ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL
Faculty of Electrical and Computer Engineering
COURSE SYLLABUS
Electromagnetic Theory I

1. CODE AND NUMBER OF CREDITS

CODE	**FIEC03426**	
NUMBER OF CREDITS : 4	**Theoretical: 4**	**Practical: 0**

2. COURSE DESCRIPTION

The course covers the study of electrostatic and magnetostatic fields, applying different procedures and laws to calculate electric fields, electric potential, capacitance, resistance, magnetic fields, magnetic flow, self and mutual inductances, electromagnetic induction. This is apply to different configurations and different media systems

The course will provide the main basis to begin the analysis of electric machines and telecommunications. the approach is primarily conceptual and the mathematical component is simple.

The students recommended skills are: general knowledge of vector analysis, differential and integral calculus and graphic expression.
During the development of the course, additional to each exam, homeworks, short lessons and some research are submitted. Also is encourage student participation in class.

3. PRE-REQUISITES AND CO-REQUISITES

PRE-REQUISITES	ICF01131 PHYSICS C
CO-REQUISITES	ICM01966 MULTIPLE VARIABLES CALCULUS

4. CORE TEXT AND OTHER REQUIRED REFERENCES FOR THE TEACHING OF THE COURSE

CORE TEXT	1. William H. Hayt, Jr. – John A. Buck, "Teoría Electromagnética", seventh edition 2006, McGraw-Hill
REFERENCES	1. Martin A. Plonus, "Applied Electromagnetics", 1978, McGraw-Hill 2. Joseph A. Edminister, "Electromagnetismo", first edition 1992, McGraw-Hill 3. Paul Lorraine - Dale Carson, "Electromagnetic Fields and Waves", second edition 1970, Freeman 4. Stanley V. Marshall – Richard E. DuBroff – Gabriel G. Skitek, "Electromagnetic Concepts and Applications", fourth edition 1996, Prentice Hall 5. Reitz Milford/Christy, "Fundamentos de Teoría Electromagnética" 6. Alberto Tama, "Problemas de Electromagnetismo", first edition 2005, ESPOL.

5. COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:
1. To calculate electric fields for different configurations, as in vacuum as in others medias
2. To draw the path of the electric fields for different configurations
3. To define and calculate the electric potential.
4. To define and calculate the capacitance in symmetric configurations.
5. To define and calculate the electrical resistance for different configurations and materials
6. To calculate magnetic fields at different medias
7. To understand the magnetization phenomenon and magnetic materials classification
8. To define and calculate the inductance in different configurations
9. To apply magnetization phenomena and electromagnetic induction in the principles of electrical equipment operation such as transformers and rotating machines (generator and motor).

6. COURSE PROGRAM

I. ELECTROSTATIC IN THE VACUUM (sessions - 8 hours)
- Concepts of net, static, stationary, punctual and testing charge
- Coulomb's law
- Static electrical field for different charge distributions
- Electrostatic power
- Equal power surfaces
- Solid angle
- Gauss's law. Applications and examples.

II. ELECTROSTATIC AND CONDUCTORS (sessions – 7 hours)
- Conductors behavior in the static electrical field
- Gauss applications on materials
- Boundary conditions between conductors and vacuum
- Differential form of the Gauss's law
- Poisson and Laplace's equations
- Capacitance calculation

III. ELECTROSTATIC AND DIELECTRICS (sessions – 7 hours)
- Electrostatic field in dielectric presence
- Electrical dipole
- Polarization
- Polarization charges. Examples
- Definition of the electrical displacement vector
- Gauss's generalized form. Applications
- Boundary conditions between dielectrics

IV. ELECTRICAL IMAGES KELVIN'S METHOD (sessions – 2 hours)
- Generalities
- Punctual charge close to a grounded infinite plane conductor
- Punctual charge close to a grounded sphere conductor
- Punctual o lineal charge close to plane conductors intersection

V. STATIONARY CURRENT FIELDS (sessions – 4 hours)
- Electrical current
- Current density
- Continuity equation
- Electrical conduction mechanism in solids and liquids
- Ohm's law – conductivity
- Joule's law
- General properties of the stationary current field
- Boundary conditions
- Resistance calculation

VI. MAGNETOSTATIC IN THE VACUUM (sessions – 8 hours)
- Magnetic field: definition and properties
- Biot-Savart's law
- Magnetic flow: definition and properties
- Ampere's law. Applications
- Magnetic vectorial potential

VII. MAGNETOSTATIC AND MATERIALS (sessions – 10 hours)
- Torque in a circular current loop
- Magnetic dipole
- Magnetization: definition and mechanism
- Magnetization currents
- Generalized Ampere's law
- Magnetic susceptibility. Permeability
- Boundary conditions
- Physical properties of iron magnetic fields
- Equivalent magnetic circuit
- Magnetic circuit of a permanent magnet

VIII. ELECTROMAGNETIC INDUCTION (sessions – 8 hours)
- The electromagnetic induction phenomenon
- F.E.M. induced in conductors by means of a time variable flow
- Description and basic principles of a transformer

- F.E.M. induced in conductors that moves around a stationary field
- Description and basic principles of a motor and a generator
- Mutual and self inductance: definition and calculation
- Boundary conditions

IX. MAXWELL'S EQUATIONS (sessions – 2 hours)
- The four Maxwell's equations

7. WORKLOAD: THEORY/PRACTICE

SESSIONS PER WEEK: 2 (THEORETICALS)
EACH SESSION DURATION: 2 HOURS

8. CONTRIBUTION OF THE COURSE TO THE EDUCATION OF THE STUDENT

Electromagnetic Theory is a basic course in electrical engineering careers, it establishes the pillars of the laws applied to circuit analysis, provides to the students the basic criteria essential to understand and start the study of electrical machines and telecommunications. This course requires knowledge of vector algebra, differential and integral calculus, mathematics and physics.

BASIC TRAINING	PROFESSIONAL TRAINING	SOCIAL SKILLS DEVELOPMENT
	X	

9. THE RELATIONSHIP BETWEEN THE LEARNING OUTCOMES OF THE COURSE AND THE LEARNING OUTCOMES OF THE DEGREE PROGRAM

LEARNING OUTCOMES OF THE DEGREE PROGRAM*	CONTRIBUTION (High, Medium, Low)	LEARNING OUTCOMES OF THE COURSE**	THE STUDENT MUST:
a) An ability to apply knowledge of mathematics, science and engineering.	High	1,2,3,4,5,6,8	Solve derivative forms or simple integrals. Have knowledge of basic physics. Having spatial vision of bodies.
b) An ability to design and conduct experiments, and to analyze and interpret data	Low	1,2,3,4,5,6,7,8 ,9	Analyze and interpret data according to different configurations or systems presented in the electric and magnetic fields
c) An ability to design a system, component or process to satisfy realistic constraints.			
d) An ability to function on multidisciplinary teams.			
e) An ability to identify, formulate and solve engineering problems.	Medium	1,3,4,5,6,7,8	Based to a configuration or Submitted system, the student must identify the appropriate method to solve the problem
f) An understanding of ethical and professional responsibility.	Low		Promoting reading of articles in personal and professional ethics
g) An ability to communicate effectively.	Low	1,3,4,5,7,9	Research Applications papers about various topical of the course
h) A broad education necessary to understand the impact of engineering solutions in a social, environmental, economic and global context.	Low	1,3,4,5,9	To relate the application of laws studied in the course to the different areas of electrical engineering
i) A recognition of the need for, and an ability to engage in life-long learning.	Low	1,3,4,5,7,9	To maintain a commitment to permanent exercise of their knowledge, skills and abilities, sending works
j) A knowledge of	Low	9	To recognize the application of the ET

	contemporary issues.			laws in modern equipment design
k)	An ability to use the techniques, skills, and modern tools necessary for engineering practice.	Low	9	To apply techniques learned to understand, analyze and interpret the problems related to electromagnetism
l)	Capacity to lead, manage and undertake projects.			

10. EVALUATION IN THE COURSE

Evaluation activities	
Exams	X
Tests	X
Homework/tasks	X
Projects	
Laboratory/Experiments	
Class participation	
Visits	
Other	

11. PERSON RESPONSIBLE FOR THE CREATION OF THE SYLLABUS AND THE DATE OF ITS CREATION

Created by	JORGE FLORES MACÍAS, ENG.
Date	3 MAY 2013

12. APPROVAL

ACADEMIC SECRETARY OF THE ACADEMIC DEPARTMENT	DIRECTOR OF TECHNICAL ACADEMIC SECRETARY
NAME: Mrs. Leonor Caicedo G.	NAME: Eng. Marcos Mendoza
SIGNATURE:	SIGNATURE: ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL
Date of approval by the Directive Council: 2013-537 2013-10-7	Ing. Marcos Mendoza V. DIRECTOR DE LA SECRETARIA TÉCNICA ACADÉMICA

13. VALIDITY OF THE SYLLABUS

RESOLUTION OF THE POLYTECHNIC BOARD:	13-12-343
DATE:	2013-12-12