Summer – 2019 Examinations

Model Answers

Subject & Code: Electrical & Electronic Measurements (17322)

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.

Summer – 2019 Examinations

Model Answers

Subject & Code: Electrical & Electronic Measurements (17322)

1 Attempt any TEN of the following: 20

1 a) List different methods of developing damping torque.

Ans:

Methods of developing Damping Torque:

1) Air friction damping. 2 Marks
2) Fluid friction damping.
3) Eddy current damping.

1 b) Define:

(i) Precision
(ii) Accuracy

Ans:

(i) Precision:

It is the measure of consistency or repeatability of the measurements; it is also known as degree of exactness. 1 Mark

(ii) Accuracy:

It is the closeness with which an instrument reading approaches the true value of the quantity being measured. 1 Mark

1 c) Name the material used for:

(i) Moving coil
(ii) Spring of PMMC instrument

Ans:

(i) Material used for Moving Coil: **Copper** 1 Mark
(ii) Material used for Spring of PMMC Instrument: **Phospher bronze** 1 Mark

1 d) List one method of range extension of D.C ammeter and a.c. ammeter.

Ans:

Method of Range Extension of D.C Ammeter: 1 Mark

i) By using shunt resistance.

Method of Range Extension of A.C Ammeter:

i) By using CT. 1 Mark
ii) By using shunt resistance.

1 e) State the function of control spring.

Ans:

Function of Control Spring: 2 Marks

i) To produce control torque or force.
ii) To lead current to the moving coil.

1 f) A single phase wattmeter rated for 500V, 10A has full scale deflection of 1250W.State the multiplying factor of wattmeter

Ans:

$$\text{Multiplying factor} = \frac{\text{Voltage Range} \times \text{Current Range} \times \text{PF}}{\text{FSD}}$$ 1 Mark

$$\text{Multiplying factor} = \frac{500 \times 10 \times 1}{1250} = 4 \ldots\ldots\ldots\ldots \text{ (Assuming PF=1)}$$

1 Mark

1 g) Enlist any four errors that occur in dynamometer type wattmeter.

Ans:

Errors in Dynamometer Type Wattmeter:

1) Errors due to method of connection.
2) Error due to pressure coil inductance.
3) Error due to pressure coil capacitance.
4) Error due to mutual inductance effect.
5) Error due to stray magnetic fields.
6) Error due to eddy currents.
7) Temperature error.
8) Error due to vibration of moving system.
9) Error due to friction.

½ Mark for each of any four errors = 2 Marks

1 h) State two advantages of two-wattmeter method.

Ans:

Advantages of Two Wattmeter Method for 3-Phsae Power Measurement:

1) It is used for balanced as well as unbalanced load.
2) For the star type load, it is not necessary to connect the neutral point for connection of wattmeter.
3) Delta load need not to be opened to connect the wattmeter.
4) For balanced loads, it possible to measure power factor along with the power.
5) Only two watt meters are required which reduces cost of instruments
6) It is possible to measure reactive volt-amperes for balanced loads also.
7) The circuit connections are independent of load connection.

1 Mark for each of any two points = 2 Marks

1 i) Define electrical energy. State its unit.

Ans:

Electrical Energy:

Electrical energy is defined as the work done in moving electrical charge in electrical field. 1 Mark

OR

The total power delivered or consumed by electrical load over specific unit time duration.

Unit of Electrical Energy: 1 Mark

The unit of electrical energy is the joule (or watt-second) **OR** Kilowatt-hour (kWH).

1 j) State the meaning of energy meter constant K. State its unit.

Ans:

Meaning of Energy Meter Constant (K):

Energy Meter Constant is the no. of revolutions made by disc in meter per unit (kWh) consumption of energy. 1 Mark

Unit of energy meter constant K is rev/kWH 1 Mark

1 k) Give ranges of low and high resistances.

Ans:

1) Ranges of low resistance: **Less than 1 ohm.** 1 Mark
2) Ranges of high resistance: **Greater than 0.1 Mega ohm.** 1 Mark

1 l) State the use of synchroscope.

Ans:

Use of Synchroscope:

The synchroscope is used to determine the exact instant of switching required to connect the alternators in parallel or put an alternator in parallel with the infinite bus. Its pointer gives the idea of the faster or slower machine to make adjustments in speed of alternators for synchronising. 2 Marks

1 m Give application of C.R.O.

Ans:

Applications of CRO:

1) Voltage measurement.
2) Current measurement.
3) Measurement of phase difference.
4) Measurement of phase.
5) Measurement of frequency.
6) Measurement of inductance.
7) Measurement of capacitance.
8) Tracing the waveform.
9) Measurement of amplitude of variable quantity.
10) Used in television circuits.
11) Used in radar circuits
12) It can display different types of waveforms.
13) For finding B-H curves.
14) For studying the heart beats
15) To detect standing waves in transmission lines
16) To check faulty components in various circuits.
17) For checking transistor.
18) It can measure short time interval.

½ Mark for each of any four applications = 2 Marks

2 Attempt any <u>FOUR</u> of the following: 16

2 a) Describe different types of errors in analog measuring instruments.

Ans:

Types of Errors in Analog Measuring Instruments:

A) <u>Gross error</u>: These are due to mistakes on the part of person using the instrument.

B) <u>Systematic Error</u>: It has three sub types as:

i) Instrumental Error: These errors are caused due to the mechanical structure of measuring instrument.

a) Inherent shortcomings of instruments: Instrument may read too low or too high.

b) Improper use of instruments: Improper handling e.g. overloading, overheating, failure to adjust zero, use of high resistance leads.

c) Loading effect: Cause distortion in original signal.

4 Marks

ii) Environmental error: These are because of surrounding conditions such as temperature, pressure, humidity, dust, vibrations or external magnetic fields or electrostatic fields.
iii) Observational Error: Parallax errors, incorrect multiplying factor.

C) Random error: These persist even after gross and systematic errors are removed.

b) Write one advantage and one disadvantage each for spring control method and gravity control method.

Ans:

Advantages of Spring Control Method:

1) The spring-controlled meters may be used in any position.
2) In some instruments, springs can be used as current leads.
3) As springs are light in weight, practically there is no increase in weight of the moving system hence high torque to weight ratio.
4) The spring-controlled meters have uniform scale.

Any one advantage = 1 Mark

Disadvantages of Spring Control Method:

1) Temperature change affects spring length causing change in magnitude of controlling torque.
2) Accidental stress in the springs may damage them.
3) Spring will not respond if stressed beyond their elastic limit.
4) Controlling torque cannot be adjusted easily.

Any one disadvantage = 1 Mark

Advantages of Gravity Control Method:

1) It is very simple method.
2) It is economical method.
3) It is unaffected by temperature changes.
4) It is not subjected to fatigue.
5) Controlling torque can be adjusted easily by control weight.

Any one advantage = 1 Mark

Disadvantages of Gravity Control Method:

1) Instrument should to kept in vertical position only.
2) Scale is non-uniform.
3) Control weights add to the weight of instrument.

Any one disadvantage = 1 Mark

c) Compare PMMC and MI instrument (any four point).

Ans:

Comparison Between PMMC & MI Instrument:

Points	PMMC instruments	MI instruments
Principle	When current carrying conductor is placed in a magnetic field, it experiences mechanical force.	Piece of iron is attracted / repelled by the magnet or magnetic field.
Scale	Uniform	Non-uniform
Torque / Weight ratio	Higher	Lower
Application	PMMC instruments are used only for DC measurements	Used for DC as well as AC measurements
Cost	Higher cost for same range	Lower cost for same range

1 Mark for each of any four points = 4 Marks

Damping	Eddy current damping	Air friction damping
Sensitivity	More sensitive.	Comparatively less sensitive.

d) State any four merits of two wattmeter method for 3 ∅ power measurement.

Ans:

Merits of Two Wattmeter Method for 3 ∅ Power Measurement:

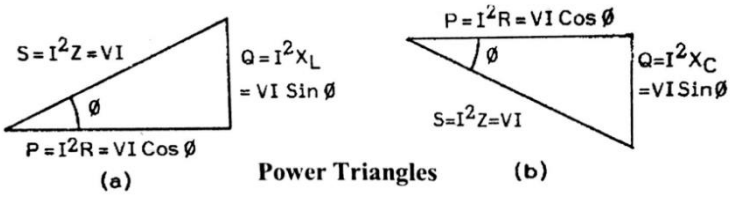
1) It is used for balanced as well as unbalanced load.
2) For the star type load, it is not necessary to connect the neutral point for connection of wattmeter.
3) Delta load need not to be opened to connect the wattmeter.
4) For balanced loads, it possible to measure power factor along with the power.
5) Only two watt meters are required which reduces cost of instruments
6) It is possible to measure reactive volt-amperes for balanced loads also.
7) The circuit connections are independent of load connection.

1 Mark for each = 4Marks

e) Draw power triangle. Name each side with relation and unit.

Ans:

Power Triangle:



2 Marks for any one Power triangle

Apparent power (S) is given by the relation:

$$S = VI = I^2Z$$

Unit: volt-amp (VA) or (kVA)

Active power (P) is given by the relation:

$$P = VI\cos\emptyset = I^2R$$

Unit: Watt (W) or (kW)

Reactive power (Q) is given by the relation:

$$Q = VI\cos\emptyset = I^2X$$

Unit: Volt-amp-reactive (VAR) or (kVAR)

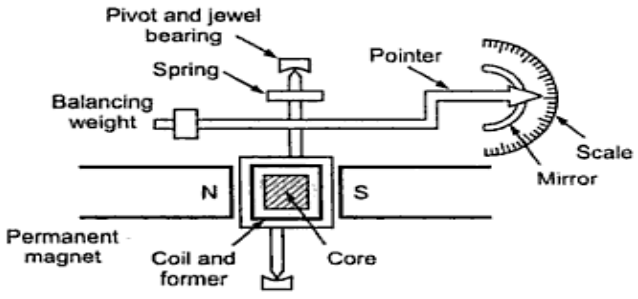
1 Mark for relations

1 Mark for units

f) Draw neat labelled diagram of PMMC instrument.

Ans:

PMMC Type Instrument:



4 Marks for labeled diagram
3 Marks for partially-labeled diagram
2 Marks for unlabeled diagram

3 Attempt any FOUR of the following: 16

3 a) Explain working of phase sequence indicator.

Ans:

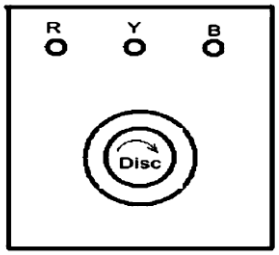
Phase Sequence Indicator:

There are two types of phase sequence indicators:

(a) Rotating type phase sequence indicator

(b) Static type phase sequence indicator

(a) Rotating Type Phase Sequence Indicator:

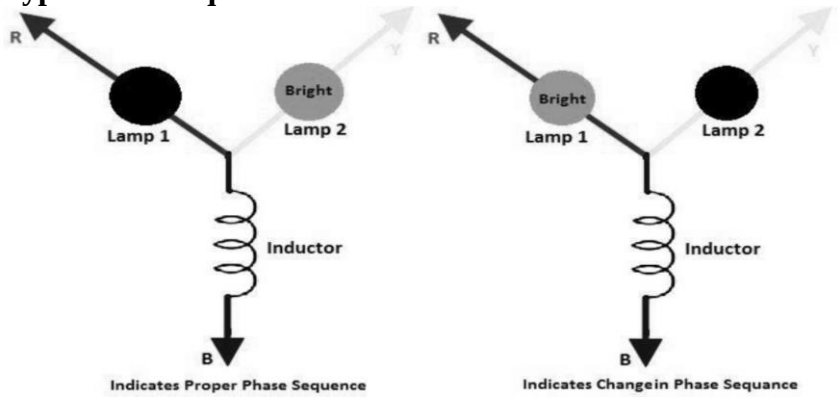


Rotating Type

It consists of three coils mounted 120^0 apart in space. The three ends of coils are brought out and connected to three terminals marked R-Y-B as shown in figure. The coils are star connected and are excited by supply whose sequence is to be determined. An aluminum disc is mounted on the top of coils. The coils produce rotating magnetic field, when they are energized by three phase supply. The rotating magnetic field sweeps the stationary aluminum disc and produces eddy currents in the aluminum disc. A torque is produced by the interaction of eddy currents with the field. The disc revolves because of the torque and the direction of rotation depends upon the phase sequence of the supply. An arrow indicates the direction of rotation of the disc. If the direction of the rotations is same as that indicated by arrow head, the phase sequence of the supply is same as the marked on the terminals of the instrument. However, if the disc revolves opposite to the direction indicated by arrow, the sequence of the supply is opposite to that marked on the terminals.

4 Marks for explanation of any one type

(2) Static Type Phase Sequence Indicator:



It consists of two lamps and one inductor. Connect two lamps, lamp1 to R-phase, lamp2 to Y-phase and inductor to B-phase as shown in the figure. Resistors are connected in series with the lamps for protecting the lamps from over currents and

breakdown voltages. If the phase sequence of supply is RYB, then the lamp 2 will glow brighter than lamp 1; if the sequence of the supply is reversed or altered, then the lamp 1 will glow brighter than the lamp 2.

3 b) Give significance and purpose of electrical measurement system.

Ans:

Significance and Purpose of Electrical Measurement System:

1) The complete area of automation / automatic control is based on measurement.
2) The new discoveries / innovations require sophisticated measurement techniques.
3) The measurement is required to monitor a process / operation.
4) It is required to measure all physical / electrical / mechanical quantities.
5) The measurements are required in a research and development (R&D) department.
6) The measurement is widely required in various industries for quality production.
7) The measurement is widely required in various Educational Institutes for training purpose.
8) The measurement is required for trading and dealing purposes.
9) The measurement is required to set particular standards and tolerances.
10) The measurement conforms validity of hypothesis and adds its understanding.

1 Mark for each of any four points = 4 Marks

3 c) Compare analog ammeter and voltmeter on:

i) Connection in the circuit
ii) Resistance value
iii) Circuit symbol
iv) Power consumption

Ans:

Comparison Between Analog Ammeter and Voltmeter:

Particulars	Ammeter	Voltmeter
Connection in the circuit	Connected in series with the load	Connected in parallel with the load
Resistance value	Very low	Very high
Circuit symbol		
Power consumption	$P = I^2 R_a$ watt where, I = Current flowing through ammeter. R_a = Ammeter resistance.	$P = (V^2 / R_v)$ watt where V= Voltage across voltmeter. R_v = Voltmeter resistance.

1 Mark for each point = 4 Marks

3 d) Name the different torques and their function in measuring instrument.

Ans:

Different Torques in Measuring Instruments:

1) Deflecting torque
2) Controlling / Restraining torque.

1 Mark

3) Damping torque.

Function of Deflecting Torque:

To produce deflection proportional to the quantity being measured. 1 Mark

Function of Controlling Torque:

1) To restrict the motion of pointer / spindle and stop the pointer at the relevant position to get correct reading.
2) To bring back pointer to zero position when the quantity under measurement is removed.

1 Mark for any one function

Function of Damping Torque:

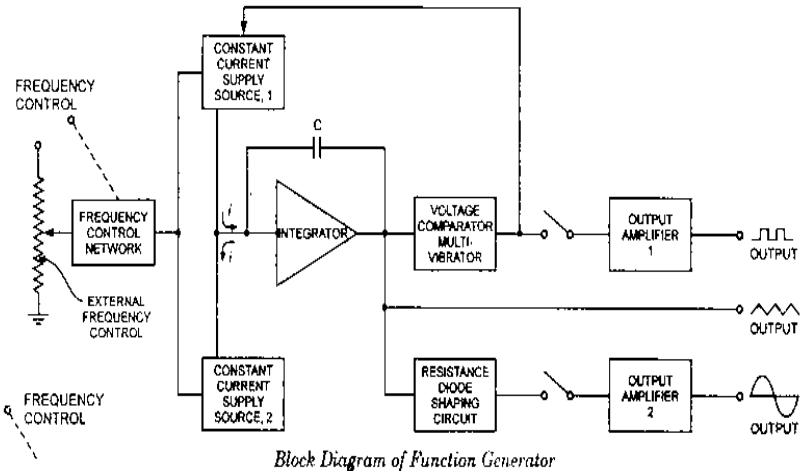
1) To stop pointer / spindle at the final steady state position.
2) Bring the pointer to stand still quickly.
3) Minimizes the oscillations about final reading position.

1 Mark for any one function

3 e) Draw block diagram of function generator. Give its applications.

Ans:

Block Diagram of Function Generator:



Block Diagram of Function Generator

2 Marks for block diagram

Applications of Function Generator:

1) For testing the bandwidth of audio frequency amplifier.
2) It can produce sine wave, triangle wave, saw tooth wave, even arbitrary waveform.
3) It has a very wide frequency range; it is an indispensable universal signal source.
4) It can be used for production, testing, equipment maintenance and laboratory testing
5) It is widely used in other areas of science and technology, such as medicine, education, chemistry, communication, earth physics, industrial control, military, aerospace etc.
6) Used for troubleshooting of different analog and digital circuits
7) It acts as source for alignment of receivers.

1 Mark for each of any two applications = 2 Marks

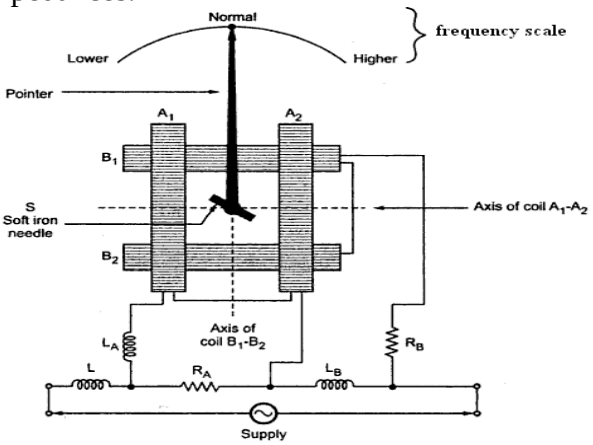
3 f) Draw and describe Weston-type frequency meter.

Ans:

Weston Type Frequency Meter:

There are two fixed coils, A and B. Each coil is divided into two equal parts and are fixed such that their magnetic axis are perpendicular to each other. At their center a soft iron needle is placed on spindle to which the pointer is attached. The mounting and connections are shown in the figure. Inductor L damps the harmonics in the current. 2 Marks for

When connected across the supply, coils A and B draw currents to produce magnetic fields that act on the soft iron needle to deflect it. The position of the needle depends on these currents. Under normal frequency (due to proper selection of R_A, R_B, L_A, $L_{B,}$) two forces make the pointer to show normal frequency. When the frequency is other than normal, the reactances L_A and L_B will be different with resistances unchanged, leading to deflections in either direction depending on the frequency of currents there in, due to changed impedances. — description



2 Marks for diagram

4 Attempt any FOUR of the following: 16

4 a) A 50 A, 230 volt energy meter makes 61 revolutions in 37 seconds. If the meter constant is 520 rev/kwh. State the pecentage error in the energy meter?

Ans:

Asumming Power factor = cos ∅ = 1

Given: K= 520 rev/kwh, N = 61 rev, t = 37 sec, V = 230V, I = 50

Actual energy consumed by load (kWh)

$$= \frac{\omega \times t}{1000 \times 3600} = \frac{V \times I \times \cos\emptyset \times t}{1000 \times 3600} = \frac{230 \times 50 \times 1 \times 37}{1000 \times 3600}$$

$$= 0.1182 \text{ kWh}$$ — 1 Mark

Energy recorded by the E.M. $= \frac{N}{K} = \frac{61}{520} = 0.1173\text{b kWh}$ — 1 Mark

$$\% \text{ Error} = \frac{Actual\ Energy\ Cosumed - Recorded\ energy}{Actual\ Energy\ Consumed} \times 100$$ — 1 Mark

$$= \frac{0.1182 - 0.1173}{0.1182} \times 100$$ — 1 Mark

% Error = 0.7614 %

4 b) Explain with diagram the range extension of D.C Meter

Ans:

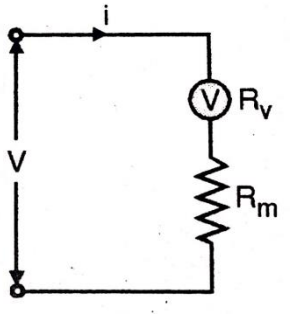
Range Extension of D.C Meter:

(Here Range extension of D.C.Ammeter and Range extension of D. C. Voltmeter is explained Students can attempt any one explanation)

Range Extension of D.C Voltmeter:

The range of D.C Voltmeter can be extended by connecting a high resitance called as 'Multiplier' in series with the meter coil.

Let V – be the full scale deflection of the votmeter
R_v – be the resitance of voltmeter
R_m – be the resitance of multiplier
i - be the full scale deflection current flowing through meter

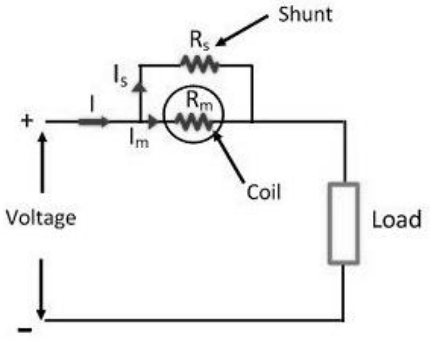


Consider the above figure

$V = i R_v + i R_m$
$V = i (R_v + R_m)$
$V / i = R_v + R_m$
$R_m = (V / i) - R_v$

2 Marks for diagram & 2 Mark for explanation of any one method = 4 Marks

Range Extension of D.C Ammeter: The range of D.C Ammeter can be extended by connecting a low resitance called as Shunt in parrllel with the meter coil.



Let R_m = Resistance of ammeter
R_s = Resitance of Shunt.
I = Total current from mains
I_m = Maximum rated current of ammeter
I_s = Current flowing through shunt,
As $I = I_m + I_s$
Also $I_m R_m = I_s R_s$
$R_s = I_m R_m / I_s$

Subtitutig value of I_s from above equtations, we get
$R_s = I_m R_m / I – I_m$

4 c) A moving coil instrument gives FSD of 15mA and has a resistance of 100Ω. Calculate the value of shunt resistance so that it can be used as 0-2.5-5 A.

Ans:

FSD = I_m = 15mA =15×10^{-3}A, R_m = 100Ω.

A) Value of shunt resistance for 2.5 A current range

$$R_{Sh} = \frac{Im\ Rm}{I-Im} = \frac{15\times10^{-3}\times100}{(2.5-15\times10^{-3})} = 0.603\Omega$$ 2 Marks

B) Value of shunt resistance for 5 A current range

$$R_{Sh} = \frac{Im\ Rm}{I-Im} = \frac{15\times10^{-3}\times100}{(5-15\times10^{-3})} = 0.3009\Omega$$ 2 Marks

4 d) Explain the measurement of medium resistance by simple V- I method.

Ans:

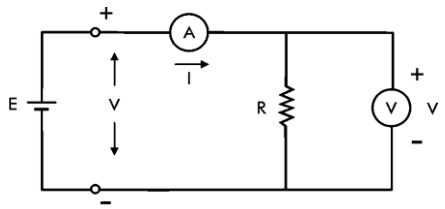
Measurement of Medium Resistance by Simple V- I Method:

In this method, use suitable source, ammeter and voltmeter and connect them as shown in the diagram.

Take reading of voltmeter and ammeter, then value of resistance = R = V/I Ω

To minimise the error take 4 to 5 observation for the same resistance and take their average.

2 Marks for explanation

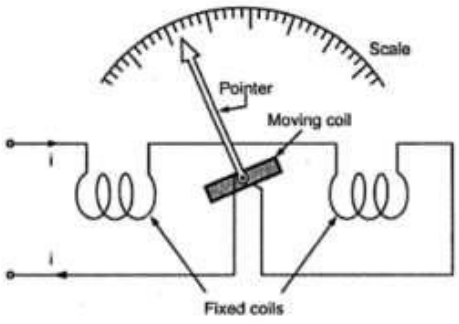


2 Marks for diagram

4 e) Explain dynamometer type instrument with neat diagram.

Ans:

Dynamometer type Instrument:



2 Marks for diagram

Construction:

It essentially consists of the fixed and moving coil. The fixed coil is split into two equal parts which are placed close together and parallel to each other. Moving coil is pivoted in between two fixed coils.The fixed and moving coils are exited / connected as shown in figure. The moving coil is attached to the moving system so that under the action of deflecting torque the pointer moves over the scale.

1 Mark for construction

Working:

When the instrument is connected in the circuit operating current flow through the

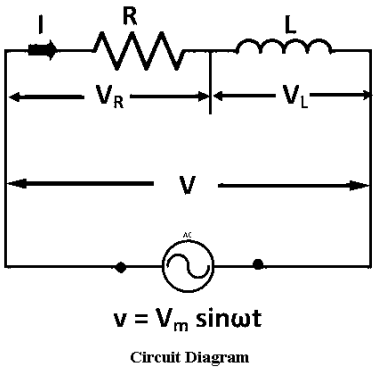
coils due to this mechanical force exists between the coils. The result is that moving coil moves the pointer over the scale to give reading. When direction of current reverses, then it reverses the direction of current of fixed as well as moving coil so that the direction of deflecting torque remains unchanged hence these instruments can be used for measurement of A.C. & D.C. power.

1 Mark for working

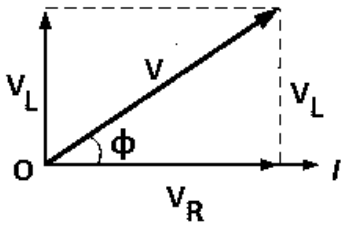
4 f) Draw circuit diagram and phasor diagram of R-L and R-C series circuit.

Ans:

Circuit And Phasor Diagram of R-L Series Circuit:



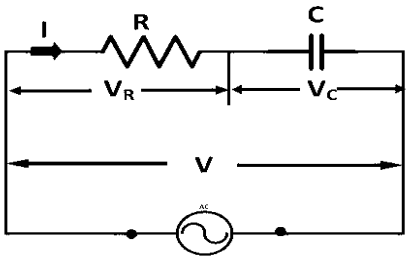
Circuit Diagram



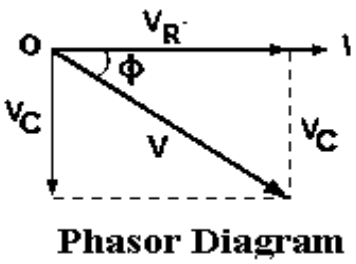
Phasor Diagram

1 Mark for circuit & 1 Mark for phasor diagram = 2 Marks

Circuit And Phasor Diagram of R-C Series Circuit:



Circuit Diagram



Phasor Diagram

1 Mark for circuit & 1 Mark for phasor diagram = 2 Marks

5 Attempt any FOUR of the following: 16

a) Draw a neat labeled diagram of megger. Explain its working.

Ans:

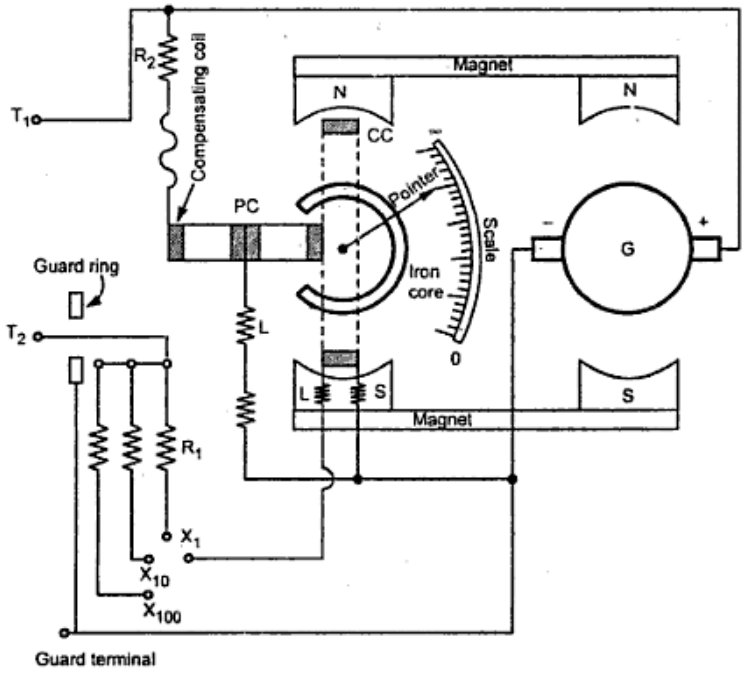
Megger:

Working:

Two coils the current coil and pressure coil are mounted at an angle on the same spindle and form the part of the moving system. These coils are connected to a small hand driven generator, with polarities such that torque produced by them will act in opposition to each other. The coils being placed in the air gap of a permanent magnet will move in it, the potential coil is connected in series with a fixed control resistance and the current coil is in series with a resistance to control the current flowing through it and the resistance under test. When the resistance under test is infinity no current flows through the current coil, the pressure coil will therefore set itself perpendicular to the magnetic axis, and the pointer indicates infinity on dial. If the resistance under test is very low, the high current will flow through the current coil, it makes the

2 Marks for working

pressure coil; to lie in the direction of axis of permanent magnet, as the effect of pressure coil will be negligible, the position of the pointer in this case is marked as zero. For value in between the pointer will indicate values in between zero and infinity. The dial is marked with values of resistances in mega ohms by calibration. When the instrument is not working the pointer may rest at any position on the dial.

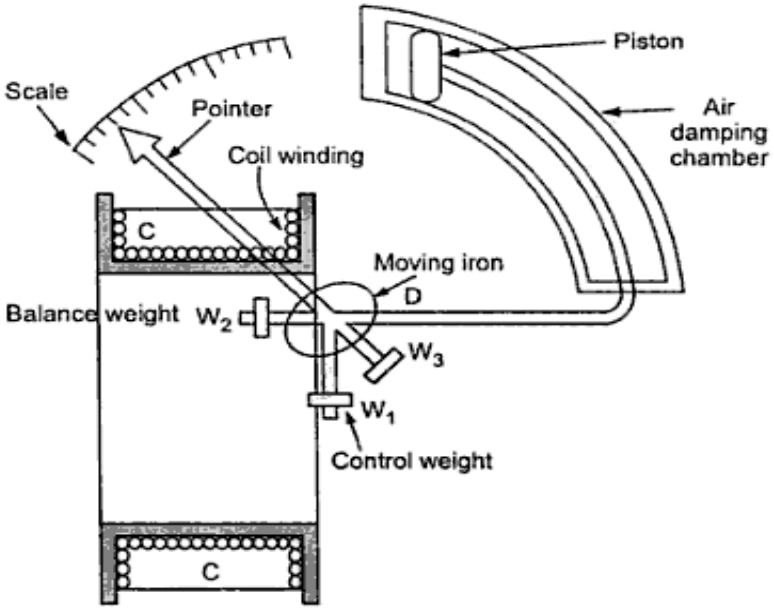


2 Marks for diagram

b) Draw neat labelled diagram of attraction type MI instrument.

Ans:

Attraction Type MI Instrument:



Labeled diagram 4 Marks

Partially labeled diagram 3 Marks

Unlabeled diagram 2 Marks

.

5 c) "Secondary of current transformer should not be open". Justify.

Ans:

Secondary of a CT should not be Open Circuited:

If secondary of CT is open circuited ,then current through secondary becomes zero hence the ampere-turns produced by secondary which generally opposes primary ampere-turns becomes zero. As there is no counter m.m.f., unopposed primary m.m.f (ampere-turns) produce high flux in the core. This produces excessive core losses, heating the core beyond limits. Similarly heavy e.m.f's will be induced on the primary and secondary side. This may damage the insulation of the winding. This is danger from the opeartor point of view as well. So secondary of a CT should not be open circuited. — 4 Marks

5 d) A 3-phase, 500V motor load has a power factor of 0.4. Two watt meters are connected to measure input. They show input power is 30 kW. Find out readings of each wattmeter.

Ans:

Given: $V_L = 500V$, $\cos Ø = 0.4$ & $(W_1 + W_2) = 30kW = 30000W$

As, $W_1 + W_2 = \sqrt{3}\, V_L\, I_L \cos Ø$

$30000 = \sqrt{3} \times 500 \times I_L \times 0.4$

$I_L = \frac{30000}{\sqrt{3} \times 500 \times 0.4} = 86.602$ A — 1 Mark

$W_1 = V_L\, I_L \cos(30° + Ø)$ — 1 Mark

Now, $\cos Ø = 0.4$, $Ø = 66.42°$

$\therefore W_1 = 500 \times 86.602 \times \cos(30° + 66.42°)$

$W_1 = (- 4842$ W) — 1 Mark

$W_2 = V_L\, I_L \cos(30° - Ø)$

$\therefore W_2 = 500 \times 86.602 \times \cos(30° - 66.42°)$

$W_2 = (34842$ W) — 1 Mark

5 e) State the effect of power factor variation on reading of wattmeter in two wattmeter method for 3 Φ circuit.

Ans:

Effect of Load P.F. variation on Reading of Wattmeter in Two Wattmeter Method for Three Phase Circuit:

In two wattmeter method the readings of two wattmeters are given by equations:

$W_1 = VI \cos(30+ø)$ and $W_2 = VI \cos(30-ø)$

We will consider different cases of power factors

1. If power factor is unity i.e. p.f.=1 $(ø = 0^0)$

   $W_1 = V\, I \cos(30+0)$ and $W_2 = V\, I \cos(30-0)$

   $W_1 = V\, I \cos 30$ and also $W_2 = V\, I \cos 30$

   Thus **when load pf is unity, both the wattmeters read equal readings.**

2. If power factor is 0.5 lagging i.e. $ø = 60^0$

   $W_1 = V\, I \cos(30+60)$ and $W_2 = V\, I \cos(30-60)$

   $W_1 = V\, I \cos 90$ and $W_2 = V\, I \cos(-30)$

   $W_1 = V\, I\, (0)$ and $W_2 = V\, I \cos(-30)$

1 Mark for each of four cases with effect = 4 Marks

W_1=0 and W_2=V I cos (-30)

Thus it is observed that **when load pf is 0.5 one of the wattmeter reads zero and all the power is measured by second wattmeter.**

3. If **power factor is between 0.5 and 0**. i.e. is greater than 60^0 & less than 90^0, **one of the wattmeter gives positive reading and second wattmeter give negative reading.**

   Hence for taking reading of second wattmeter its pressure coil connections or current coil connections is to be interchanged**.**

4. If power factor is 0 i.e. ø = 90^0

   W_1=V I cos(30+90) and W_2=V I cos(30-90)

   W_1=V I cos(120) and W_2=V I cos(-60)

   W_1=0.5* V I and W_2=(-0.5)*V I

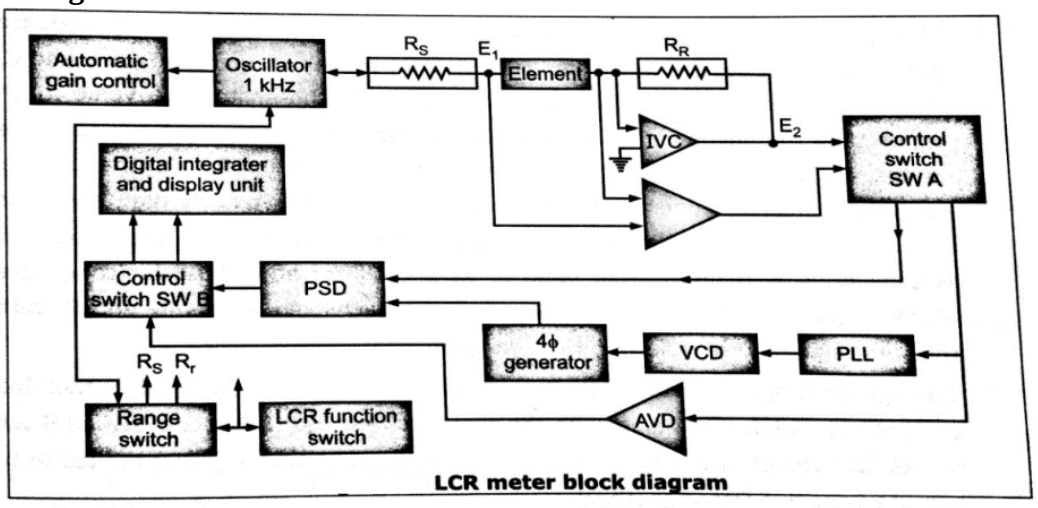
   Thus it is observed that **when load pf is zero, both the wattmeter reads equal and opposite power.**

   For leading power factors: - The readings of two wattmeters only interchange.

5 f) Write the working of L-C-R meter with neat diagram.

Ans:

Working of L-C-R meter:



2 Mark for diagram

A LCR meter i.e Inductance (L), Capacitance (C), and Resistance (R) test equipment is used to measure the inductance, capacitance and, resistance of a component. It works on the principle of impedance measurement.

In general versions of LCR meter, these quantities are not measured directly, but determined from a measurement of impedance. The necessary calculations are, incorporated in the instrument's circuitry; the meter reads L, C and R directly with no human calculation required. It will determine the relative change in magnitude of the repetitive variations of the voltage and current known as amplitudes.

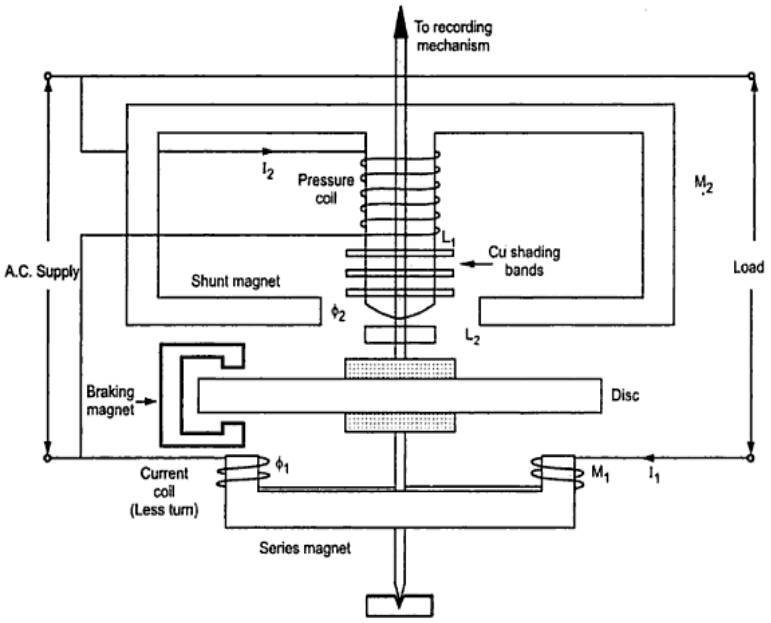
2 Marks for working

6 Attempt any FOUR of the following: 16

6 a) Draw neat labelled diagram of single phase induction type energy meter.

Ans:

Single Phase Induction type Energy Meter:



Labeled diagram 4 Marks

Partially labeled diagram 3 Marks

Unlabeled diagram 2 Marks

6 b) Differentiate between analog and digital multimeter.

Ans:

Difference Between Analog and Digital Multimeter:

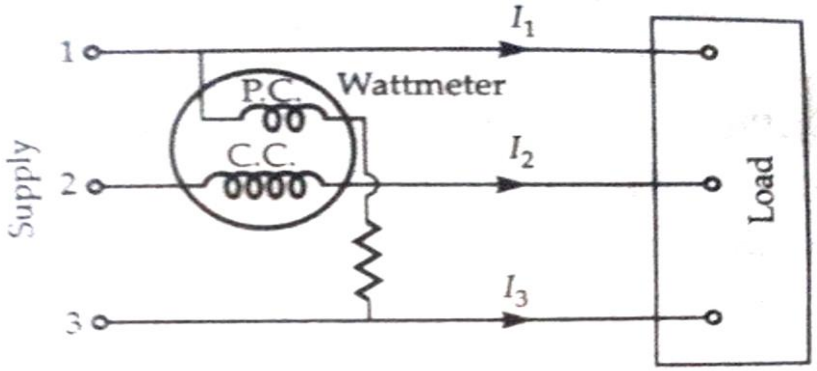
Analog multimeter	Digital multimeter
1. Power supply is not required	1. Power supply is required
2. Less suffered from electric noise	2. Suffered from electric noise.
3. It provides measurement in analog form with metal pointer.	3. It provides measurement in digital form using digits as per resolution needed.
4. It uses simple display with markings for various ranges as per R, V and I measurements.	4. It uses LCD display.
5. It does not require ADC converter i.e. analog to digital converter	5. It requires ADC converter and quantity to be displayed is in digital form.
6. Accuracy of measurement is lower	6. Accuracy of measurement is higher
7. Input resistance vary as per range to be measured.	7. Input resistance is constant for all ranges.
8. Simple & rugged in construction	8. Complicated & delicate in construction
9. Bigger in size	9. Compact in size
10. Economical	10.Expensive

1 mark for each of any four differences = 4 marks

6 c) Draw neat labeled circuit diagram and phasor diagram of one wattmeter method of reactive power measurement in 3-phase balanced load.

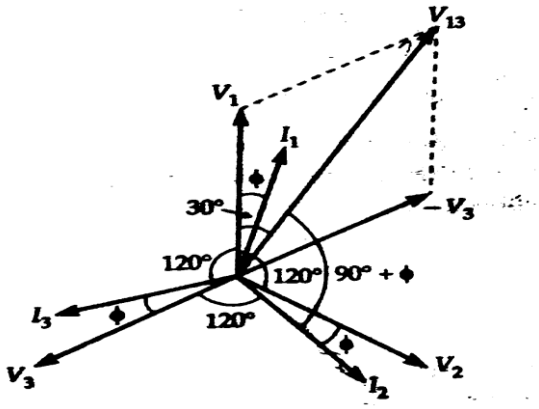
Ans:

Circuit Diagram of One Wattmeter Method of Reactive Power Measurement in 3-Phase Balanced Load:



2 Marks for Circuit diagram

Phasor diagram:

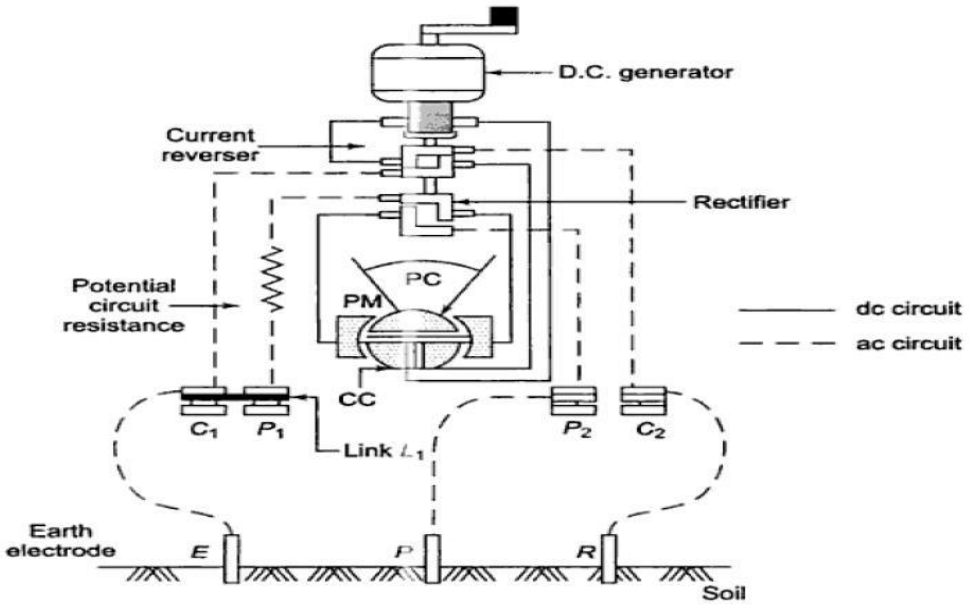


2 Marks for phasor diagram

6 d) Explain Working of earth tester.

Ans:

Working of Earth tester:



2 Marks for diagram

It is connected to earth electrode E, whose resistance is to be measured, and the other spike P and R, as shown in the figure.

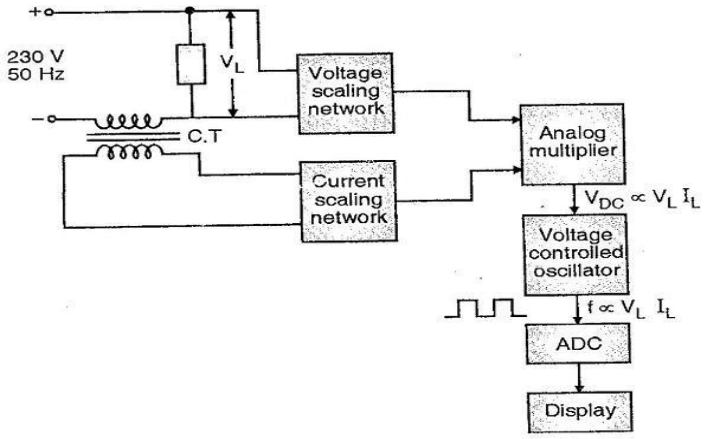
When handle is rotated the D.C. flows from the generator through the current coil of the movement to the current reverser, and alternating current from the reverser through the soil between the electrode E and R . This voltage drop between electrode P and E is rectified by the rectifier and fed to the potential coil of the meter. As the indication of the meter depends upon the ratio of the potential across its potential coil, and current passing through its current coil, the deflection of the pointer will indicate directly resistance in ohm of the earth electrode under test.

2 Marks for working

6 e) Explain electronic type energy meter.

Ans:

Electronic Type Energy Meter:



2 Marks for diagram

1. CT reduces current to reasonable value for current scaling network.
2. Voltage & current scaling networks reduce proportionally the voltage & current to values suitable for the analog multiplier.
3. Analog multiplier gives a dc voltage proportional to the product of the voltage and current drawn from supply that is the power drawn.
4. The voltage controlled oscillator gives a frequency proportional to its input (which is proportional to the power).
5. The ADC converts the square wave frequency analog output to display the energy in Watt-hour.

2 Marks for explanation

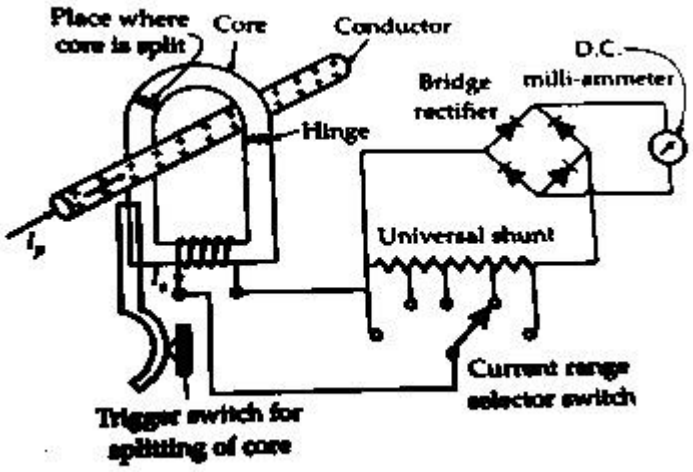
6 f) Explain working of clip on ammeter.

Ans:

Working of Clip on Ammeter:

Clip on ammeters are used to measure the high current flowing through bus bar, cable or fuse holders, which act as primary. It consists of split core current transformer whose secondary winding is connected to rectifier type moving coil instrument. The primary becomes conductor, whose current is to be measured. The split core gets aligned by the force of a spring tension. The core is covered with insulating material. Hence higher current through conductors can be measured by transformer action. A selector switch is provided to select secondary number of turns, which ultimately changes the current range. For measuring current, the core is opened by pressing trigger as shown and then clipped over the current carrying conductor. The dial will record the current directly.

2 Marks for description



2 Marks for diagram