NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING
ELECTRONICS ENGINEERING PROGRAM

SYLLABUS - EE411 ELECTRONIC DEVICES

I. GENERAL INFORMATION

CODE	**:**	EE411
SEMESTER	**:**	5
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory – Practice)
PREREQUISITES	**:**	EE111 Analysis of Electrical Circuits I
CONDITION	**:**	Compulsory
INSTRUCTOR	**:**	Domingo Lazo, Dario Utrilla

II. COURSE DESCRIPTION

The course trains the student to understand the principles of physical operation and the application of semiconductor-based electronic devices, complementing with conductive and insulation materials. From electrical characteristics the student develops the physical and mathematical modeling of electronic devices. He/she studies electric conduction in materials and analyzes p-n junction, the semiconductor diode, the bipolar transistor, unipolar transistors, such as the field-effect transistor (FET), Power electronic and optoelectronic devices. Experiments are carried out and problems are solved. Specialized software is used.

III. COURSE OUTCOMES

1. Analyze concepts of the physics of semiconductors that support electronic devices characteristics.
2. Apply fundamental characteristics of the application of devices in electronic devices, understanding limitations and their nonlinear nature.
3. Analyze and apply the operation zones of each electronic device, and, understanding its operation, determine the mathematical and physical modeling for each of its zones.
4. Analyze the parasitic-components effect that limit the operation of the devices already studied.
5. Solve typical exercises and problems to master techniques of analysis and design of electronic circuits. Specialized software simulation is used.

IV. LEARNING UNITS

1. STUDY OF SEMICONDUCTOR'S APPLIED PHYSICS / 12 HOURS

Electric properties of the materials in general. Calculations of characteristics, parameters and their application in the electronics. Use of differential equation, charge neutrality laws and continuity equation. Analysis and experimentation of the temperature effect and the

radiation in the resistive properties of materials and their applications in thermistors and photoresistors.

2. P-N JUNCTION AND SEMICONDUCTOR DIODE / 24 HOURS

Definitions/ Characteristics and parameters / mathematical model determination / circuit model determination / temperature effects and parasitic components / Piecewise linearization and applications / Application of nonlinear characteristics in circuits / Experimentation and simulation assessing results / Problem solving and physical experimentation of the devise and its applications, practical considerations.

3. BIPOLAR JUNCTION TRANSISTOR / 18 HOURS

Definitions / Characteristics and parameters / Mathematical model determination for each operation zone / Circuital model determination / Temperature effects and parasitic components / Piecewise linearization and applications / Experimentation and simulation assessing results / Solutions of problems and the physical experimentation of the devise and its applications, practical consideration.

4. FIELD-EFFECT TRANSISTOR/ 18 HOURS

Definitions and classifications / Characteristics and parameters / Exposition of the circuit and mathematical model in each of its operation zones / Temperature effects and parasitic components / Piecewise linearization and applications / Application of the nonlinear characteristic in circuits / Experimentation and simulation assessing results / Solution of problems and physical experimentation of the devise and applications, practical considerations.

5. POWER ELECTRONIC DEVICES AND OPTOELECTRONIC DEVICES / 12 HOURS

Definitions and classifications / Characteristics and parameters / Determination of the mathematical model / Determination of the circuit model / Temperature effects and parasitic components / Piecewise linearization and applications / Application of the nonlinear characteristic in circuits / Experimentation and simulation assessing results / Solution of problems and physical experimentation of the devise and applications, practical considerations.

VI. METHODOLOGY

The course is carried out in computing lab, theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practice sessions, several problems are solved, and their solutions are analyzed. In lab sessions, students experiment physically with the devices, and Multisim simulation software is used to contrast and analyze the solutions found, it also can be used as a support in the problem solving. At the end of the course the student must hand in and expose a research paper on topics complementing what was seen in class (or it can be an integrator project). In all sessions student's active participation is encouraged through questions, case discussion and information search.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = (EP + EF + (P1+P2+P3+P4)/4) / 3

EP: Mid-Term Exam EF: Final Exam P#:Quizzes

VIII. BIBLIOGRAPHY

1. **TISZA, J.**
   Electronic Devices and Their Application (Spanish)
   Edited by CONCYTEC, 1990

2. **SEDRA - SMITH**
   Microelectronics (Spanish)
   Oxford University Press Editorial, 2005

3. **GRAY, P**
   Analysis and Design Of Analog Integrated Circuits
   John Wayle & Son Editorial, 2009