



NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL ENGINEERING PROGRAM

EE364 – ELECTRICAL MEASUREMENTS II

I. GENERAL INFORMATION

CODE	: EE364 – Electrical Measurements II
SEMESTER	: 7
CREDITS	: 02
HOURS PER WEEK	: 03 (Theory)
PREREQUISITES	: EE363 – Electrical Measurements I
CONDITION	: Mandatory

II. COURSE DESCRIPTION

It is a subject of a theoretical nature and belongs to the area of professional training. Its purpose is to train the student in the operation of measuring instruments and equipment oriented to the processes of production, transformation, transmission and use of electric energy. The operation and maintenance activities of electrical systems.

III. COURSE OUTCOMES

At the end of the course the student will:

- Recognize the characteristics, disadvantages and virtues of the various ways of measuring in the field of electricity
- Meet the main standards related to electric field and laboratory measurements
- Learn the methodology to interpret and analyze measurements made in the field and laboratory
- Define equipment requirements and the influence of external factors when making a measurement
- Values the information obtained from technical catalogs and technical standards differentiating reliable sources of information from others.
- Apply concepts of electrical circuit courses in problems with a real character, mainly within the functionality of analog equipment.

IV. LEARNING UNITS

1. WIRING FAILURES IN ENERGY TRANSPORTATION

Types of failures. Determination of the type of failure. Stages and methods for locating the place of failure. Insulation resistance. Dielectrics. Measurement methods: Logometric, megohmmeter and discharge instruments.

2. GROUNDING SYSTEMS

Goals. Utilization. Elements. Dangers of ground faults: touch, step and transfer voltages. Current by the human body: limits and effects.

3. SPECIFIC LAND RESISTANCE.

Features. Influential factors. Measurement methods Determination of the value. Grounding resistance: Design. Tests. Measurement methods.

4. INTENSITY MEASUREMENT TRANSFORMERS.

Generalities Intensity transformers: Technical and operational characteristics. Types. Relations and angle errors. Accuracy class. Utilization. Connection. Tests.

5. VOLTAGE MEASUREMENT TRANSFORMERS.

Technical and operational characteristics. Types. Relations and angle errors. Accuracy class. Utilization. Connection. Tests.

6. SYNCHRONIZATION.

Terms. Behavior of an electrical system before and after parallel installation. Instruments. Polarized and induction blade synchroscope. Alternative methods for synchronization.

7. MEASUREMENT OF REACTIVE POWER AND POWER FACTOR

Wattmeter in HUMMEL connection. Wattmeter with RC offset. Quadrature wattmeters. Method of the 2 autotransformers. Commercial parameters. Power factor of single-phase and three-phase loads. Cross coil phasemeters. Polarized blade phasemeters.

8. MEASUREMENT IN TRANSFER OF ELECTRICAL ENERGY.

Electric rates Magnitudes and quantities to be measured. Energy. Maximum demand and excess power. Necessary instruments. Status take. Information consistency. Billing processes

9. ELECTROMECHANICAL ELECTRICAL ENERGY METERS

Induction counters: Parts. Equation of pairs. Disk speed Constants Classification by the number of systems and by the type of rate. Built-in maximeter. With clock for switching. Wiring.

10. HYBRID AND ELECTRONIC COUNTERS.

Hybrid counters: General. Basis of design. Information accumulator and clock. Programming. Status measure. Reports. Electronic counters: design bases. Blocks diagram. Description of parts and components. Operation. Status measure. Reports Application.

11. MULTIFUNCTION PROGRAMMABLE METERS

Meter hardware: General. Basis of design. Block diagrams. Description of parts and components. Main and optional cards. Communication modes.

12. MANAGEMENT OF MULTIFUNCTION PROGRAMMABLE METERS

Software for handling. Setting. Programming. Data acquisition. Reports Applications. Manufacturers and types of meters.

13. LOCAL MEASUREMENT AND TELEMETRY SYSTEMS

Boards. Dispositives. Instruments. Selection of measuring transformers. Communication cables. Totalization. Telemetry: Distance measurement. Generalities Methods Description of each method. Application.

14. MEASUREMENTS FOR THE OPERATIONAL ANALYSIS AND MANAGEMENT OF ELECTRICAL SYSTEMS.

Measurement of quantities, quantities and parameters. Analysis of the operational status. Load diagrams Factors Energy losses. Aging of materials and equipment. Failure Statistics.

V. METHODOLOGY

The course takes place in theory sessions. In these sessions the teacher presents the concepts and bases on electrical measurements. Some sessions, application examples will be proposed and students should solve them using the concepts learned. In all classes the active participation of the student is promoted both in the analysis and in the solution of problems.

VI. EVALUATION FORMULA

The learning will be evaluated through the "B" system.

- Partial Exam (PE): Weight 1
- Final Exam (FE): Weight 2

$$FA = \frac{PE + 2 * FE}{3}$$

VII. BIBLIOGRAPHY

- "Modern electronic instrumentation and measurement techniques", William D, Cooper. Pearson Prentice Hall, 1991.
- "Electrical Measurements and Measuring Instruments", S. Kamakshaiah, J. Amarnath. I. K International Pvt, 2011.
- "Capacitors Magnetic Circuits and Transformers", Sal G. CreateSpace Independent, 2002.