LESSON PLAN

SIBSAGAR POLYTECHNIC, DEMOW

SUBJECT NAME: ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS I (EMMI- I)

SUBJECT CODE: EL- 403

SEMESTER: 4th SEMESTER

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DATE: 10.04.2020

CHAPTER 2:MEASUREMENT AND INSTRUMENTATION SYSTEM 11th hour

Measurement: The measurement of a given quantity is essentially an act or the result of comparison between the quantity(whose magnitude is unknown) and a predefined standard. Hence by comparison the result is expressed in numbers. Infact measurement is the the process in which one can convert physical parameters into meaningful numbers.

There are two basic requirements-

- The standards used for comparison purposes must be accurately defined
- The apparatus used and the method adopted must be accurately provable

SIGNIFICANCE OF MEASUREMENTS

When a measurement is done it means that we can express it in numbers and thus the result can be known. However when we cannot express in terms of numbers our knowledge cannot be termed as satisfactory.

There are two functions of all branches of engineering

- Design of equipment and processes
- Proper operation and maintenance of equipment and processes

METHODS OF MEASUREMENTS

Direct methods- Here the unknown quantity also known as measurand is directly compared against a standard. The result is expressed in numerical number and units.

Indirect methods- Sometimes direct methods are not possible, feasible and practicable. They are inaccurate because they involve human factors.

- **Discussion on role of instruments in different field and why measurement is important?**
- **Elucidating of mechanical, electrical and electronic instruments**

CLASSIFICATION OF INSTRUMENTS GENERALLY.

- ✓ Absolute instruments
- ✓ Secondary instruments

12th hour

- ✓ **Absolute instruments:** These instruments give the magnitude of quantity under measurement in terms of physical constants of the instrument.

  Examples- Tangent Galvanometer and Rayleigh's Current balance

- ✓ **Secondary instruments:** These instruments are so constructed that the quantity being measured can only be measured by observing the output indicated by the by the instrument. They are calibrated by comparison with an absolute instrument or another secondary instrument which has already been calibrated against an absolute instrument.

  Examples- Glass thermometer and pressure gauge

FUNCTIONS OF INSTRUMENT

- ➢ Indicating function
- ➢ Recording function
- ➢ Controlling function

- **Indicating function:** In many cases the information about the unknown quantity is obtained as a deflection of pointer of a measuring instrument,thus performing indicating function

  Example: Speedometer indicates speed of automobile

- **Recording function:** In many cases the information about the unknown quantity is obtained as a written record usually on paper,thus performing recording function.

  Example: Recording voltmeter in a substation which keep record of variations in a substation.

- **Controlling function:** In many cases the information about the unknown quantity is used to control the original measured quantity,thus performing recording function.

  Example: Thermostats for temperature control

APPLICATION OF MESUREMENT SYSTEMS: 13th hour

- ❖ Monitoring of processes and operations
- ❖ Control of processes and operations
- ❖ Experimental Engineering analysis

MEASUREMENT SYSTEM PERFORMANCE:

- ❑ **Static characteristics:** Some applications involve the measurement of quantities that are either constant or vary slowly with time. It is a set of criteria that gives a meaningful description of quality of measurement without interfering with dynamic descriptions that involve the use of differential equations.
- ❑ **Dynamic characteristics:** Many measurements are concerned with rapidly varying quantities and dynamic relations exists between output and input which are done with the help of differential equations are said to be dynamic characteristics.

The main static characteristics are-

a) Static error
b) Accuracy
c) Reproducibility
d) Drift
e) Dead zone
f) Sensitivity

What is true value?

- It is defined as the average of an infinite number of measured values when the average deviation due to the various contributing factors tends to zero.

1**) Static error:** A static error is defined as the difference between the measured value and the true value of the quantity. The true value is the exact value of the measurement which is impossible to obtain. Hence the approximate true value of the measurement should be taken into consideration.

b) **Accuracy**: It refers to the set of measurement of a same physical quantity closed to the true value of that physical quantity. Accuracy can be expressed in the following-

1) Point accuracy
2) Accuracy as a percentage of scale range
3) Accuracy as percentage of true value

b) **Precision:** It refers to the set of measurement of a same physical quantity closed to each other. Precision is determined by the least count of the measuring instrument. The smaller is the least count, the greater is the precision.

c) **Resolution:** If the input is slowly increased from some arbitrary input value(non-zero),it will be found out that output does not change till a certain increment is exceeded. This increment is called resolution.

d) **Reproducibility:** It is defined as the degree of closeness with which a given output may be repeatedly measured. It is specified in terms of units for a given period of time. Perfect reproducibility means an instrument has no drift i.e for a given input the measured values do not vary with time.

e) **Repeatability:** It is defined as the variation of scale readings and is random in nature. It is a measure with which a given input may be measured again and again. It is not specified in terms of scale readings over a period of time

DYNAMIC CHARACTERISTICS:

The set of criteria defined for the instruments, which are changes rapidly with time, is called 'dynamic characteristics'.

The various dynamic characteristics are:

i) Speed of response

ii) Measuring lag

iii) Fidelity

iv) Dynamic error

- Speed of response:

It is defined as the rapidity with which a measurement system responds to changes in the measured quantity.

- Measuring lag:

It is the retardation or delay in the response of a measurement system to changes in the measured quantity.

- Dynamic error:

It is the difference between the true value of the quantity changing with time & the value indicated by the measurement system if no static error is assumed. It is also called measurement error.