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

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# ML114 – ANALYSIS OF ELECTRICAL CIRCUITS I

## I. GENERAL INFORMATION

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| CODE | : ML 114 Analysis of Electrical Circuits I |
| GRADE | : 4 |
| CREDITS | : 5 |
| HOURS PER WEEK | : 6 (Theory - Practice) |
| PREREQUISITES | : Physics III |
| CONDITION | : Mandatory |

## II. SUMMARY

The course prepares the student to be able to solve problems of DC circuits (stable and transient states).
It is for this reason that the course begins with the development of the elements of the electric circuit and the variables that describe them, as well as enunciate and explain the Kirchoff's laws. Resistive circuits are then studied to provide a solid introduction to the circuit concept and its analysis. Next we consider the different theorems and principles developed for the precise analysis of electrical circuits, as well as general methods of solution. We study the energy storage elements and the response in steady and transient regime with stored initial energy of circuits RL and RC.

## III. COMPETENCES

The student:

1. Knows and explains the properties and characteristics of the elements of an electric circuit.
2. Understand and apply the main laws and properties existing an electric circuit.
3. Apply the theory of algebraic equations in the resolution of problems of DC circuits.
4. Apply the theory of Differential Equations in the resolution of problems of DC circuits.
5. Interprets the concepts of voltage, current, power and applies them to realize a balance of powers in an electric circuit of direct current. Interprets the results obtained when solving an electrical circuit and relates it to some practical application.

IV. LEARNING UNITS

1. FUNDAMENTAL CONCEPTS: VARIABLES AND ELEMENTS OF THE ELECTRICAL CIRCUIT. RESISTIVE CIRCUITS / 06 HOURS

Introduction / Definitions and scopes / Electric circuit / Unit systems / Current types / Voltmeters, ammeters and wattmeters / Linear models of circuit elements / Circuit active and passive elements / Kirchhoff laws / Power balance in an electric circuit .

2. REDUCTIONS AND TRANSFORMATIONS IN RESISTIVE CIRCUITS / 12 HOURS
(RINCE) / Voltage and current divider / Equivalence between a real voltage source and a real current source / Dependent sources / Symmetry in electrical circuits / Application problems.

3. METHODS OF ANALYSIS OF RESISTIVE CIRCUITS / 12 HOURS

Topology Algebra / Circuit analysis by methods of mesh analysis and nodes analysis with independent and dependent sources / Transformations and restriction equations.

4. APPLICATION OF PROPERTIES AND THEOREMS IN RESISTIVE CIRCUITS / 12 HOURS

Properties of Proportionality and Overlap / Thevenin and Norton Theorems, Maximum Power Transfer Theorem / Connection of Measurement Instruments / Application Problems.

5. ELEMENTS OF ENERGY STORAGE. / 18 HOURS

Elements of electrical energy storage: Capacitors and Inductors / Energy stored in capacitors and inductors / Analysis of electrical circuits RL, RC and RLC with switches / Static DC electric circuits / Capacitors and inductors, in series and in parallel / Application problems.

6. TRANSITIONAL CIRCUITS OF FIRST AND SECOND ORDER (RL, RC, RLC) / 18 HOURS

/ First-order transient circuits RL and RC / RL and RC circuits with dependent sources. Application problems.
Second order transient circuits / RL, RC and RLC circuits with dependent sources / Singular Functions / Application of the Laplace Transform in the solution of first and second order transient circuits / Application problems

7. MAGNETICALLY COUPLED CIRCUITS / 06 HOURS

Inductance and self-induction / Mutual inductance or mutual inductance / Air core transformer / Magnetic coupling coefficient / Transient magnetically coupled circuit response / Natural current / Points rule / Equivalent circuits with conductive coupling / Application problems.

## V. LABORATORIES AND PRACTICAL EXPERIENCES

Work is left to be carried out in the computer lab in order for students to solve electrical circuits using the ORCAD-SPICE simulator. Practical experiences are also left on the main subjects of the course to be carried out in the electricity laboratory.

## V. METHODOLOGY

The course is developed in sessions of theory and practice. In theory sessions, the teacher presents concepts, theorems and applications. In practical sessions, various problems are solved and their solution is analyzed. In the laboratory sessions, Orcad-Pspice simulation software is used to solve problems and analyze their solution. At the end of the course the student must present and present an integrative project or project. In all the sessions the active participation of the student is promoted.

## VI. EVALUATION FORMULA

Evaluation System "F". Calculation of Final Average: PF = (EP + 2 EF + PP) / 4 EP: Partial Exam EF: Final Exam PP: Average of Qualified Practices.

## VII. BIBLIOGRAPHY


1. BOYLESTAD ROBERT. Introduction to Circuit Analysis. Editorial Pearson Education, 2004.
2. JOHNSON DAVID. Basic Analysis of Electrical Circuits. Editorial PRENTICE-HALL HISPANOAMERICANA, 2005.