NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES
ENGINEERING PHYSICS PROGRAM

IF372 – ELECTROMAGNETISM FOR ENGINEERING

I. GENERAL INFORMATION

CODE	**:**	IF372 Electromagnetism for Engineering
SEMESTER	**:**	6
CREDITS	**:**	5
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	CF222 Physics IV, CF391 Mathematical Methods for Physics II
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

This course is theoretical and practical and provides students with principles of electrostatics and electricity under the conceptual framework of field and electric potential, theory of it is applied both conductors and dielectrics. Use calculus methods at intermediate level including Del operator and integration theorems. This course is requisite for Electromagnetism II, and basis for antenna, transmission lines, via satellite, and others. Deal with topics such as Coulomb's law, field, electric flux and potential, electric dipole. Solution to Laplace's equation. Solution to Poisson's equation. Method of image charges. Linear dielectric. Solution to Laplace's and Poisson's equations in dielectric media. Electrostatic potential energy. Electric current.

III. COURSE OUTCOMES

1. Understand concepts of electric field and potential and the calculation of them, from distributions of charges that generate them, in both vacuum and in the presence of conductor objects.
2. Identify and solve value problems of boundary with conductors, integrating Poisson's or Laplace's equation for one and two dimensions.
3. Understand the interaction between electric fields with dielectric material.
4. Formulate the concept of electric potential energy and its application in the calculation of electrostatic system forces.
5. Define electric current, explain how it is generated and solve the stationary-current circuit in its geometrical aspects as a boundary value problem.

IV. LEARNING UNITS

1. FORCE, FIELD AND POTENTIAL / 14 HOURS

Electric forces. Electric charge. Coulomb's law / Point charge system. Superposition principle. Continuous charge system / Coordinate system: Cartesian, Cylindrical and Spherical ones. / Electric field: definition of electric field. Point-charge field. Continuous-charge field. Lines of force / Gauss's law / Electric flux, Gauss's law. Application: Conductors in electrostatic equilibrium. Differential form of Gauss's law / Electric potential. Electrical potential difference, units. Point and continuous charge potential. Line integral of electric field. Equipotential surfaces. Ground potential. Electric dipole.

2. BOUNDARY VALUE PROBLEMS / 10 HOURS

Boundary conditions in a discontinuity surface. Laplace's and Poisson's equations. Linearity and unity theorems / Solutions to Laplace's equation in one dimension, in Cartesian, cylindrical and spherical

coordinates / Solution to Laplace's equation in two dimensions using a coordinate system / Solution to Poisson's equation in one dimension / Method of image charges.

3. ELECTROSTATIC AND DIELECTRICS / 10 HOURS

Dielectric, polarization of a dielectric / Potential and field of a polarized material / Bound charge densities. Gauss' law with dielectrics and the displacement vector. Linear, isotropic and homogeneous dielectrics. Dielectric's sensitivity and permittivity / Laplace's equation in a dielectric.

4. ELECTRIC POTENTIAL ENERGY

Electrostatic energy. Charged system as a stored energy reserve. Energy of N point charges. Electrostatic energy of a continuous charge. Electrostatic energy according to fields of electric energy density. Capacitors. Forces and torques from the system energy: constant charge and potential.

5. ELECTRIC CURRENT / 06 HOURS

Electric current. Definition, types of current, current density. Current microscopic description, charge carriers / Conduction current and drift velocity, current as density vector flux. Continuity equation. Electromotive force of a source / Current boundary conditions / Calculation of current in a linear medium as a boundary value problem. Laplace's equation.

V. METHODOLOGY

The course is carried out in theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. Several problems are solved and their solutions are analyzed in seminars. After practice sessions, students complete and hand in the part unseen in the quiz they have taken. In all sessions student's active participation is encouraged.

VI. EVALUATION FORMULA

The average grade PF is calculated as follows:

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

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

VII. BIBLIOGRAPHY

1. **CHENG D.K.**
   Electromagnetism fundamentals for Engineering (Spanish)
   Ed. Addison Wesley Iberoamerican, 2007.

2. **SADIKU MATTHEW**
   Elements of Electromagnetism (Spanish)
   Ed. Oxford, Mexico, 2003.

3. **TALLEDO ARTURO**
   Electromagnetic Field Theory (Spanish)
   Ed. CIENCIAS, LIMA, 1996.