

EE8403 - Measurements and Instrumentation -Engineering.

UNIT-I.

Functional elements of an instruments -
Static and dynamic characteristics -
Errors in measurement - Statistical evaluation
of measurement data - standards and
calibration - Principle and types of analog
and digital voltmeters, ammeters.

UNIT-II.

Principle and types of multi meters -
single and three phase watt meters
and energy meters - magnetic measurements -
Determination of B-H curve and measurements
of iron loss - Instrument transformers -
Instruments for measurement of frequency
and Phase.

UNIT-III. → Comparative methods of measurements

Dc. Potentiometers, Dc. bridges (Wheatstone bridge, Kelvin and Kelvin double bridge) and Ac bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self balancing bridges, Interference and Screening - Multiple earth loops - Electromagnetic Interference - Grounding Techniques.

UNIT-IV. → Storage and Display devices.

Magnetic disk and tape - Recorders - digital plotters and printers, CRT, digital CRO, LED, LCD and DOT matrix display - Data loggers.

UNIT-V. → Transducers and Data Acquisition system.

Classification of transducers - selection of transducers - Resistive, Capacitive and inductive Transducers - piezoelectric, Hall effect, optical and digital transducers - Elements of data acquisition system - Smart sensors - Thermal Images.

Unit-2.

2 Marks (important Questions).

1.) List any 4 characteristics of a measurement system :- (Dec. 2017)

- i) Accuracy
- ii) Precision
- iii) Sensitivity
- iv) Linearity.

2.) Define resolution :- (Dec/2017)

It is the ability of the measurement system to detect and faithfully indicate small changes in the characteristics of the measurement result.

3.) A voltmeter reads 152 volts for a particular measurement. If the true value of the measurement is 154 volt. Determine the Percentage static relative error and static correction :- (April 2018)

$$\% \text{ static error} = \left(\frac{\text{measured value} - \text{True value}}{\text{True value}} \right) \times 100$$

$$= \left(\frac{\text{measured value} - \text{True value}}{\text{True value}} \right) \times 100$$

$$= \left(\frac{152 - 154}{154} \right) \Rightarrow -1.298\%$$

4.) What is average deviation? What does it indicate on a measuring instrument? (April/2017)

Average deviation is a measure of the difference between observed value of the variable and some other value, often the variables mean. It indicates deviation in observed variable.

5.) Define the terms accuracy and precision: (May/2017) :-

Accuracy :- Degree of closeness with which an instrument reading approaches the true value of quantity being measured.

Precision :- It is the measure of consistency (or) repeatability of measurements.

6.) What is calibration? (May/2017).

Calibration is used to maintain instrument accuracy. It is the process of comparing an instrument to provide a

UNIT - II

2 - Marks

1.) Define Creeping: (Dec/2017)

It is defined as the tendency of a material after being subjected to high level of stress. eg.) temperatures, to change its form in relation to time

2.) why type of frequency meter is used over a wide range of voltage? why? (April/2018)

Western type frequency meter is used over a wide range of voltage, because it is not of deflection type.

3.) what makes the scale of MI instruments cramped at both lower and upper end? (April/2018)

Scale is almost uniform in between the lower and higher ends i.e.) scale is usable over 80% of its length.

1) State the reasons for the two types of errors in a potential transformer? (May/2019)

The voltage applied to the Primary of the potential transformer first drops due to the internal impedance of the Primary. Then it appears across the Primary winding and transformed Proportionally its turns ratio, to the Secondary winding.

2) List out various causes which occur error in a dynamometer wattmeter? (May/2019)

i) Error due to eddy currents

ii) Error due to mutual inductance

iii) Error due to connections

iv) Error due to Pressure coil.

3) How are basic instruments converted to high range ammeter? (May 2016).

In ammeter the range can be extended by connecting a shunt resistor.

The value of shunt resistor is given by,

result, of a sample within acceptable range.

7.) Name the dynamic characteristic of measurement system? (May/2016).

- i) speed of response
- ii) fidelity
- iii) lag
- iv) Dynamic error.

8.) Define static sensitivity? (Nov/2016).

It is defined as the ratio of the change in output to the corresponding change in input under static conditions.

9.) What are the sources of errors in DC voltage measurement? (Dec/2018).

Radio frequency interference

Thermal emf errors

noise caused by magnetic fields.

10.) Classify the Types of errors :-

- a) Gross errors
- b) Systematic errors
 - i) Instrumental errors
 - ii) Environmental errors
 - iii) Observational errors.
- c) Random errors

11.) Define standard ?

A standard is defined as the physical representation of a unit of measurement. The term standard is applied to a piece of equipment having known measure of physical quantity.

12.) Classify the types of standards :-

- i) International Standards
- ii) Primary Standards
- iii) Secondary Standards
- iv) Working Standards.

$$P_{sh} = \frac{R_m}{m-1}, \text{ where } m = I/I_m$$

m \rightarrow multiplying Power

R_m \rightarrow Internal resistance.

7) Write any 4 types of analog ammeters used for instrumentation. (NOV. 2016).

i) Moving coil Ammeter

ii) Moving Iron Ammeter

iii) Hot wire Ammeter

iv) Electrodynamic Ammeter.

8) Define transformation ratio of an instrument transformer.

$$\left. \begin{array}{l} \text{Transformation} \\ \text{Ratio} \end{array} \right\} = \frac{\text{Primary Current}}{\text{Secondary Current}}$$

1) What is the function of multimeter?
 A multimeter can be hand held device useful for basic fault finding and field services work (or) a bench instrument which

* Consumes more power

* Can measure to a very high degree of accuracy.

10.) What is Analog Voltmeter?

Analog Voltmeters are instruments that measure voltage (or) voltage drop in a circuit. They display values on a dial, usually with a needle (or) moving pointer.

11.) What is digital ammeter?

Digital ammeter designs use of analog to digital converter (ADC) to measure the voltage across the shunt resistor, the digital display is calibrated through the shunt to read the current.

UNIT - III - 2 Marks

1. what is Potentiometer:-

A Potentiometer is an instrument designed to measure an unknown voltage by comparing it with a known voltage.

2. Application of Potentiometer:-

* Measurement of small emfs (upto 2V.)

* Comparison of emf of 2 cells.

* Measurement of resistance

* Measurement of current.

3. what are the types of DC bridges

* Wheatstone Bridge

* Kelvin's Bridge.

* Kelvin's double bridge.

4. What is Kelvin's Bridge :-
Kelvin's bridge is not suitable for measurement of very low resistance. Kelvin's bridge is a modification of Wheatstone bridge and is used to measure values of resistance below 1Ω .

5. What is Schering Bridge ?
The Schering bridge is one of the most important AC bridge, is used for measurement of capacitors, it is also measures the insulating properties of the electrical cables and equipments.

6. What is earth loop ?
Earth loops form a distinct part of the grounding system of electrical equipment.

* The operating cost is quite less.

7.

LED	LED .
* Consumes more power	* Consumes less power.
* High Cost	* Low Cost .
* More life time	* Less life time.
* Capable of generating its own light	* Requires an

3. Mention the application of LVDT :-
LVDT are used to measure,

* Displacement

* Force

* Weight

* Pressure

* Position .

9. Define smart sensor :-

Smart sensors are sensors with integrated electronics that can perform one (or) more of the following

functions.

- i) Logic functions
- ii) Two-way communication.
- iii) Make decision.

What are the materials used for piezoelectric transducers?

Common piezoelectric materials include ammonium di-hydrogen phosphate, quartz and ceramics made with barium titanate, Potassium di-hydrogen phosphate and lithium sulphate are used in real applications.

1. Define Recorder :-

It is used to record all quantities electrical and non-electrical as a function of time.

2. What is Magnetic tape recorder :-

Magnetic tape recorder is a recorder which records analog data in

Such a manner that they can be reproduced in electrical form again.

What are the various methods of recording data?

* Direct Recording

* Frequency modulation recording.

* Pulse duration recording.

4. Basic Components of magnetic tape

recorder :-

- * Recording Head.
- * Magnetic tape
- * Reproducing Head.
- * Tape transport mechanism.
- * Conditioning devices.

5. List the main parts of cathode

ray tube :-

- * Electron gun assembly
- * Deflection plate assembly
- * Fluorescent screen
- * Glass envelop.

State the features of ink jet printers:-

- * They can print from 2 (or) 4

Pages per minute.

UNIT-3 - 2 Marks :-

1. Define - Transducer :-

A Transducer is defined as a device that receives energy from one system and transmits it to another, often in a different form.

2. Write the parameters of electrical transducers :-

- i) Linearity
- ii) Sensitivity
- iii) Dynamic range
- iv) Repeatability
- v) Physical size.

Define : Viscosity :-

Viscosity is defined as the property which determines the magnitudes of the resistance of the fluid to shearing force.

4. Write the types of potentiometer :-
The types of potentiometer are,

- i) Translatory
- ii) Rotational
- iii) Helipot.

5. In what principles, Inductive transducer works?

- i) Variation of self-inductance.
- ii) Variation of mutual inductance.

6. Write a short notes on LVDT :-

LVDT - (Linear Variable Differential Transformer) converts the mechanical energy into electrical energy. It has single primary winding and two secondary windings wound on a hollow cylindrical former.

7. List the advantages of "LVDT" :-
- * High range of displacement measurement.
 - * Friction and electrical isolation.
 - * Immunity from external effects.
 - * Ruggedness.

8. Define Inductive Transducers :-

Inductive Transducers is defined as a device that converts physical motion into a change in inductance. It may be either of "active" or "passive" type.

9. Give the principle of Capacitive Transducers :-

Where,

$$C = \frac{kA}{d}$$

k = dielectric constant
 A = Total Area of capacitor surfaces.
 d = distance between 2 capacitive surfaces.

What is meant by 'Digital Transducers' -
Digital Transducers are also called
as encoders. They are normally in the
form of linear (or) rotary displacement
transducers. Hence they require analog to
digital converter to realize the
digital data.