



GENERAL INFORMATION

Data of the subject	
Subject name	Electromagnetic Fields
Subject code	DIE-GITI-221
Main program	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Second year]
Credits	6,0 ECTS
Type	Básico
Department	Department of Electrical Engineering
Coordinator	Efraim Centeno Hernáez

Teacher Information	
Teacher	
Name	Francisco Javier Herraiz Martínez
Department	Department of Electronics, Control and Communications
Office	Alberto Aguilera 25
EMail	fjherraiz@icai.comillas.edu
Phone	2423
Teacher	
Name	Silvia Vargas Castrillón
Department	Department of Electrical Engineering
EMail	svargas@icai.comillas.edu
Teacher	
Name	Constantino Malagón Luque
Department	Department of Electrical Engineering
EMail	cmalagon@icai.comillas.edu
Teacher	
Name	Eduardo Iglesias Jiménez
Department	Department of Mechanical Engineering
EMail	eiglesias@icai.comillas.edu
Teacher	
Name	Efraim Centeno Hernáez
Department	Department of Electrical Engineering
Office	Santa Cruz de Marcenado 26 [D-601]
EMail	Efraim.Centeno@iit.comillas.edu



Phone	6279
Teacher	
Name	Enrique Picatoste Calvo
Department	Department of Electrical Engineering
E-Mail	epicatoste@icai.comillas.edu
Teacher	
Name	Oibar Martínez Vílchez
Department	Department of Electrical Engineering
E-Mail	omvilchez@icai.comillas.edu

DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Course contents

Contents

Chapter 1: Electrostatics. Charges and fields

- 1.1. Coulomb law
- 1.2. Electric field: concept and vectorial representation
- 1.3. Gauss's law and application to the calculation of the electric field in plane, spherical and cylindrical symmetries
- 1.4. Electrostatic energy
- 1.5. Force on a layer of charge

Chapter 2: Electric potential. Vector operators.

- 2.1. Equipotential surfaces and gradient operator
- 2.2. Definition of electric potential
- 2.3. Divergence and Differential Gauss's Law
- 2.4. Poisson and Laplacian equation.
- 2.5. Curl and Stokes' theorem.

Chapter 3: Conductors

- 3.1. General characteristics of conductors
- 3.2. Uniqueness of solutions theorem
- 3.3. Screen effect

- 3.4. Image method.
- 3.5. Metallized equipotential bonding
- 3.6. Analytical solution of Laplace's equation
- 3.7. Capacity of conductors and capacitors
- 3.8. Energy stored in a condenser
- 3.9. Forces on conductors and method of virtual works for the calculation of forces
- 3.10. Calculation of the field by numerical methods: relaxation method

Chapter 4: Electric field in matter

- 4.1. Dielectric polarization. Internal and external fields
- 4.2. Capacitors with dielectric material
- 4.3. Electric dipole moment: field of a dipole, torques and forces in a dipole
- 4.4. Polarized materials and type of polarization
- 4.5. Electric Displacement Vector and Applications
- 4.6. Industrial applications of electrostatics

Chapter 5: Electric current

- 5.1. Ohm's law
- 5.2. Current density
- 5.3. Vector Ohm's Law
- 5.4. General calculation of resistances
- 5.5. Equation of conservation of charge and continuity
- 5.6. Joule's Law
- 5.7. Theories of electrical conduction: kinetic and wave theory
- 5.8. Industrial applications

Chapter 6: Magnetic field in the empty space

- 6.1. Definition of the magnetic field
- 6.2. Field and forces produced by a current line
- 6.3. Ampère's Law
- 6.4. current sheets
- 6.5. Magnetic field properties and uniqueness theorem
- 6.8. Differential Biot-Savart law

6.9. Magnetic potential vector

Chapter 7: Electromagnetic induction

7.1. Integral and differential Faraday's law

7.2. Magnetic force and induced stress

7.3. Self-induction and mutual induction

7.4. industrial applications.

Chapter 8: Electromagnetic fields in matter

8.1. Analogies between magnetization and polarization

8.2. Magnetic dipole moment: field of a dipole, torques and forces on a dipole

8.3. Vector H magnetic field intensity and Ampère's law

8.4. magnetic materials. B-H curve and hysteresis loop.

8.5. Eddy's currents

8.6. Magnetic circuits

8.7. Industrial applications of magnetostatics. Electromechanical analysis of magnetic systems with air gap. Force in systems with linear motion. Torque in systems with circular motion. Conductors embedded in magnetic materials

8.8. Numerical methods for the solution of complex magnetostatic problems

Chapter 9: Maxwell's equations and electromagnetic waves

9.1. Ampère–Maxwell law

9.2. Maxwell's equations

9.3. Wave equation

9.4. Properties of electromagnetic waves

9.5. Energy of an electromagnetic wave and Poynting vector.

9.6. Industrial applications.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
<p>Exams</p> <ul style="list-style-type: none"> • Mid-term exam • Final exam 	<ul style="list-style-type: none"> • Theory understanding. • Application of concepts to the resolution of practical problems. • Analysis and interpretation of the results obtained in solving problems. • Written communication. 	<p>85</p>



Continuous performance assessment	<ul style="list-style-type: none">• Follow-up test• Theory understanding.• Application of concepts to the resolution of practical problems.• Analysis and interpretation of the results obtained in solving problems.• Written communication.• Attendance and attitude in class.• Class attendance level.• Class participation.	15
-----------------------------------	--	----

Grading

Ordinary call:

- 5% participation in class
- 10% follow-up test
- 25% mid-term exam mark
- 60% mark of the final exam

Failure to attend more than 15% of the classes may result in the loss of the right to take the ordinary call exam (and even the retake exam) of the subject (article 93.3 of the General Regulations, and articles 7.2 and 7.3 of the Academic Norms).

If a retake exam is required (extraordinary call):

- 3.75% participation in class
- 7.5% follow-up test
- 18.75% mid-term exam
- 70% retake exam

BIBLIOGRAPHY AND RESOURCES

Basic References

- E. M. Purcell. Electricidad y Magnetismo, 2ª edición. Reverté 1994. (Also available in english)
- T.A. Moore. Six ideas that shaped physics, Unit. E. 2ª ed. McGraw-Hill

In compliance with current regulations on the **protection of personal data**, we would like to inform you that you may consult the aspects related to privacy and data that you have accepted on your registration form by entering this website and clicking on "download"

<https://servicios.upcomillas.es/sedelectronica/inicio.aspx?csv=02E4557CAA66F4A81663AD10CED66792>