



**Model Answers**  
**Winter – 2018 Examinations**  
**Subject & Code: Electrical & Electronics 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 should assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given 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 should give credit for any equivalent figure/figures drawn.
- 5) Credits to 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 (as long as the assumptions are not incorrect).
- 6) In case of some questions credit may be given by judgment 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.



**Model Answers**

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- 1 a) Attempt any FIVE: 20**
- 1 a) Define measurement and state the significance of electrical measurement system.
- Ans:**  
**Measurement:** Measurement is essentially a process in which magnitude of a quantity is determined in comparison with another similar quantity with significant units. **OR**  
The measurement of a given parameter or quantity is the act or result of a quantitative comparison between a predefined standard and an unknown quantity to be measured.
- OR Any Equivalent Definition**
- Significance of Electrical Measurement System:**
- i) The complete area of automation / automatic control is based on measurement.
  - ii) The new discoveries / inventions require sophisticated measurement techniques.
  - iii) The measurement is required to monitor a process / operation.
  - iv) It is required to measure all physical / electrical / mechanical quantities.
  - v) The measurement is required in Research and development (R & D) department.
  - vi) The measurement is widely required in various industries for quality production.
  - vii) The measurement is widely required in various educational institutes for training purpose.
  - viii) The measurement is required for trading and dealing purposes.
  - ix) The measurement is required to set particular standards and tolerances.
  - x) The measurement conforms the validity of hypothesis and also adds to its understanding.
- OR Any other valid points**
- 1 b) List three advantages & one disadvantage of PMMC instrument.
- Ans:**  
**Advantages of PMMC type instrument:**
- 1. Scale is uniform
  - 2. Power consumption is very low.
  - 3. Can be used as ammeter or voltmeter of different ranges with the help of shunt and multiplier.
  - 4. More sensitive as compared with MI type
  - 5. The torque to weight ratio is high which gives a high accuracy.
  - 6. Most accurate instrument for measurement of DC quantities.
  - 7. Effective eddy current damping.
  - 8. Errors due to stray magnetic fields are small, due to strong operating magnetic field.
- Disadvantages of PMMC instrument:**
- 1. Costly
  - 2. Used for measurement of DC only & not AC.
  - 3. Thermoelectric e.m.f. may cause errors when it is used with shunts.
  - 4. The strength of permanent magnet reduces with aging.



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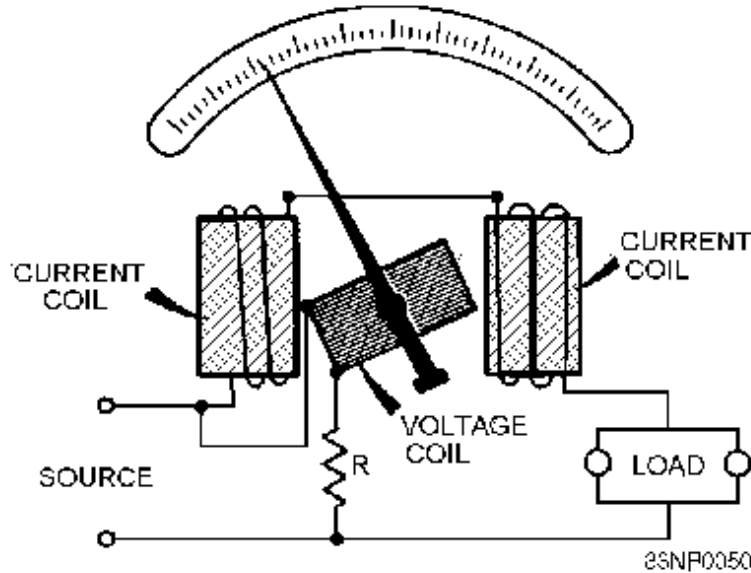
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- 1c) Draw the labeled diagram of dynamometer type wattmeter showing its construction.

**Ans:**

**Dynamometer type Wattmeter:**



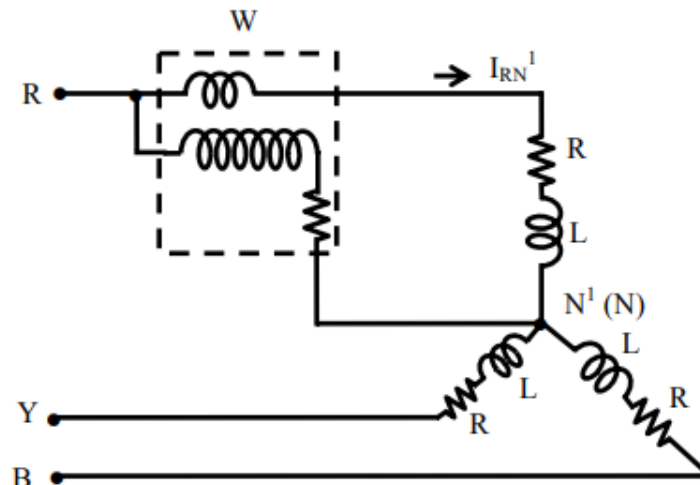
4 marks for labeled diagram  
3 marks for partially-labeled diagram  
2 marks for unlabeled diagram

**OR Any Equivalent Diagram**

- 1d) Draw the connection diagram of one wattmeter method to measure active power in three phase circuit. State one limitation of this method.

**Ans:**

**Connection Diagram of One Wattmeter Method to Measure Active Power in Three Phase Circuit:**



3 marks

**OR Equivalent Diagram**

**Limitations:**

- 1) Used only for 3- $\Phi$  balanced load and not for unbalanced loads.
- 2) Star point must be accessible for connecting the pressure coil.
- 3) Delta connection must be opened to connect current coil.

Any one limitation  
1 mark

- 1e) List four main parts of operating mechanism of induction type energy meter.



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**Ans:**

**Main Parts of Operating Mechanism of Induction type Energy Meter:**

- 1) Aluminum Disc
- 2) Braking magnet
- 3) Series magnet
- 4) Shunt magnet
- 5) Current coil
- 6) Pressure coil
- 7) Recorder
- 8) Copper shading bands

1 mark for  
each of any  
four parts  
= 4 marks

1 f) Classify the resistances from the point of view of measurements.

**Ans:**

**Classification of Resistances From the Point of View of Measurements:**

- 1) Low resistance: All the resistances of the order of  $1\Omega$  or less are classified as low resistances.
- 2) Medium resistance: The resistances from  $1\Omega$  onwards up to  $0.1\text{ M}\Omega$  are classified as Medium resistances.
- 3) High resistance: The resistances of the order of  $0.1\text{ M}\Omega$  and higher are classified as high resistances.

4 marks

1 g) What is CRO? List three uses of it.

**Ans:**

**Cathode Ray Oscilloscope(CRO):**

The cathode ray oscilloscope (CRO) is a type of electrical instrument which displays, measures and even can analyze the waveforms of electrical/ electronic signals and others electronic and electrical phenomenon. It is a very fast X-Y plotter, which shows the input signal versus another signal or time.

1 mark

**Uses of CRO:**

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

1 mark for  
each of any  
three uses  
= 3 marks

2 **Attempt any FOUR :**

**16**

2a) Compare PMMC & MI instruments on the basis of:



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- |                 |                        |
|-----------------|------------------------|
| (i) suitability | (ii) power consumption |
| (iii) scale     | (iv) cost              |

**Ans:**

**Comparison Between PMMC & MI Instrument:**

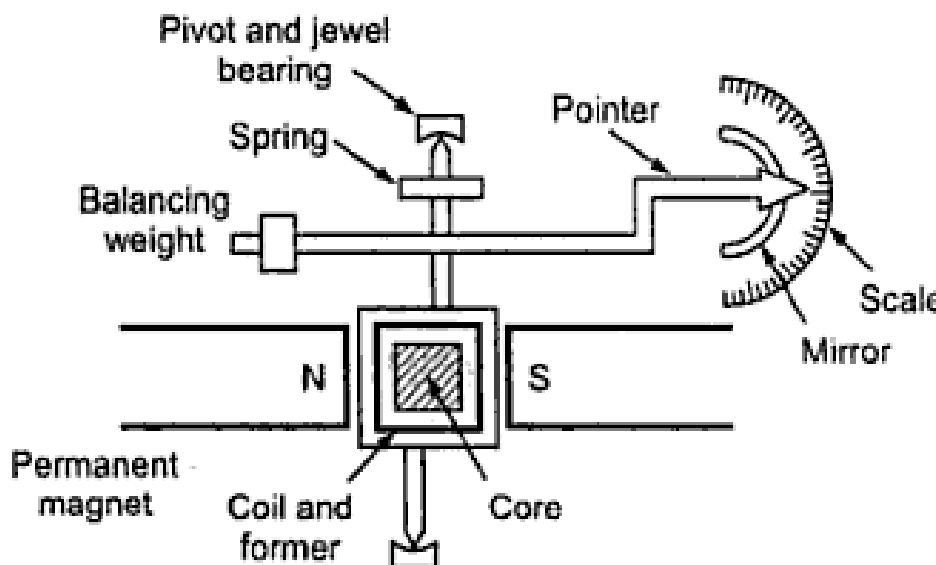
Basis	PMMC instruments	MI instruments
Suitability	PMMC instruments are used only for DC measurements	Used for DC as well as AC measurements
Power consumption	Less	More
Scale	Uniform	Non-uniform
Cost	Higher cost for same range	Lower cost for same range

1 mark for each point = 4 marks

2b) Draw the labeled diagram of PMMC instrument.

**Ans:**

**PMMC Instrument:**



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

**OR Equivalent figure**

2c) List four electrical effects used in measuring instruments.

**Ans:**

**Electrical Effects Used in Measuring Instruments:**

1. Magnetic Effect
2. Electromagnetic induction effect:
3. Heating effect
4. Electrostatic effect
5. Hall effect
6. Electrochemical effect

1 mark for each of any four effects = 4 marks



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2d) List three torques used in analog instruments. Also state the function of any one torque.

**Ans:**

**List of Torques used in Analog Instruments:**

1. Deflecting torque
2. Controlling / restraining torque.
3. Damping torque.

3 marks

**Function:**

**1. Deflecting torque:**

- 1) To create deflection proportional to the quantity to be measured.

**2. Controlling / Restraining 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  
function of  
any one  
= 1 mark

**3. Damping Torque:**

- 1) To stop pointer / spindle at the final deflected position.
- 2) Bring the pointer to stand still quickly.
- 3) To minimize oscillations about final position.

2e) Define:

- |                  |                      |
|------------------|----------------------|
| (i) accuracy     | (ii) precision       |
| (iv) sensitivity | (iv) reproducibility |

**Ans:**

**i) Accuracy:** It is the closeness with which an instrument reading approaches the true value of the quantity being measured.

**ii) Precision:** It is the measure of consistency or repeatability of the measurements; it is also known as degree of exactness.

**iii) Sensitivity:** It is the ratio of output response to specified change in the input.

**iv) Reproducibility-** It is the degree of closeness with which a given value may be repeatedly measured.

1 mark for  
each definition  
= 4 marks

2f) List four advantages of electronic instruments over other instruments.

**Ans:**

**Advantages of Electronic Instruments Over Other Instruments:**

- 1) Easy to read.
- 2) High accuracy, resolution and precision.
- 3) No frictional losses as there are no moving parts.
- 4) No external adjustments.
- 5) Large frequency range due to absence of moving parts.
- 6) Compact and portable.
- 7) They are more efficient.
- 8) Many measurements can be carried either simultaneously or in rapid succession.
- 9) Electronic instruments can detect and amplify very weak signals and can measure the events of very short duration.
- 10) Higher degree of reliability.

Any four  
advantages  
= 4 marks

3 **Attempt any FOUR :**

**16**

3a) Draw the connection diagram of voltmeter and ammeter to measure voltage and



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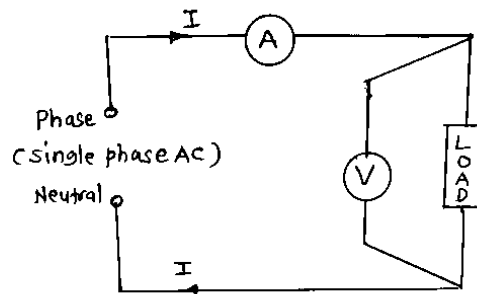
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current in single phase ac circuit.

Ans:

**The Connection Diagram of Voltmeter and Ammeter to Measure Voltage and Current in Single Phase AC Circuit:**



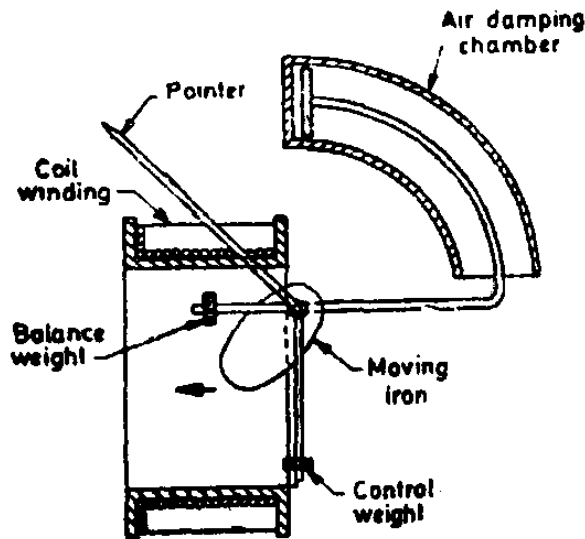
4 marks

OR Any Equivalent Diagram

3b) Draw the labeled diagram of MI attraction type instrument.

Ans:

**MI Attraction Type Instrument:**



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

*Attraction type MI Instrument*

3c) PMMC instrument is not suitable to measure AC. Why?

Ans:

**PMMC Instrument is Not Suitable to Measure AC:**

PMMC type instrument uses two permanent magnets in order to create stationary magnetic field. These types of instruments are used only for measurement of the DC quantities. If we use this instrument on AC, whenever the direction of current is reversed during negative half cycle, the direction of torque will also be reversed. This results in average value of torque as zero. The pointer will not deflect due to high frequency from its mean position showing zero reading. However it can measure the direct current very accurately.

4 marks

3d) State the reason for:



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- i) PMMC instrument has linear scale.
- ii) MI instrument has non-linear scale.

**Ans:**

**i) PMMC Instrument has Linear Scale:**

As the angular deflection of PMMC instrument is proportional to operating current, the PMMC instrument scale is linear / uniform. 2 marks

**ii) MI instrument has non-linear scale:**

The deflection of needle of moving iron instrument is given in terms of rms value of voltage or current. As the angular deflection of Moving Iron Instrument is proportional to square of operating current, the instrument has basically square law response. Due to this square law response, the Moving Iron instrument scale is non-linear / non-uniform. 2 marks

3e) A PMMC instrument gives full scale deflection of 5mA when a voltage of 50mV is applied across it. Calculate:

- (i) Value of  $R_{sh}$  for full scale deflection of 50 A.
- (ii) Value of  $R_s$  for full scale deflection of 500 V.

**Ans:**

**Given:**

Full scale deflection current  $I_m = 5 \text{ mA} = 5 \times 10^{-3} \text{ A}$

Required full scale deflection current  $I = 50 \text{ A}$ .

Full scale deflection Voltage  $V_m = 50 \text{ mV} = 50 \times 10^{-3} \text{ V}$

Required full scale deflection Voltage  $V = 500 \text{ V}$ .

**Shunt resistance  $R_{sh}$  :**

$$R_m = V_m / I_m = 50 \times 10^{-3} / 5 \times 10^{-3} \\ = 10 \Omega$$

$$\text{Now, } R_{sh} = I_m \cdot R_m / (I - I_m) \\ = 5 \times 10^{-3} \times 10 / (50 - 5 \times 10^{-3}) \\ = 0.05 / 49.995 \\ = \mathbf{0.001 \Omega} \quad \text{2 marks}$$

**Series Resistance  $R_{se}$ :**

$$R_{se} = (V / I_m) - R_m \\ = (500 / 5 \times 10^{-3}) - 10 \\ = 100000 - 10 \\ = \mathbf{99990 \Omega} \quad \text{2 marks}$$

f) A 1 mA PMMC meter with internal resistance of 100  $\Omega$  is to be converted into 100mA ammeter. Calculate value of shunt resistance required.

**Ans:**

**Given:**

Full scale deflection current  $I_m = 1 \text{ mA} = 1 \times 10^{-3} \text{ A}$

Required full scale deflection current  $I = 100 \text{ mA}$ .

Internal resistance of meter  $R_m = 100 \Omega$

**Shunt resistance  $R_{sh}$  :**

$$\text{Now, } R_{sh} = I_m \cdot R_m / (I - I_m) \quad \text{2 marks} \\ = 1 \times 10^{-3} \times 100 / (100 \times 10^{-3} - 1 \times 10^{-3}) \\ = 0.1 / 99 \times 10^{-3} \\ = \mathbf{1.01 \Omega} \quad \text{2 marks}$$





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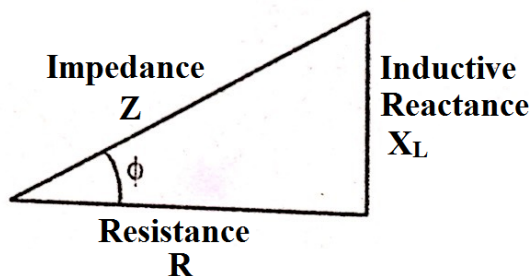
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- 4 a) Draw the impedance triangle for  
i) R-L circuit                      ii) R-C circuit

Ans:

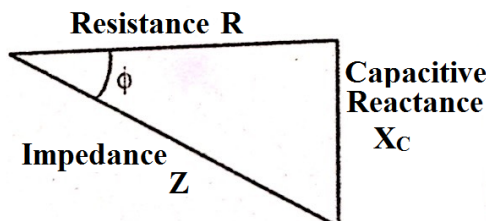
**Impedance Triangle for R-L Circuit :**



2 marks

Impedance triangle for R-L series circuit

**Impedance Triangle for R-C Circuit :**



2 marks

Impedance triangle for R-C series circuit

- 4 b) Explain the meaning of multiplying factor of wattmeter. Why it is required?

Ans:

Multiplying Factor is used for calculating the final value of wattmeter reading.

Its value is calculated by

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

OR

Multiplying factor for a wattmeter is that parameter by virtue of which one can use small scaled wattmeter to get the power readings up to multiplication factor times (multiplied) the smallest scale possible for the given wattmeter. It allows to measure power up to 4–6 times the power a wattmeter can measure for the smallest scale.

2 marks

**Requirement of Multiplying Factor:**

Wattmeter is constructed such that it can read power only on a single scale. The wattmeter consists of two coils: current coil and pressure coil. The ampere rating of current coil is decided by the series (low current) and parallel (high current) connections and the voltage rating of pressure coil is decided by the series resistance (multiplier) connected in series with the pressure coil. By selecting the rating of these two coils the range extension can be done and same wattmeter can be used for one or two more range of power. For each range, its multiplying factor is different.

2 marks

- 4 c) Define active, reactive and apparent power stating their equations with units.

Ans:

(i) **Active Power:**

Active power (P) is the product of voltage, current and the cosine of the



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phase angle between voltage and current.

Unit: watt (W) or kilo-watt (kW) or Mega-watt (MW)

$$P = VI\cos\phi \text{ or } P = I^2R$$

**(ii) Reactive Power:**

Reactive power (Q) is the product of voltage, current and the sine of the phase angle between voltage and current.

4 marks

Unit: volt-ampere-reactive (VAR), or kilo-volt-ampere-reactive (kVAR) or Mega-volt-ampere-reactive (MVAR)

$$Q = VI\sin\phi \text{ or } Q = I^2X$$

**(iii) Apparent Power (S):**

This is the product of RMS voltage and RMS current.

Unit: volt-ampere (VA) or kilo-volt-ampere (kVA)

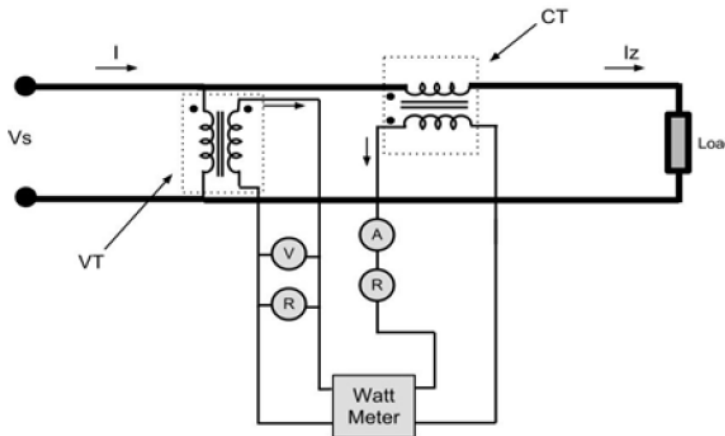
or Mega-vol-ampere (MVA)

$$S = VI \text{ or } S = I^2Z$$

4 d) Explain how the range of wattmeter can be extended.

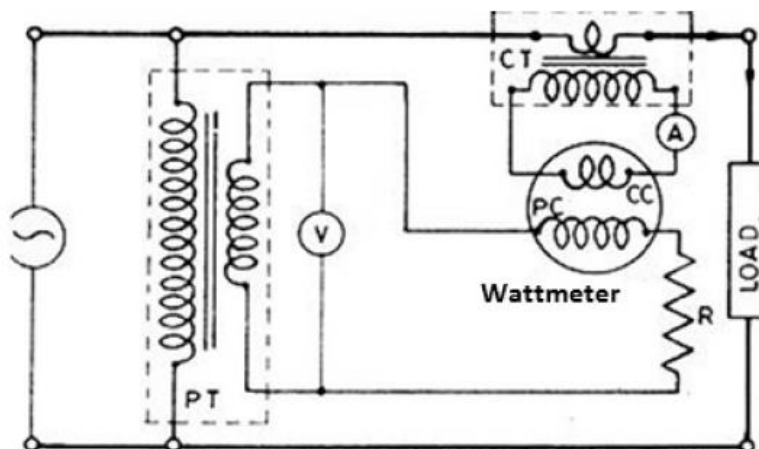
**Ans:**

**Extension of Wattmeter range:**



2 marks for diagram

**OR**



**Explanation:** The range of wattmeter can be extended to measure power of A.C. circuit having high voltage and large current, by using potential transformer (P.T.) and current transformer (C.T.), which reduces the voltage applied across the wattmeter and current flowing through the instrument.

2 marks for explanation



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In such case,

The actual power = Wattmeter reading x P.T.ratio x C.T. ratio

**OR Equivalent Answer**

- 4 e) Explain the effect of power factor on wattmeter reading in two wattmeter method for (i) unity p.f. (ii) zero p.f.

**Ans:**

**Effect of P.F. on Reading of Wattmeter in Two Wattmeter Method:**

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

$$W_1 = V I \cos(30^\circ + \phi) \quad \text{and} \quad W_2 = V I \cos(30^\circ - \phi) \quad \text{1 mark}$$

We will consider following cases of power factors

**1. If power factor is unity i.e. p.f.=1 ( $\phi=0^\circ$ )**

$$W_1 = V I \cos(30^\circ + 0) \quad \text{and} \quad W_2 = V I \cos(30^\circ - 0) \quad \text{1.5 marks}$$

$$W_1 = V I \cos 30^\circ \quad \text{and also} \quad W_2 = V I \cos 30^\circ$$

Thus both the wattmeter reads equal readings and each wattmeter reads half of the total power

**2. If power factor is 0 i.e.  $\phi = 90^\circ$**

$$W_1 = V I \cos(30^\circ + 90) \quad \text{and} \quad W_2 = V I \cos(30^\circ - 90) \quad \text{1.5 marks}$$

$$W_1 = V I \cos 120^\circ \quad \text{and} \quad W_2 = V I \cos(-60^\circ)$$

$$W_1 = 0.5 * V I \quad \text{and} \quad W_2 = V I * (-0.5)$$

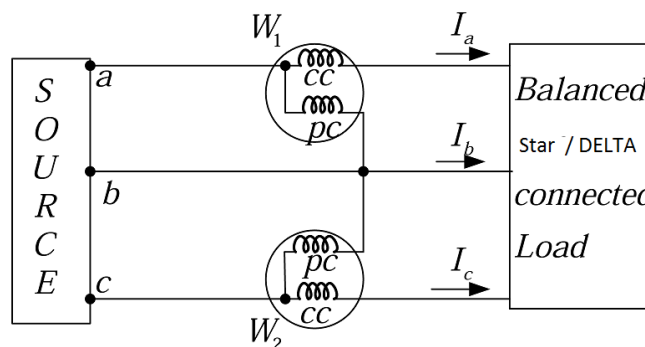
Thus both the wattmeter reads equal and opposite power.

- 4 f) In case of active power measurement in 3-phase ckt by two wattmeter method:

- (i) Draw the connection diagram
- (ii) State the formula for active and reactive power
- (iii) List two advantages
- (iv) If one wattmeter reads 2000 W and other reads 1500 watt, calculate power factor of load.

**Ans:**

**(i) Connection Diagram of Active Power Measurement in 3-phase ckt by Two Wattmeter Method:**



1 mark

**OR Equivalent Diagram**

**(ii) Formula for Active and Reactive power:**

$$\text{Total active power } P = (W_1 + W_2) = \sqrt{3} V_L I_L \cos \phi$$

$$\text{Total reactive power } Q = \sqrt{3}(W_1 - W_2) = \sqrt{3} V_L I_L \sin \phi$$

1 mark

**(iii) Advantages:**

1. This method can be used for balanced as well as unbalanced loads.
2. Connections of watt meters are independent of load connection.
3. For balanced loads PF can also be determined.

1 mark for



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4. Only two watt meters are required for power measurement which reduces cost.

any two advantages

5. Reactive power can also be measured for balanced loads.

(iv) Assuming  $W_1 = 2000 \text{ W}$  and  $W_2 = 1500 \text{ W}$

$$\text{Power factor of Load} = \cos \phi = \cos \left[ \tan^{-1} \frac{\sqrt{3}(W_1 - W_2)}{(W_1 + W_2)} \right]$$

$$\cos \left[ \tan^{-1} \frac{\sqrt{3}(2000 - 1500)}{(2000 + 1500)} \right] = \cos 13.895^\circ = 0.97$$

1 mark

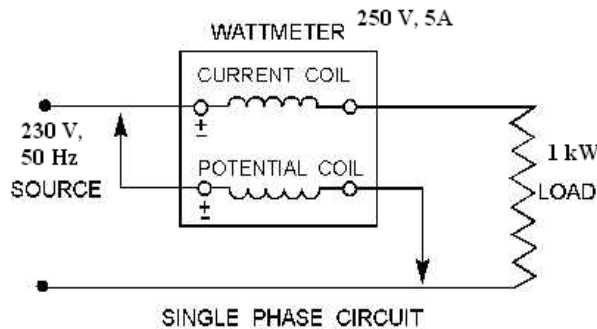
5 **Attempt any FOUR :**

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5a) i) Draw the connection diagram of dynamometer type wattmeter showing measurement of power in single phase AC circuit.

**Ans:**

**Connection Diagram of Dynamometer Type Wattmeter for Measurement of Power:**



2 marks for labeled diagram

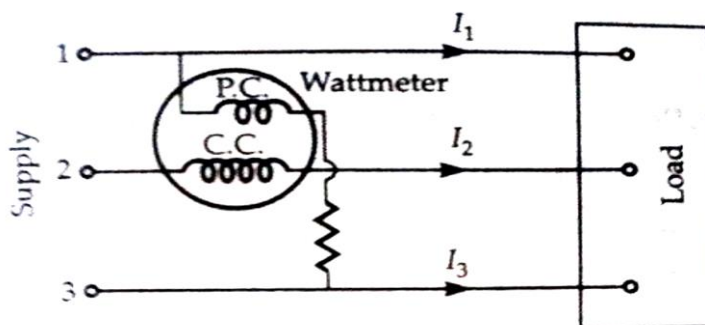
1 mark for partially labeled diagram

**OR Equivalent Diagram**

5a) ii) Draw the connection diagram of measurement of reactive power in 3 phase circuit by one wattmeter method.

**Ans:**

**Connection Diagram of Measurement of Reactive Power in 3 Phase Circuit by One Wattmeter Method:**



2 marks for labeled diagram

1 mark for partially labeled diagram

5b) i) Define electrical energy and state its unit.

**Ans:**

**Electrical energy :**

Electrical energy is defined as the work done in moving electrical charge in electrical fields over specific time duration.

**OR**

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

1 mark



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**Unit of electrical energy:**

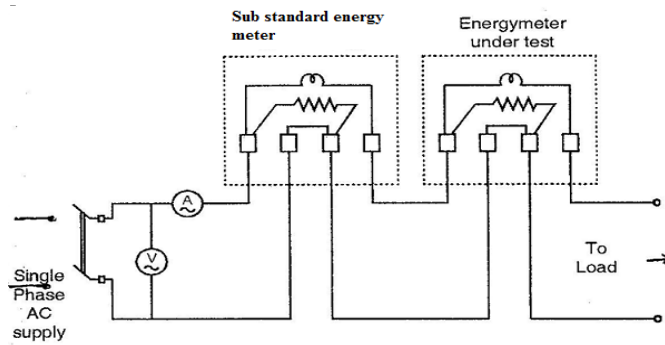
The basic unit of the electrical energy is the joule (or watt-second) **OR** The commercial or practical unit of electrical energy is the kilowatt-hour (kWh).

1 mark

5b ii) Draw the circuit diagram to calibrate single phase energy meter by direct loading.

**Ans:**

**Circuit Diagram to Calibrate Single Phase Energy meter by Direct Loading:**



Calibration of energymeter

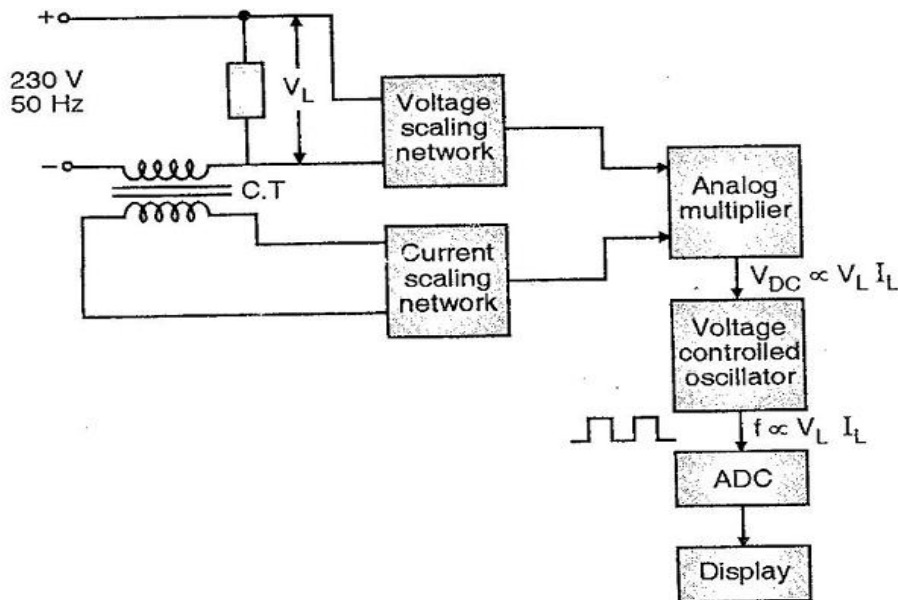
2 marks for labeled diagram

1 mark for partially labeled diagram

5c) i) Draw the block diagram of digital energy meter.

**Ans:**

**Block Diagram of Digital Energy Meter:**



2 marks for labeled diagram

1 mark for partially labeled diagram

5c) ii) List two advantages of digital energy meter over induction type energy meter.

**Ans:**

**Advantages of Digital Energy Meter Over Induction Type Energy Meter:**

- 1) Easy to read.
- 2) High accuracy.
- 3) High resolution.
- 4) No frictional losses because there are no moving parts.
- 5) No external adjustments.

2 marks for any two advantages



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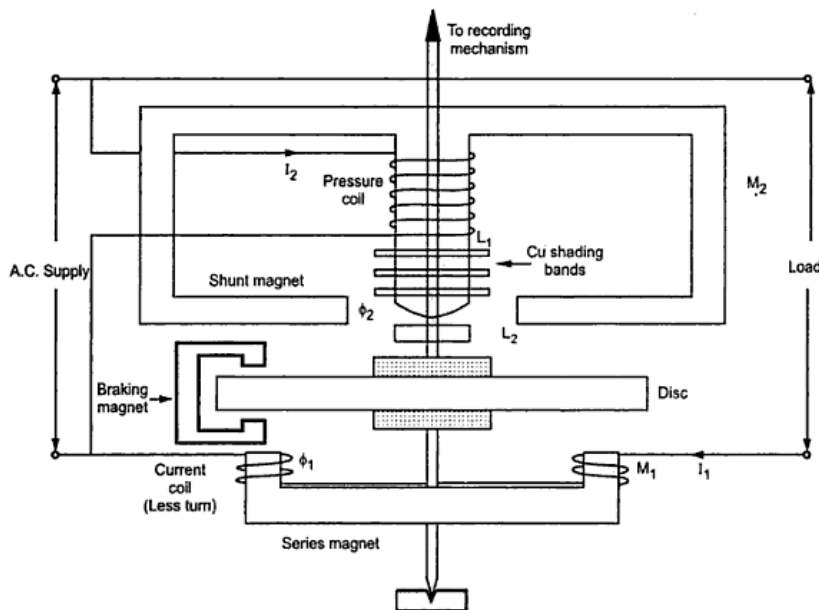
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- 6) Large frequency range due to absence of moving parts.
- 7) Eliminating manual meter reading errors.
- 8) Monitoring the electric system more quickly.
- 9) Offering more detailed feedback on energy use.
- 10) Highly efficient.

5d) i) Draw the labelled connection diagram of 1-phase induction type energy meter.

**Ans:**

**Diagram of 1-Phase Induction Type Energy Meter:**



2 marks for labeled diagram

1 mark for partially labeled diagram

5d) ii) What is creeping in energy meter? State any remedy by which it can be avoided.

**Ans:**

**Creeping in Energy Meter:**

It is defined as the slow and continuous rotation of the disc of the energy-meter when only pressure coil is energized with no current in the current coil (load current = 0).

1 mark

**Remedies of Avoiding Creeping in Energy Meter:**

In order to prevent the creeping on no load, two holes are drilled in the disc on diametrically opposite sides of the spindle. This causes sufficient distortion of the field to prevent rotation of the disc when one of the holes comes under the pole of shunt magnet.

**OR**

In other case, small piece of iron wire is attached to the edge of the disc. The force of attraction is exerted by the brake magnet on this iron wire is sufficient to prevent continuous rotation of the disc on no load condition.

1 mark

5e) Explain with diagram simple V-I method to measure medium resistance.

**Ans:**

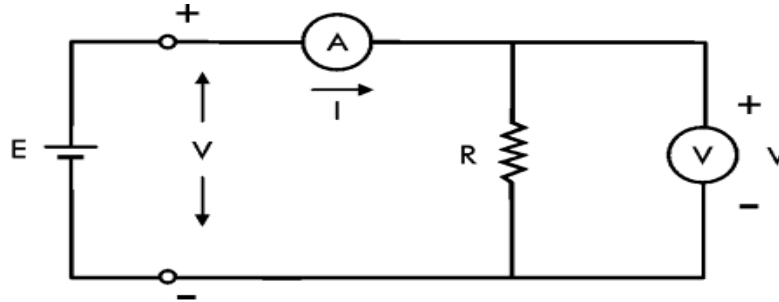
**V-I Method to Measure Medium Resistance:**

2 marks

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for diagram

2 marks for explanation

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

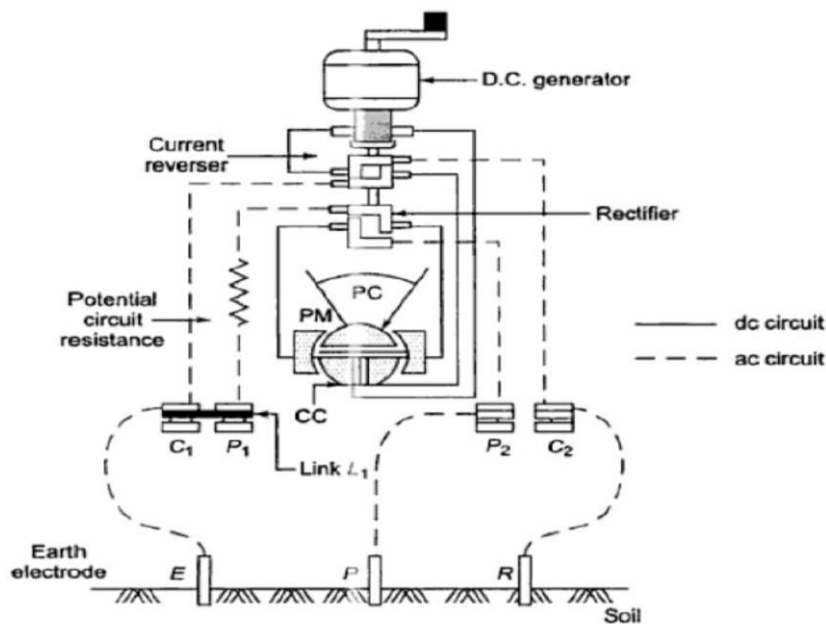
Take reading of voltmeter and ammeter, then value of resistance =  $R = V/I \Omega$

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

5f) Draw connection diagram of earth tester to show its construction.

**Ans:**

**Connection Diagram of Earth Tester:**



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

**OR Equivalent Diagram**

6 **Attempt any FOUR :**

**16**

6a) Explain how megger can be used for measurement of high resistances.

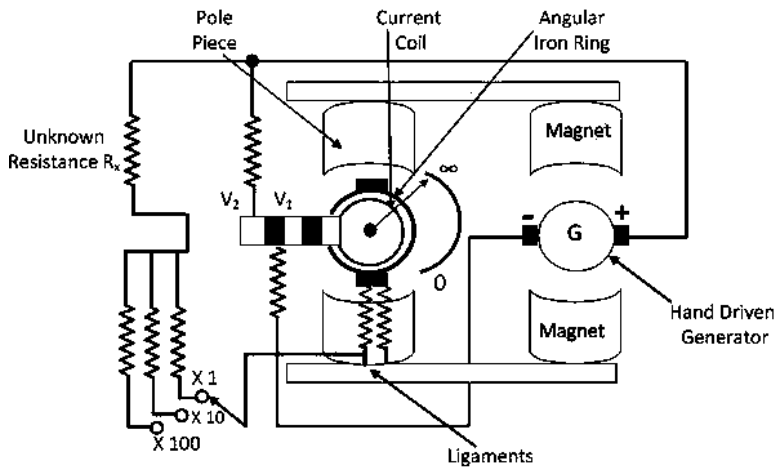
**Ans:**

**Measurement of High Resistances with Megger:**

**Model Answers**

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2 marks  
for diagram

The constant voltage is used for testing the insulation / high resistance with the help of hand driven generator.

The Megger has three coils two pressure coils and one current coil. The pressure coil rotates the moving coil in the anticlockwise direction, whereas the current coil rotates it in the clockwise direction.

2 marks for  
explanation

When the unknown resistance is connected in the circuit, the pointer of the moving coil becomes stable. The pressure coil and the current coil balance the pointer and set it in the middle of the scale.

The deflection of the pointer is directly proportional to the voltage applied to the external circuit. When the testing circuit is applied across the Megger, and if there is no shorting throughout the insulation then the pointer deflects towards the infinity or high value of resistance which shows that the resistance has high insulation.

**OR Equivalent Diagram and Explanation**

- 6b) Compare analog multimeter v/s digital multimeter on
- |              |                        |
|--------------|------------------------|
| (i) accuracy | (ii) power requirement |
| (iii) cost   | (iv) portability       |

**Ans:**

**Comparison Between Analog Multimeter with Digital Multimeter:**

Parameter	Analog Multimeter	Digital Multimeter
Accuracy	Accuracy of measurement is low	Accuracy of measurement is high
Power requirement	Power is not required	Power is required
Cost	Cost is less	Cost is more
Portability	Size is large compared to digital multimeter	Compact in size and portable

1 mark for  
each point  
total 4 marks



Model Answers

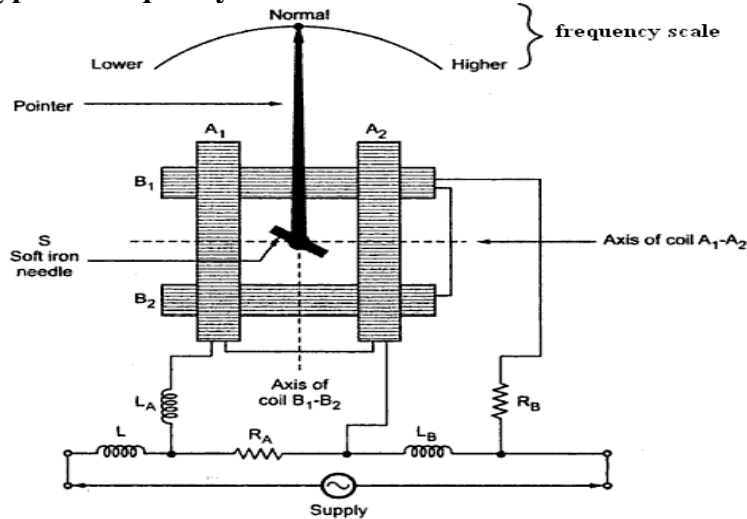
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6c) Draw a connection diagram of weston type of frequency meter.

Ans:

**Weston Type of Frequency Meter:**



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

6d) Explain with diagram working of phase sequence indicator.

Ans:

**Working of Phase Sequence Indicator:**

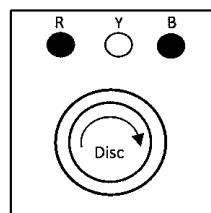
There are two types of phase sequence indicators and they are:

(a) Rotating type

(b) Static type

**(a) Rotating type of phase sequence indicator:**

It consists of three star connected coils mounted  $120^\circ$  apart in space with three ends brought out and marked R-Y-B as shown in figure. An aluminum disc is mounted on the top of coils. The coils produce rotating magnetic field, when three phase windings are energized by three phase supply. Which sweep the stationary aluminum disc and produces eddy emf induced in the disc which circulates an eddy current in aluminum disc. Hence a torque is produced and disc revolves, the direction of rotation depends upon the phase sequence of the supply. 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. However if the disc revolves in opposite direction indicated to arrow head, the sequence of the supply is opposite to that marked on the terminals.



Rotating Type Phase Sequence Indicator

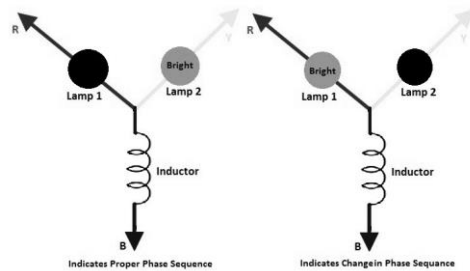
4 marks for working of any one type of phase sequence indicator with diagram

OR

**(b) Static type of phase sequence indicator:**



**Model Answers**  
**Winter – 2018 Examinations**  
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Connect two lamps, lamp1 to R-phase, lamp2 to Y-phase and inductor to B-phase as shown in the above figure. Resistors are connected in series with the lamps for protecting the lamps from over currents and breakdown voltages. If the 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.

- 6e) State the function of synchroscope. Also state the purpose of synchronizing.

**Ans:**

**Function of Synchroscope:**

The synchroscope is used to determine the exact instant of switching required to connect the alternators in parallel or put an alternator across the infinite bus.

2 marks

Its pointer gives the idea of the faster and slower machine to make adjustments of speed of alternators for synchronizing.

**Purpose of synchronizing:**

1. Supply continuity can be maintained in the event of breakdown of one alternator, others being functional.
2. Alternators are loaded such that they exhibit higher efficiency.
3. Saving in fuel.
4. Maintenance and repair becomes easy without disturbing supply continuity.
5. Small capacity of reserved units.
6. Easy future expansion.

2 marks for  
any two  
purposes

- 6f) Explain the use of function generator.

**Ans:**

**Use of Function Generator:**

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

1 mark for  
each of any  
four uses  
total 4 marks