ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)

Instructor

Dr. B. P. Pandey

Assistant Professor

Department of Electronics and Communication Engineering

Madan Mohan Malaviya University of Technology , Gorakhpur

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UNIT-1
Lecture 2

Qualities, Measurements and Digital Display Devices

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Lecture 5 & 6:

- Limiting Errors
- LED

Lecture 7:

- LCD
- Incandescent Display

Lecture 8:

- LVD
- Printers

Lecture 9:

- Digital voltmeters
- Spectrum analyzer

Type of Static Error

They are of three types : **Gross Error**, **Systematic Error** and **Random Error**.

- **Gross error**: these are basically due to human mistakes in reading or in using instruments or errors in recording observations.
  - These errors cannot be treated mathematically.
  - One of the basic gross error that occurs frequently is the improper use of instrument. They can be minimized by proper reading of the measuring parameter.
- **Systematic error**: these errors occur due to the shortcoming of the instrument, such as defect or ageing of the instruments.

  These are basically of three types:
  - **Instrumental:** are inherent in instruments because of their mechanical structure. For example, in the D'Arsonal movement, friction in the bearing of the various components, irregular spring tension or overloading of the instrument.

    It can be minimized by**:**
    - Selecting a suitable instrument for a particular measurement.
    - Applying correctional factor after determining amount of instrumental error.
    - Calibrating the instrument against a standard.
  - **Observational:** are the error introduced by the observer. The most common error is the parallax error in reading a meter scale, the error of estimation when obtaining a reading from the meter scale. These errors are caused by habit of individual observers.

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- **Environmental error**: are due to conditions external to the measuring instruments, including conditions in the area surrounding the instrument, such as change in temperature, pressure, humidity or of magnetic fields.

  These can be avoided by:

  - Air conditioning
  - Using magnetic shields
  - Hermetically sealing certain components of the instruments.

- **Random error** : are the error that remain after gross error and systematic error and are least accounted for.
  - These errors are due to undefined causes not determinable in the ordinary process of making the measurement.
  - Such errors are normally small and follow the law of probability.

Sources of Error

The sources of error other than a piece of inability of hardware is to provide a true measurement are:

- Insufficient knowledge of design conditions and process parameters.
- Poor design.
- Poor Maintenance.
- Error caused by person operating the instrument.
- Certain design limitations.

Assignment Questions

- Explain the gross error in detail. How it can be minimized?
- Explain systematic error in detail. How I can be minimized?
- Explain random error in detail.
- What are the causes of environmental errors?
- Define absolute errors.

Conceptual Questions

- **Improper setting of range of a multi meter leads to an error called**

(a) Random error (b) limiting error (c) instrumental error (d) observational error

- **A means of reducing environmental errors is the regulation of**

(a) ambient noise (b) temperature (c) light (d) mains voltage

- **The ability of an instrument to respond to the weakest signal is defined as**

(a) sensitivity (b) repeatability (c) resolution (d) Precision

- **Static errors are caused due to**

(a) Human Error (b) instrumental error (c) environmental error (d) random error

- **Limiting errors are**

(a) Manufactures specification of accuracy (b) manufacturers specification of instrumental error (c) environmental error (d) random error

Practice Problems

- Three resistors of 330Ω are connected in series. One has 5% tolerance, and the other two have 10% each . Calculate the minimum and maximum of total resistance.
- The voltages at two opposite ends of a 470 Ω, $\pm$ 5 % resistor are measured as V1 =12 V and V2 = 5V. The measuring accuracies are $\pm$ 0.5 V for V1 and $\pm 2\%$ for V2. Calculate the level of current in the resistor and specify its accuracy.
- (b)Calculate the maximum and minimum power dissipation in the resistor.
- A 470 Ω, $\pm$ 10 % resistor has a difference of 12V across its terminals. If the voltage is measured with $\pm$ 6% accuracy, determine the power dissipation in the resistor and specify the accuracy in the result.

THANK YOU