sketch .	M 3.01	U
XI	Draw and explain basic block diagram of digital frequency meter.	M 3.03	U
	OR		
XII	Draw and explain the block diagram of CRO	M 3.04	U
XIII	Explain the classification of transducers.	M 4.01	U
	OR		
XIV	Explain the construction of a dc tachogenerator with the help of a neat diagram .	M 4.01	U

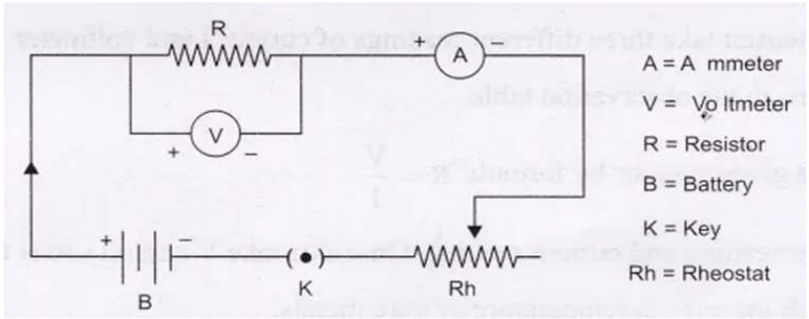
Scoring Indicators

Model Question Paper I

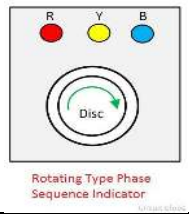
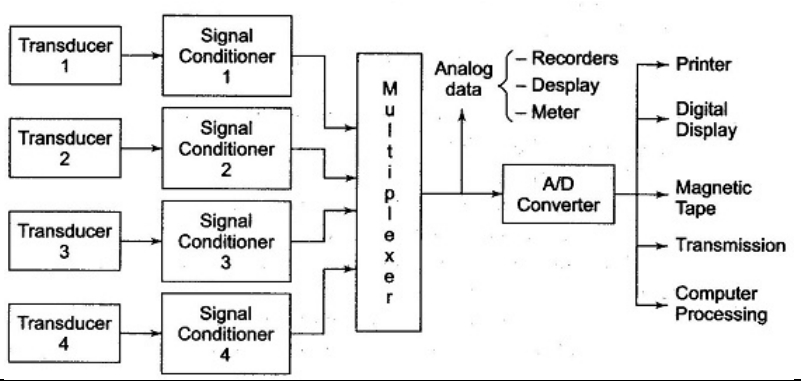
ELECTRICAL AND ELECTRONICS MEASURING INSTRUMENTS

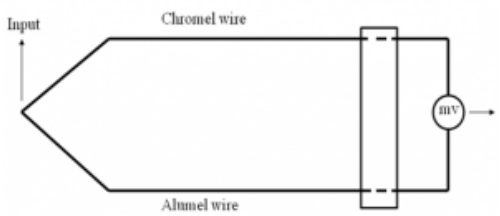
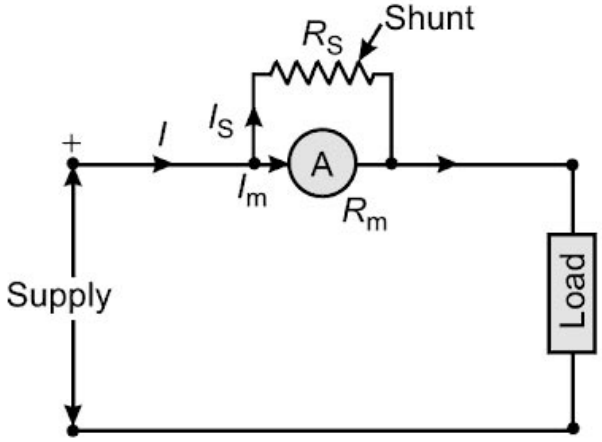
Q No	Scoring Indicators	Split score	Sub Total	Total Score
	PART A			
I. 1	Tangent Galvanometer		1	
I. 2	Deflecting Torque,Controlling Torque,Damping Torque		1	
I. 3	(1) Small deflection torque on the moving system even when the pressure coil and current coil are fully energised. (2) Introduction of large error due to inductance of pressure coil at low power factor.	0.5*1	1	
I. 4	Air friction Damping		1	
I. 5	Insulation of the cable may breakdown causing a flow of current from the core of the cable to lead sheath or to earth.		1	
I. 6	Produces a sharply focused beam of electrons which is accelerated to high velocity.		1	
I. 7	zero to one		1	
I. 8	A transducer is a device which, when actuated transforms energy from one form to another.		1	
I. 9	LVDT		1	

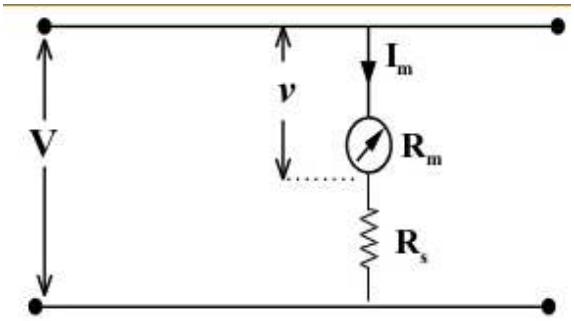
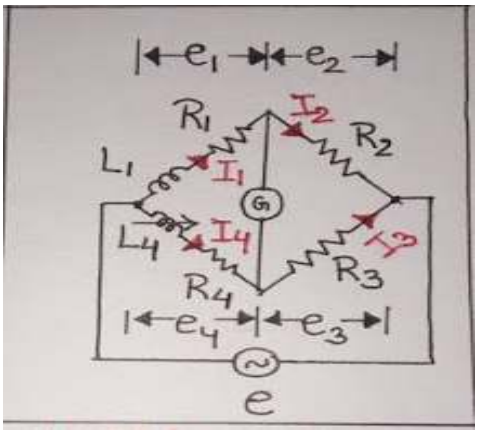
	PART B			
II. 1	**<u>Classification of measuring instruments</u>**. *Write any six classifications* *6* 0.5 mark =3 marks*  		3	
II. 2	**<u>Comparison between moving Iron and moving coil instruments</u>** *any three points* *3* 1 mark =3 marks*	1+1+1	3	

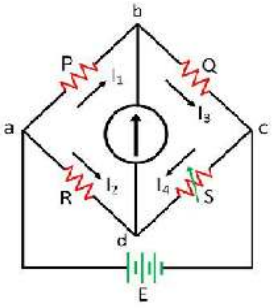
	<table><tr><th>MC Instruments</th><th>MI Instruments</th></tr><tr><td>1.More accurate</td><td>Less accurate than MC Type</td></tr><tr><td>2.Cost is high</td><td>Cheap in cost</td></tr><tr><td>3. Uniform scale</td><td>Non uniform scale</td></tr><tr><td>4.Eddy current damping is used</td><td>Air friction damping is used</td></tr><tr><td>5.Used only for DC measurement</td><td>Used for AC as well as DC measurements</td></tr></table>			
II. 3	**Voltmeter ammeter method** *circuit diagram(1.5)* *Explanation(1.5)*	1.5+ 1.5	3	
	 This method is based on Ohms law R= V/I = (Voltmeter reading)/(Ammeter reading)			
II. 4	**<u>Classification of resistance</u>** *Write 3 classification (3*1mark=3marks)* Low (below 1Ω) medium (1Ω to 0.1MΩ) High (0.1MΩ and above)	*3*1*	3	

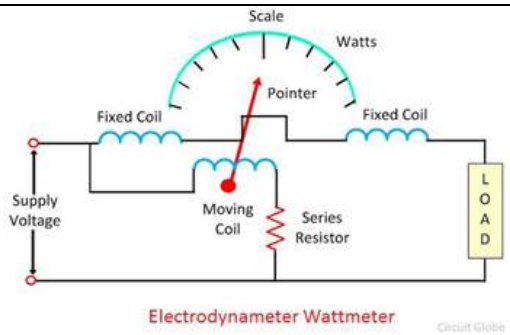
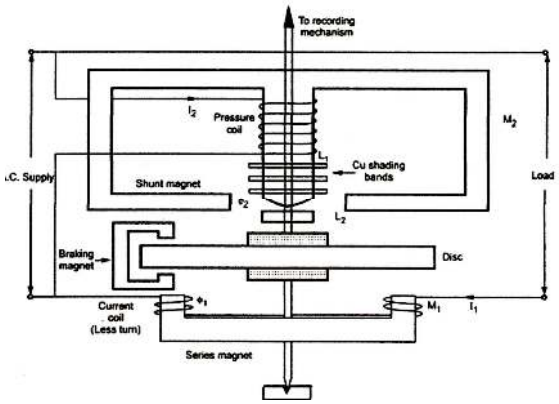
II. 5	**Principle of DSO** *Explanation 3 marks* A digital storage oscilloscope is defined as the oscilloscope which stores and analyzes the signal digitally, i.e. in the form of 1 or 0 preferably storing them as analogue signals. The digital oscilloscope takes an input signal, stores them and then displays them on the screen. The digital oscilloscope has advanced features of storage, triggering and measurement. Also, it displays the signal visually as well as numerically.		3	
II. 6	**Advantages of digital meters.** *3*1 mark=3 marks* 1. The digital instruments display the reading in the numeric form which reduces the error. 2. The digital output is obtained by the instrument which acts as an input for the memorable devices like floppy, recorder, printer etc. 3. The power consumption is less in the digital instruments.	*3*1*	3	
II. 7	**Rotating type phase sequence indicators** *Explanation 2 marks* *Diagram1mark* Rotating type phase sequence indicators show the direction of the phase sequence by rotating the disc placed at the centre 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	2+1	3	

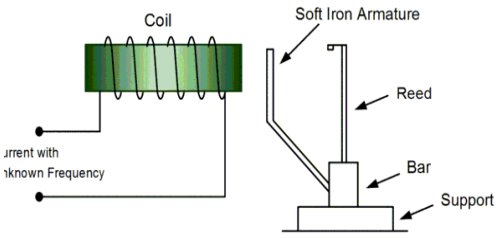
	aluminium disc.  Rotating Type Phase Sequence Indicator			
II. 8	**Features of Thermistors** *3*1 mark=3 marks* 1.Thermistors are compact ,rugged and inexpensive. 2.The response time of the thermistor can vary from fraction of a second to minutes ,depending on the size of the detecting mass and thermal capacity of the thermistor. 3.Thermistors can be installed at a distance from their associated measuring circuits if elements of high resistances are used such that the resistance of leads is negligible.	*3*1*	3	
II. 9	**Data acquisition system** *Block diagram 3marks*  		3	
II.10	**Thermocouple** *Explanation 2 marks* *Diagram 1 mark* The thermocouple can be defined as a kind of temperature sensor that is used to measure the temperature at one specific	2+1	3	

	point in the form of the EMF or an electric current. This sensor comprises two dissimilar metal wires that are connected together at one junction. The temperature can be measured at this junction, and the change in temperature of the metal wire stimulates the voltages.The amount of EMF generated in the device is very minute (millivolts), so very sensitive devices must be utilized for calculating the e.m.f produced in the circuit. The common devices used to calculate the e.m.f are voltage balancing potentiometer and the ordinary galvanometer. From these two, a balancing potentiometer is utilized physically or mechanically.  			
	PART C			
III	**Range Extension of ammeter** *Circuit 2 marks* *steps 3 marks* *final answer 2 marks*  Rsh =ImRm/Ish =5*4/45 Rsh=0.22Ω	2+3+2	7	

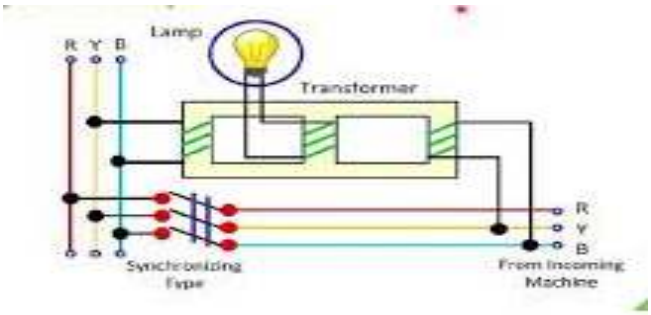
IV	**Range Extension of Voltmeter** *Circuit 2 marks* *steps 3 marks* *final answer 2 marks*  Rs = (V-v)/Im =(300-0.02)/0.01 Ans:29998Ω	2+3+2	7	
V	**Maxwell's inductance bridge** *Circuit 3 marks* *Derivation 4 marks* The bridge used for the measurement of self-inductance of the circuit is known as the Maxwell bridge.The Maxwell bridge works on the principle of the comparison, i.e., the value of unknown inductance is determined by comparing it with the known value or standard value.  since it is an ac bridge, therefore phase and magnitude both must be balanced.The balancing of the bridge can be carried out in two ways 1. by varying L_4 and one of the resistances R_2 or R_3 2. by adding an additional variable resistance R_5 in series with L_4 and then keep R_2 or R_3 constant and	3+4	7	

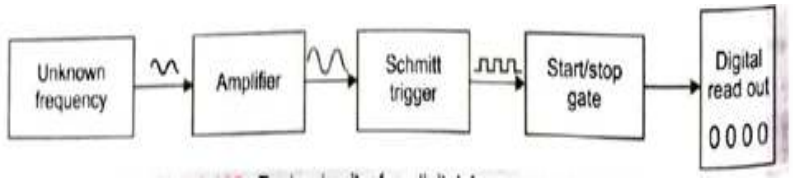
	vary L_4 and R_5 at balance, $Z_1 Z_3 = Z_2 Z_4$ $(R_1+jwL_1)R_3 = (R_4+jwL_4)R_2$ equating real and imaginary parts $R_1 R_3 = R_2 R_4$ and $L_1 = L_4R_2 /R_3$ So, the unknown inductance is measured in terms of known inductance and the two resistors.			
VI	**Wheat stone's bridge** *Circuit 3 marks* *Derivation 4 marks*  $I_1P = I_2R \ldots\ldots\ldots equ(1)$ At balanced condition $I_1 = I_3 = \frac{E}{P+Q}$ $I_2 = I_4 = \frac{E}{R+S}$ $\frac{P}{P+Q} = \frac{R}{R+S}$ $P(R+S) = R(P+Q)$ $PR + PS = RP + RQ$ $PS = RQ \ldots\ldots\ldots equ(2)$ $R = \frac{P}{Q} \times S \ldots\ldots\ldots equ(3)$	3+4	7	
	Electrodynamometer type Wattmeter construction *Diagram 3 marks* *Explanation 4 marks*	3+4	7	

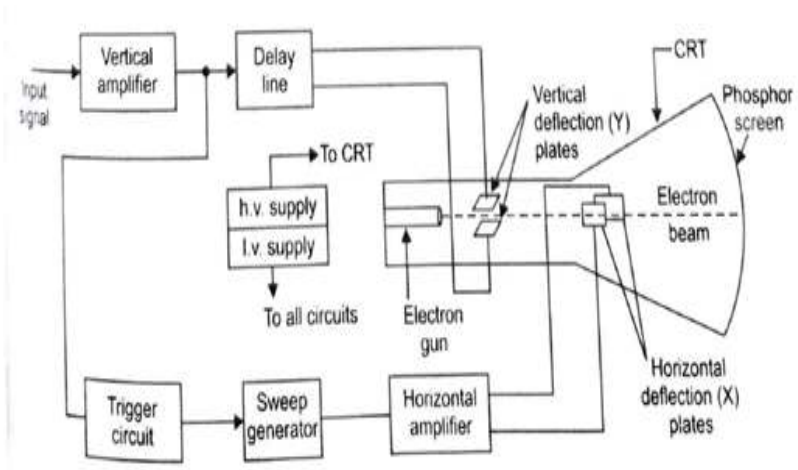
VII	 Electrodynameter Wattmeter 1.Fixed coil 2.Moving Coil 3. Control 4. Damping 5.Scales and pointers			
VIII	**<u>Induction type Energy meter Construction</u>** *Diagram 3 marks* *Explanation 4 marks*  1.Driving system 2.Moving system 3.Braking system 4.Registering system	3+4	7	
IX	**<u>Reed Type frequency meter</u>** *Diagram 3 marks* *Explanation 4 marks*	3+4	7	

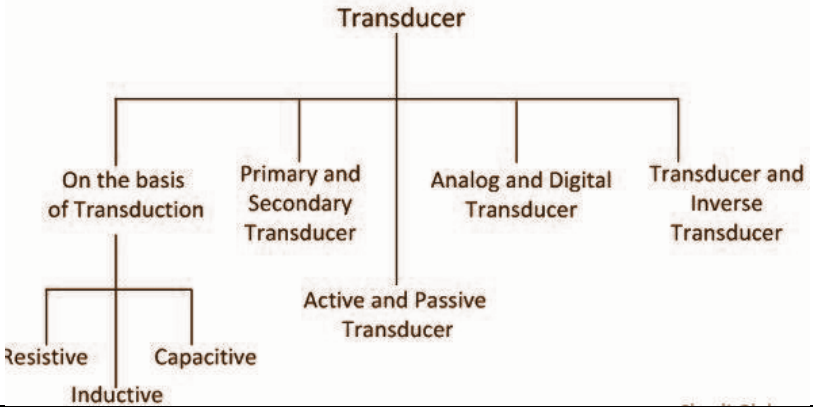
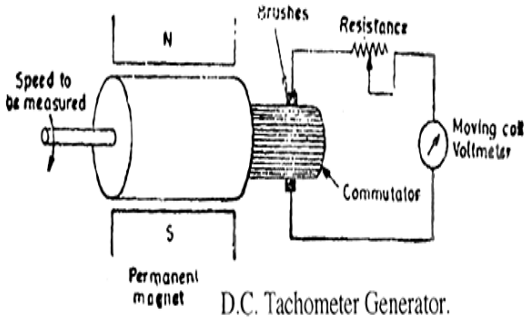
	In this type of meter, many reeds are mounted on a common support, with their free ends visible on the meter face. Each reed has its own natural frequency of vibration. When an internal electromagnet is excited by the current of unknown frequency, an alternating magnetic field is produced. If the frequency 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.  			

X	**<u>Weston synchroscope</u>** *Explanation 4 marks* *Diagram 3 marks* The winding on one outer limb of the transformer is connected to the bus bars and the winding on the other outer limb is connected to the incoming alternator. The winding on the central limb of the transformer is connected to a lamp. The two fluxes produced by the outer limbs are forced through the central limb. The resultant flux through the central limb is equal to the phasor sum of these fluxes. This resultant flux induces an e.m.f. in the windings of the central limb When the busbar voltage and the incoming machine voltages are in phase, the two fluxes through central limb are additive and thus e.m.f. induced in the central limb is maximum. Hence under these conditions the lamp connected to the central limb winding glows with maximum brightness. • When the two voltages are 180° out of phase with each other the resultant fluxes through central limb is zero and the lamp does not glow at all and is dark. • When the frequency of incoming machine is different from that of busbar, the lamp will flicker (ie. will be bright and dark alternately). The frequency of flickering is equal to the difference in frequencies of the busbar and the incoming machine.• But the flickering of the lamp cannot indicate whether the incoming alternator is fast or slow. For this purpose an electrodynamic instrument is provided.	4+3	7	


R Y B
Lamp
Transformar
R
Y
B
From Incoming
Machine
Synchronizing
Type

XI	**Basic block diagram of digital frequency meter.** *Block Diagram 3 marks* *Explanation 4 marks*  The signal is amplified before being applied to the Schmitt trigger.The Schmitt trigger converts the input signal into square wave with fast rise and fall times, which is then differentiated and clipped. As a result, the output from a Schmitt trigger is a train of pulses, one pulse for each cycle of the signes from the Schmitt trigger are fed to 'Start'/Stop gate. When this gate is enabled, the input pulses pass through this gate and are fed directly to the electronic counter, which counts the number of pulses. When this gate is disabled, the counter stops coming pulses. The counter displays the number of pulses that have passed through it in the time interval between start and stop. If this interval is known, the unknown frequency can be measured	4+3	7	
	Block of CRO *Block Diagram 4 marks* *Explanation 3 Marks*			

XII	 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 vertical amplifier. This delayed signal is then applied to vertical deflection plates of CRT. ● Trigger Circuit − It produces a triggering signal in order to synchronize both horizontal and vertical deflections of electron beam. ● Time base Generator − It produces a sawtooth signal, which is useful for horizontal deflection of 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 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 fluorescent screen. The electron beam, which is produced by an electron gun gets deflected in both vertical and horizontal directions by a pair of vertical deflection plates and a pair of horizontal deflection plates respectively. Finally, the deflected beam will appear as a spot on the fluorescent screen.	4+3	7	

XIII	**Classification of transducers** *Classification 6 marks* *Examples 1 mark*  	6+1	7	
XIV	**DC Tachometer** *Diagram 3 marks* *Explanation 4 marks*  D.C. Tachometer Generator. A DC tachometer consists of a small armature which is coupled to a machine whose speed needs to be measured. The armature revolves in field generated by a permanent magnet. Emf generated is proportional to the product of flux and speed. As flux in the magnet is constant, generated voltage is proportional to speed. The polarity of voltage output indicates direction of rotation.	3+4	7	

Module wise question analysis

Question No	Module				No of questions
	I	II	III	IV	
Part A (1 Mark)	2	3	2	2	9
Part B (3 Marks)	2	2	3	3	10
Part C (7 Marks)	2	4	4	2	12
Total questions	**6**	**9**	**9**	**7**	**31**
Total (Marks) =123	**22**	**37**	**39**	**25**	

Cognitive level wise question analysis

Question No	Cognitive level			No of questions
	Remember	Understand	Apply	
Part A (1 Mark)	7	2	0	9
Part B (3 Marks)	6	3	1	10
Part C (7 Marks)	0	10	2	12
Total questions	**13**	**15**	**3**	**31**
Total (Marks)=123	**25**	**81**	**17**	**123**

Prepared By	Scrutinised By
	
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Model Question Paper II

ELECTRICAL AND ELECTRONICS MEASURING INSTRUMENTS

Time: 3 Hour *Max.Marks: 75*

PART A

I. Answer **all** questions in one word or one sentence. Each question carries 1 mark.

1	Write the functions of control spring in PMMC instruments	M 1.03	R
2	Write one example for integrating type instruments	M 1.01	R
3	List out different methods for providing damping torque	M 1.02	R
4	Write any one bridge used for the measurement of capacitance	M 2.03	R
5	List any two faults occur in underground cables	M 2.02	R
6	Write the function of synchroscope in generating stations	M 3.01	R
7	State the function of focussing anode in a CRO	M 3.04	R
8	List out any two basic elements of a digital data acquisition system	M 4.04	R
9	Write any two temperature sensors used in industries	M 4.02	R

PART B

II. Answer any **eight** questions from the following, each question carries 3 marks.

1	Write the advantages and disadvantages of moving-coil instruments	M 1.03	R
2	Explain the working of air friction damping with the help of neat sketch	M 1.02	U
3	A moving-coil instrument has the following data: number of turns = 100, width of coil = 20 mm, depth of coil = 30 mm, flux density in the gap = 0.1 Wb/m2. Calculate the deflecting torque when carrying a current of 10 mA	M 1.03	A
4	Draw the circuit diagram of schering bridge	M 2.03	R
5	Describe the multiplication factor of wattmeter	M 2.04	R
6	Explain the working of static type phase sequence indicator	M 3.01	U
7	Explain the construction of hand operated insulation tester with the help of a neat sketch	M 3.02	U
8	Write any three applications of CRO	M 3.04	R

9	Distinguish between active and passive electrical transducers and give some examples of them	M 4.01	U
10	Write any three characteristics of transducer	M 4.01	R

PART C

Answer ALL questions. Each question carries 7 marks.

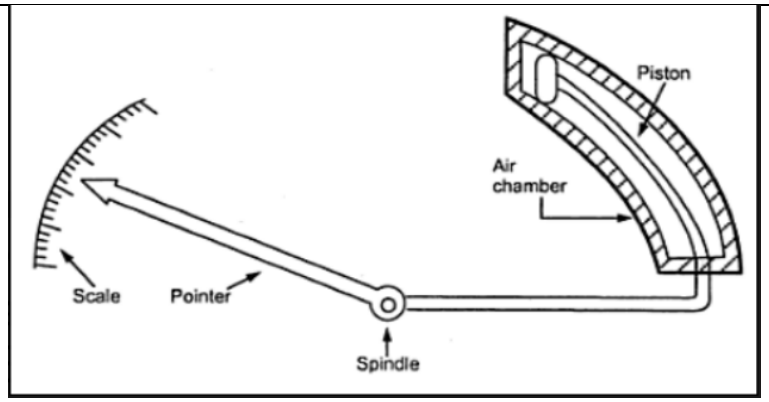
III	A moving coil instrument has a resistance of 5 Ω and gives a full scale deflection of 10 mv. Show how the instrument may be used to measure (a) voltage up to 50 V (b)current up to 10 A	M 1.04	A
	OR		
IV	Draw the circuit arrangements to use a MC instrument which gives FSD at l00mV potential difference and l0 mA current as (i) Ammeter 0-10A (ii) Volt meter 0-250V	M 1.04	A
V	Draw and identify the parts of single phase induction type energy meter	M 2.04	R
	OR		
VI	Describe with suitable schematic diagram, the Murray Loop test for localising earth fault in cables	M 2.02	R
VII	Explain the measurements of inductance using Maxwell's Bridge	M 2.03	U
	OR		
VIII	Explain the working of dynamometer type wattmeter with help of a neat sketch	M 2.04	U
IX	Explain the construction of earth tester	M 3.02	U
	OR		
X	Explain the working of single phase dynamometer type power factor meter with a neat diagram	M 3.01	U
XI	Explain the working principle of a linear variable differential transformer (LVDT) with necessary diagrams	M 4.02	U
	OR		
XII	Distinguish between thermistor and thermocouple	M 4.02	U
XIII	Explain how thermistor can be used for temperature measurement	M 4.02	U
	OR		
XIV	Draw and Explain the block diagram of digital tachometer	M 4.03	U

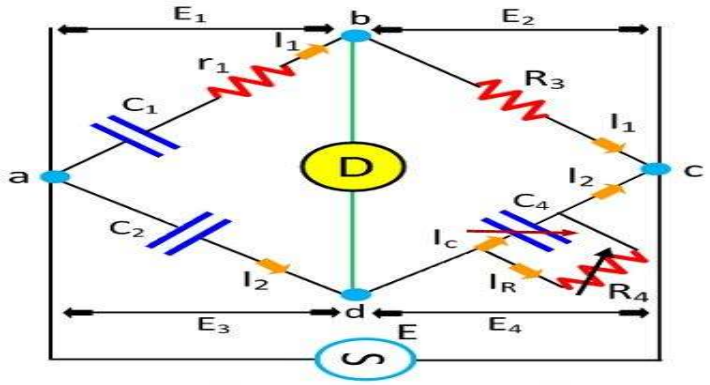
Scoring Indicators

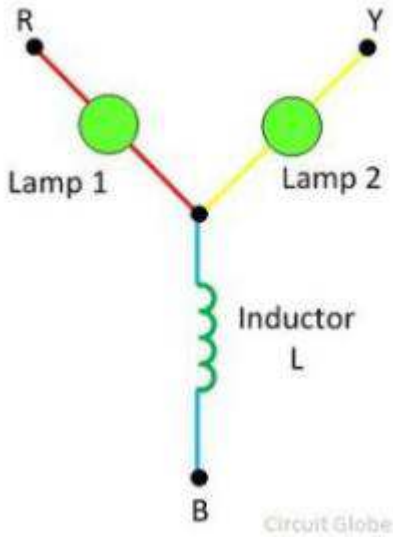
Model Question Paper II

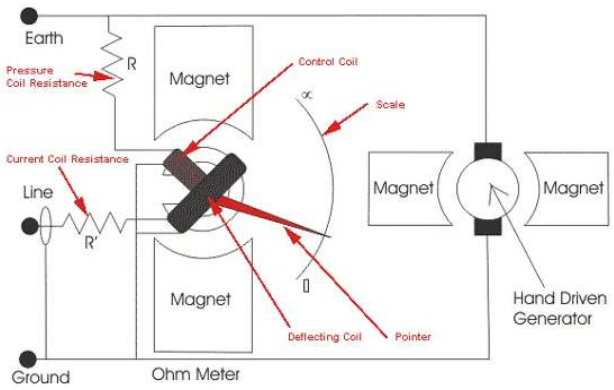
ELECTRICAL AND ELECTRONICS MEASURING INSTRUMENTS

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			
I. 1	1)Provides the path to the lead current to flow in and out of the moving coil 2)Provides control torque	2*.5	1	
I. 2	Energy meter,AH meter	1*1	1	
I. 3	1)Air friction damping 2)Fluid friction damping 3)Eddy current damping	any two 2*.5	1	
I. 4	1)ground faults: where cable insulation may break down causing a current to flow from the core of the cable to the earth 2)short-circuit faults: where a insulation failure between two cables, or between two cores of a multi-core cable results in flow of current between them	2*.5	1	
I. 5	• A synchroscope is used to determine the correct instant of closing a switch which connects the alternator to a power system bus bar • The correct instant of synchronizing is when the bus bar voltage and alternator voltage having 1. Same magnitude 2. Same phase sequence 3. Same frequency	1*1	1	
I. 6	The function of focusing anodes is to concentrate and focus the beam on the screen	1*1	1	
I. 7	(a) Sensors and transducers (b) Field wiring (c) Signal conditioning (d) Data acquisition hardware (e) PC (operating system) (f) Data acquisition software	any two 2*.5	1	

I. 8	schering bridge weins bridge de sautys bridge	any one 1*1	1	
I. 9	Thermocouple Thermistor RTD Semiconductor based IC'S	any two 2*.5	1	
	PART B			
II. 1	any three points-3*.5 <u>Advantages</u> •It consumes less power •Uniform scale •It has high torque to weight ratio •It has no hysteresis loss •Damping is effective and efficient •They are not affected by the stray magnetic field due to their strong magnetic field •They can be extended to wide range of currents and voltages any three points-3*.5 <u>Disadvantages</u> •Errors due to aging in spring and magnet •We can only measure DC •Costly •The magnetic field produced is affected by surrounding temp which causes error in reading	1.5+1.5	3	
II. 2	 •It consists of a light aluminum piston which 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.	fig-1.5 explana tion-1.5	3	

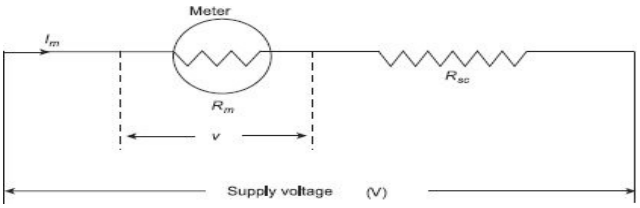
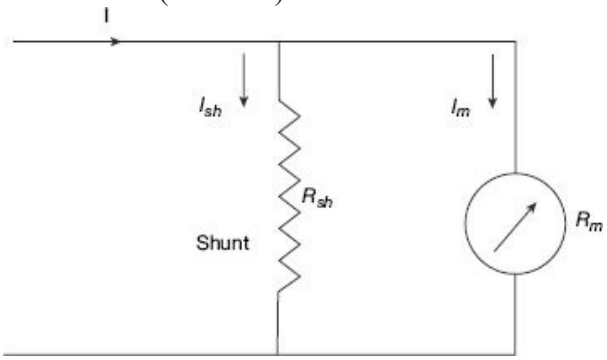
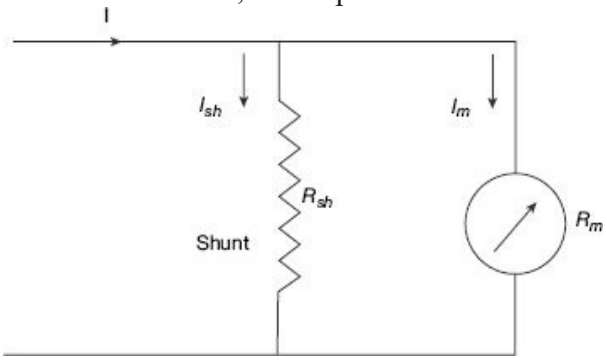
	•When the piston moves out of the air chamber, the pressure in the closed space falls, and the pressure on the open side of the piston is greater than on the other side. Thus there is again an opposition to the motion. •This method of damping system used in weak magnetic field equipments Eg: MI and electro dynamometer equipments			
II. 3	(Steps-2marks,final answer-1 marks) Total deflecting torque exerted on the coil, Td = Bilnb (N-m) B=0.1 Wb/m2 l=30mm=30*10^-4 M i=10 mA=10*10^-3 A n=100 b=20 mm=20*10^-4 M Td=Bilnb=0.1*30*10^-4*10*10^-3*100*20*10^-4 =60*10^-6 NM	2+1	3	
II.4	 Low Voltage Schering Bridge Circuit Globe (figure-2 marks,naming-1 mark)	2+1	3	
II.5	● wattmeter is constructed such that it read only power on a single scale. Only single scale will available to read the measured power. In order to take the accurate reading just we measure the reading and we will multiple along with factor called multiplication factor. That's depends on which voltage knob we connected and also the current. ● Multiplication factor =(voltage range*current range*pf)/Max scale deflection.	Equation-1.5 Definition-1.5		

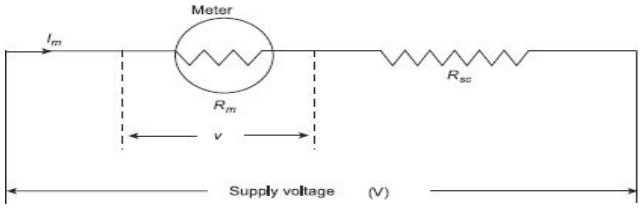
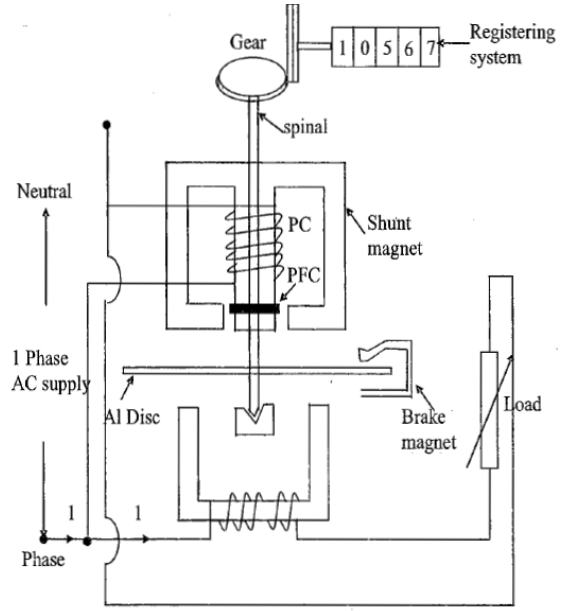
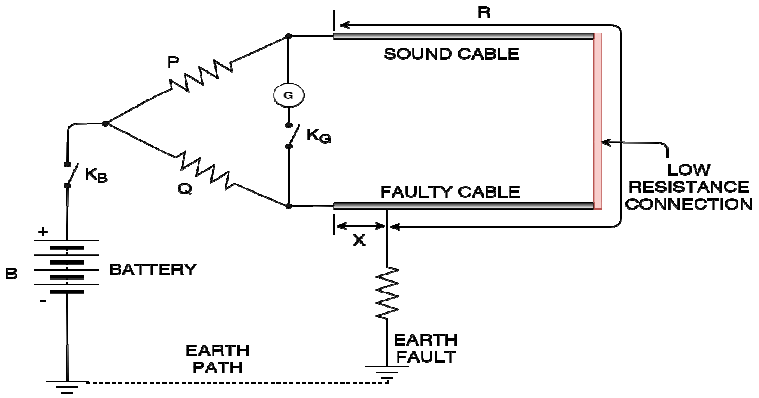
II.6	 • The static phase sequence indicators consist two lamps and an inductor. • The device whose phase sequence is used to be known is connected to the static phase sequence indicators. • If the lamp 1 is dim and the lamp 2 glows brightly, then the phase sequence of supply is RYB. • If the lamp 1 glows brightly and the lamp 2 is dim, the device has reverse phase sequence. • The brightness of the lamp depends on the voltage drops occurs across it	fig-1.5 explanation-1.5	3	

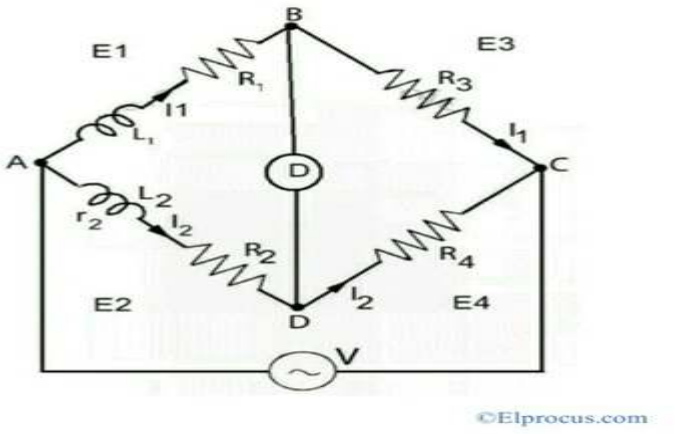
II.7	 1. Deflecting and Control coil : Connected parallel to the generator, mounted at right angle to each other and maintain polarities in such a way to produced torque in opposite direction. 2. Permanent Magnets : Produce magnetic field to deflect pointer with North-South pole magnet. 3. Pointer : One end of the pointer connected with coil another end deflects on scale from infinity to zero. 4. Scale : A scale is provided in front-top of the megger from range 'zero' to 'infinity', enable us to read the value. 5. D.C generator or Battery connection : Testing voltage is produced by hand operated DC generator for manual operated Megger. Battery / electronic voltage charger is provided for automatic type Megger for same purpose. 6. Pressure Coil Resistance and Current Coil Resistance : Protect instrument from any damage because of low external electrical	fig-1.5 explanation-1.5	3	

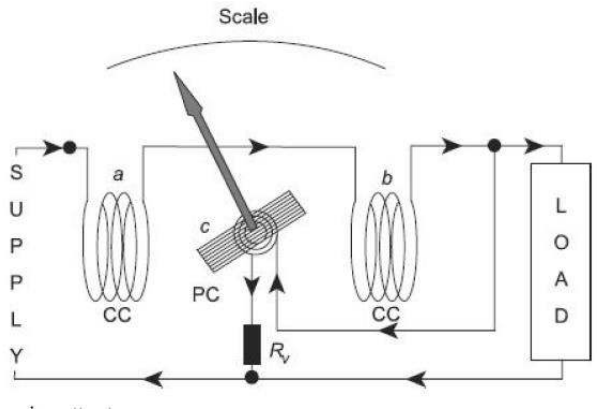
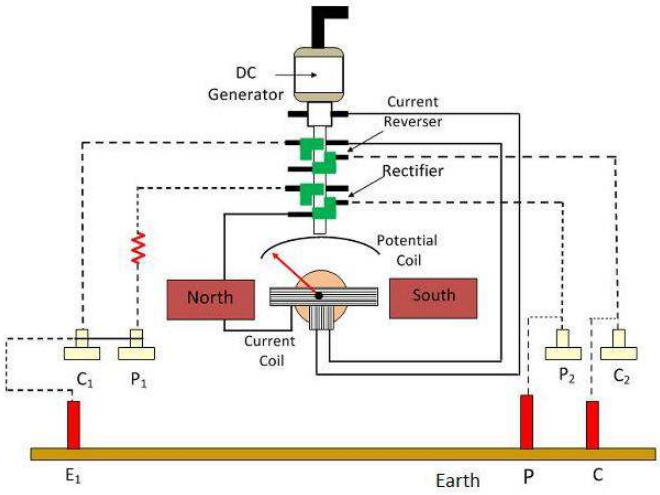
	resistance under test.			

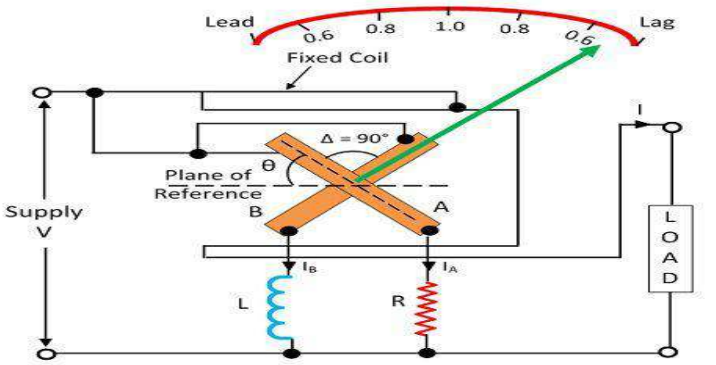
II. 8	• Tracing of an actual waveform of current or voltage. • Determination of amplitude of a variable quantity. • Comparison of phase and frequency. • Measurement of capacitance and inductance • For finding B-H curves for hysteresis loop. • For engine pressure analysis and in radar • For studying the heart beats, nervous reactions etc. • For determining the modulation characteristics and to detect the standing waves in transmission lines. • It can be used to check the diodes and the faulty components in the various circuits.	any three applications 3*1	3	
II. 9	Active transducer (definition-1,example-.5) An active transducer can be defined as, a transducer which gives the output in different forms like current or voltage without using any exterior source of energy. Eg:Tachogenerator,Thermocouple, Photovoltaic cell PassiveTransducer (definition-1,example-.5) Passive transducer is a device which converts the given non-electrical energy into electrical energy by external force Eg:Thermistor, Differential transformer	1.5+1.5	3	
II.10	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	any three 3*1	3	

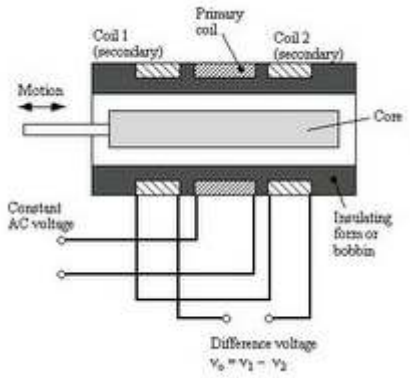
	There should not be any deformation on removal of input signal after long period of use			
	PART C			
III	Full scale deflection voltage ,v= 10 mv Rm=5Ω Full scale deflection current = 10 × 10^-3/5 = 2 mA (a) For measuring the voltage up to 50 V we need to connect a multiplier resistance RSC in series with the instrument  Rsc=(m-1)*Rm m=V/v=50/(10*10^-3)=5000 Rsc=(5000-1)*5=24995 Ω b)For measuring the current up to 10 A we need to connect a shunt resistance ,Rsh in parallel to the instrument im=10 mV/5=2 mA m=I/im=10/(2*10^-3)=5000  Rsh=Rm/(m-1)=5/(5000-1)=1.002*10^-3 Ω	part a)ckt-1marks steps-1.5 marks final answer-1 marks part b)ckt-1marks steps-1.5 marks final answer-1 marks	7	
IV	i)For measuring the current up to 10 A we need to connect a shunt resistance ,Rsh in parallel to the instrument  Vm=100 mV Im=10 mA Rm=Vm/Im=100 mV/10 mA=10 Ω	part a)ckt-1marks steps-1.5 marks final answer-1 marks part b)ckt-1marks steps-1.5	7	

	I=10 A m=I/Im=100/(10*10^-3)=10000 Rsh=Rm/(m-1)=10/(10000-1)=1*10^-3 Ω ii)V=250 V m=V/Vm=250/100 mV=2500  Rsc=Rm(m-1)=10*9999=99.99*10^3 Ω	marks final answer-1 marks		
V	 	figure-4marks identifying parts-3 marks	7	
VI	 The cable conductors form a Wheatstone bridge circuit with the two externally controllable resistors P and Q and the cable resistance X and R The galvanometer G is used for balance detection and bridge is balanced by adjustment of P and Q till the	ckt-3 marks derivation-4 marks	7	

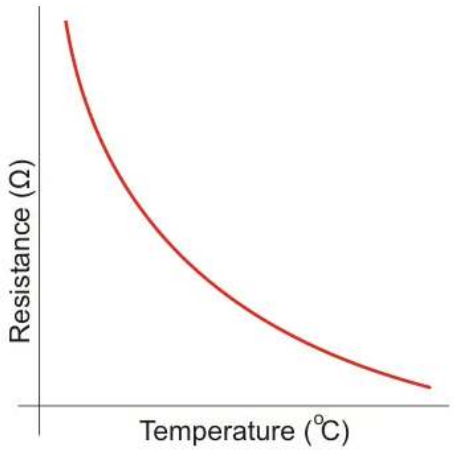
	galvanometer indicates zero deflection At balanced condition we can write(Wheatstone bridge principle) P/Q=R/X------(1) Add +1 on both sides (P+Q)/Q=(R+X)/X----------(2) X= Q/(P+Q)*(R+X)----------(3) (R + X) is the total loop resistance formed by the good cable and the faulty cable Let "L" be the length of each cable then (R+X) proportional to 2L(since resistance is proportional to length when area and resistivity are constants) If Lx represents the distance of the fault point from the test end, and L is the total length of each cable under test, then we can write Lx= Q/(P+Q)*2L----------(4)			
VII	 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 ● R1*R4=R2*R3 and wL1*R4=wL2*R3----------(3) ● R1=R2*R3/R4 ● L1=L2*R3/R4	Circuit-3 marks derivation-4 marks	7	

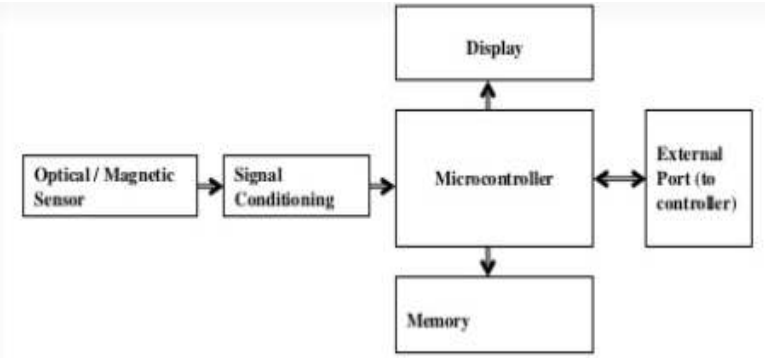
	● The unknown quantities can be measured from the above equations			
VIII	 The fixed coil produces a field Fm, and the moving coil creates a field Fr. The field Fr tries to come in line with the main field Fm, which provides a deflecting torque on the moving coil. Thus, the pointer attached to the spindle of the moving coil deflects. This deflection is controlled by the controlling torque produced by the springs	figure-4marks working -3 marks	7	
IX	 ● 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 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	figure-4 marks explanation-3 marks	7	

	● 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			
X	 Single Phase Electrodynamometer Type Power Factor Meter Circuit Globe • 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	figure-4marks explanation-3 marks	7	

	• 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 current flowing through it is 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 the coil A, and the other is on coil B(Ta and Tb) • The windings are so arranged that Ta and Tb are opposite in directions • When the instrument connected to a load whose power factor is to be measured at some point ,the pointer will come to rest(when Ta=Tb) • At that point the deflection of meter gives the power factor			
XI	 The working principle of the linear variable differential transformer or LVDT working theory is mutual induction. The dislocation is nonelectrical energy that is changed into electrical energy. The working of the LVDT circuit diagram can be divided into three cases based on the position of the iron core in the insulated former. In Case-1: When the core of the LVDT is at the null location, then both the minor windings flux will equal, so the induced e.m.f is similar in the windings. So for no dislocation, the output value (eout) is zero because both the e1 & e2 are equivalent. Thus, it illustrates that no dislocation took place. In Case-2: When the core of the LVDT is shifted up to the null point. In this case, the flux involving minor winding S1 is additional as contrasted to flux connecting with the S 2 winding. Due to this reason, e1 will be added as that of e2. Due to this eout (output voltage) is positive.In Case-3: When the core of the LVDT is shifted down to the null	figure-3 marks explanation-4 marks	7	

<table>
<tr><td></td><td>point, In this case, the amount of e2 will be added as that of e1. Due to this eout output voltage will be negative plus it illustrates the o/p to down on the location point</td><td></td><td></td><td></td></tr>
<tr><td>XII</td><td>
<table>
<tr><th></th><th>Thermocouple</th><th>Thermistor</th></tr>
<tr><td>Definition</td><td>The thermocouple is a type of device used for measuring the temperature</td><td>Thermistor is the thermal resistor whose resistance changes with the temperature</td></tr>
<tr><td>Sensing Parameter</td><td>Voltage generate at the junction</td><td>Resistance</td></tr>
<tr><td>Material</td><td>Copper, iron, Constantan, Chromel, Alloys of metals like Chrome, chromium and nickel, platinum and rhodium, tungsten and rhenium, rhodium and iridium</td><td>Manganese, nickel or cobalt oxides, semiconductor material</td></tr>
<tr><td>Accuracy</td><td>High</td><td>Low</td></tr>
<tr><td>Temperature Range</td><td>-50°C to 250°C</td><td>-200°C to 1250°C</td></tr>
<tr><td>Cost</td><td>Expensive (because of external power source and devices on circuit.)</td><td>Cheap</td></tr>
<tr><td>Uses</td><td>Industries and home appliances</td><td>Industries and home appliances</td></tr>
</table>
</td><td>any four points</td><td>7</td><td></td></tr>
<tr><td>XIII</td><td>A thermistor (or thermal resistor) is defined as a type of</td><td>working</td><td>7</td><td></td></tr>
</table>

	resistor whose electrical resistance varies with changes in temperature. Although all resistors' resistance will fluctuate slightly with temperature, a thermistor is particularly sensitive to temperature changes. Working The working principle of a thermistor is that its resistance is dependent on its temperature. We can measure the resistance of a thermistor using an ohmmeterIf we know the exact relationship between how changes in the temperature will affect the resistance of the thermistor – then by measuring the thermistor's resistance we can derive its temperature. How much the resistance changes depends on the type of material used in the thermistor. The relationship between a thermistor's temperature and resistance is non-linear. A typical thermistor graph is shown below:  If we had a thermistor with the above temperature graph, we could simply line up the resistance measured by the ohmmeter with the temperature indicated on the graph.By drawing a horizontal line across from the resistance on the y-axis, and drawing a vertical line down from where this horizontal line intersects with the graph, we can hence derive the temperature of the thermistor	-7 marks		
XIV	The operational set up of a digital tachometer consists of various blocks such as an optical or magnetic sensor, a signal conditioning unit, a microcontroller, a memory, a display, and an external port	block diagram -3 marks explanation-4 marks	7	



Optical sensing: An optical sensor consists of an optical disk placed near the motor which generates pulses proportional to the rotating shaft. A slotted disk and IR emitter are used to generate these pulses

Signal Conditioning: The output signals from the sensors are noisy, and therefore, are filtered, amplified, and digitized so that the microcontroller recognizes these signals for further action

Memory: The memory unit stores the data from the microcontroller.

Display Unit: The function of the display unit is to view the stored values transmitted from the microcontroller

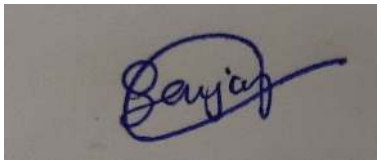
Module wise question analysis

Question No	Module				No of questions
	I	II	III	IV	
Part A (1 Mark)	3	2	2	2	9
Part B (3 Marks)	3	2	3	2	10
Part C (7 Marks)	2	4	2	4	12
Total questions	**8**	**8**	**7**	**8**	**31**
Total (Marks)=123	**26**	**36**	**25**	**36**	

Cognitive level wise question analysis

Question No	Cognitive level			No of questions
	Remember	Understand	Apply	
Part A (1 Mark)	9	0	0	9
Part B (3 Marks)	5	4	1	10
Part C (7 Marks)	2	8	2	12

Total questions	**16**	**12**	**3**	**31**
Total (Marks)=123	**38**	**68**	**17**	

Prepared By :  SANJAY V Lecturer in Electrical and Electronics Engineering Government polytechnic college Perithalmanna	Scrutinised By :  Anssa T H Lecturer in Electrical and Electronics Engineering Central Polytechnic College Thiruvananthapuram