



**NATIONAL UNIVERSITY OF ENGINEERING  
COLLEGE OF MECHANICAL ENGINEERING  
MECHANICAL-ELECTRICAL ENGINEERING  
PROGRAM**

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**ML511 – POWER SYSTEMS**

**I. GENERAL INFORMATION**

<b>CODE</b>	: ML 511 POWER SYSTEMS
<b>SEMESTER</b>	: 9
<b>CREDITS</b>	: 4
<b>HOURS PER WEEK</b>	: 6 (Theory - Practice)
<b>PREREQUISITES</b>	: ELECTRICAL ROTATING MACHINES
<b>CONDITION</b>	: Mandatory

**II. COURSE DESCRIPTION**

Introduction and fundamental concepts, components of electric power systems, System Calculation unit values, parameters and models of transmission lines, symmetrical components, short circuit studies.

**III. COURSE OUTCOMES**

The student:

1. Applies the concepts of the method of system unit and laws of electrical circuits.
2. Solves problems of electric power systems, steady and transient regime.
3. Prepares operating circuits schemes; applying the criteria of failure in short - circuit; properly calculating each solution.

**IV. LEARNING UNITS**

**1. INTRODUCTION AND KEY CONCEPTS**

- Introduction to power flow analysis. iterative methods of Gauss-Seidel and Newton Raphson. Software applications Winflu load flow. Problems.
- Concept and Structure in Power System.
- Main sources of electric power in Peru and the World.
- Power and Electricity Production in Peru.
- Electricity consumption per capita in Peru and the World.
- Typical outline of the main power plants and operating characteristics and operation.
- Current and Future electricity system in Peru Goals Long-Term National Electrification.
- Electrical Systems Interconnection.

## 2. COMPONENTS OF ELECTRIC POWER SYSTEMS

- Synchronous Generators. Equivalent circuit and main working relationships in stable regime. Main Experimental Test for the determination of its parameters.
- Concepts and conditions of parallelization.
- Potencia.- equivalent circuit transformers and main working relationships in stable regime Main Testing Experimental for determining its parameters. Concept and conditions of parallelization.
- Power lines Transmisión.- parameters. Input impedance and admittance and Transfer. Active and Reactive Power Transmission and Reception.
- Compensación.- elements Concept and Representation, charges Eléctricas.- Concept and Representation.
- Unifilar representation of the electrical power system.
- Application problems for each case.

## 3. SYSTEM OF COMPUTATION UNIT VALUES

- Definition, Justification and benefits of employment.
- Equivalent representations of single-phase circuits.
- Case Three Phase System.
- Change Bases.
- Application problems.

## 4. PARAMETERS AND MODELS OF TRANSMISSION LINES

- Fundamental phenomena Inductivos.- Relations for analytical determination of the Inductance.
- Interior and Exterior Magnetic flows to the driver.
- Inductance Calculation of a Single Phase Line single and multiple conductors.
- Case Three Phase Transmission Line. Transposition.
- Fundamental phenomena Capacitivos.- Relations for analytical determination of capacity.
- Power flows and Associated Power difference.
- Calculating the Capacity of a single phase line of single and multiple conductors.
- Case Three Phase Transmission Lines. Transposition.
- Drivers effects Suelo.- Images for calculating the capacity of the lines.
- Theory and Models Lines Transmisión.- General Equations Voltage and Current. Generalised constant.
- Models for analysis of transmission lines short and medium length.
- Application problems.

## 5. Symmetrical Components

- Definition and Application
- Advantages Secuencia.- components of employment.
- Case Three Phase current and voltages Unbalanced. Matrix transformations.
- Power depending on the Symmetrical Components.
- Secuencia.- networks Concept and Classification.
- For a no-load generator.
- Major Networks zero sequence.
- Application problems.

## 6. STUDY OF SHORTS

- Study objectives and Application.
- Oscillograms fault current of a generator. Transitory and sub-transient reactance. equivalent circuits used.
- Symmetrical.- shorts calculation methods.
- Asymmetrical short circuits. Classification and Application.
- Shorts equivalent circuits Single-phase, two-phase between the lines and ground respectively. Calculation.
- Application problems

## V. LABORATORIES AND PRACTICAL EXPERIENCES

You will practice run before taking the qualifying practices.

## VI. METHODOLOGY

During the lectures it will ensure that the student participates actively, which controls regularly take before each class. also practical examples will be developed on the blackboard, with procedures to study and a series of questions by the teacher to make students themselves are those who develop and explain the problem or work search information being this participation regarded as a oral assessment, which will be part of the overall assessment. For the development of lectures and multimedia projector board used

## VII. EVALUATION FORMULA

The course will be evaluated according to the system "F"  
Average Practices (PP) Weight 1  
Partial exam (EP) Weight 1  
Final exam (EF) Weight 2

Note Course =

Number of qualified internship: 04 (four)  
The average Practices (PP) is the arithmetic average of the three highest grades of qualified Practices. Qualified practices can be deleted. No practices will be taken out of date.

## VIII. BIBLIOGRAPHY

1. STEVENSON, "Analysis of Electric Power Systems".
2. ELGERD, "Electric Energy Systems Theory"
3. Weedy, "Power Electric Systems"
4. ROPER, "Short Circuit Currents Network. Trif."
5. WAGNER & EVANS, "Symmetrical Components"
6. WESTINGHOUSE, "Electrical Transmission and Distribution Reference Book"
7. VENTOSILLA, Copies Course

## 8. Pumacayo, Problems Course