COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	5.003	**SEMESTER**	5th
COURSE TITLE	Electromagnetic Field II		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	5	6
TOTAL	**5**	**6**

COURSE UNIT TYPE	General Knowledge
PREREQUISITES	Electromagnetic Field I
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE182/

(2) LEARNING OUTCOMES

Learning outcomes

Understanding the phenomenon of electromagnetic induction, the behavior of magnetic materials, time-varying electromagnetic fields, Maxwell equations, the propagation of uniform electromagnetic waves, the phenomenon of reflection / refraction based on the macroscopic model of classical electromagnetism.

Particularly:

1. Understanding induced electromotive force, mutual induction, self-induction. Introduction to time-varying magnetic fields and dynamics.
2. Study and understanding of the macroscopic model of description of magnetic materials, magnetization curve and magnetic circuits.
3. Time-varying electromagnetic field and Maxwell equations. Equations and boundary conditions. General form of sources in the electromagnetic field. Electromagnetic potentials and Lorentz condition.
4. Electromagnetic wave propagation and derivation of the wave equation and the diffusion equation. Power in the time-varying electromagnetic field. Poynting theorem and vector.
5. Definition of the flat uniform wave: physical significance and general case. Instantaneous value and complex representation (phasors) of magnitudes of the electromagnetic field with a harmonic time change. EEC propagation in dielectric and (perfect or not) conductive media. Polarization: definition and species. Phase velocity, wavelength, and group velocity.
6. Power density, vector and Poynting theorem, power loss and stored EEC energy. Wave propagation in a random direction. Incidence of EEC at homogeneous levels.
7. Vertical/lateral incidence of parallel/vertical polarization wave in various media. Reflection and refraction: formulation of basic laws and coefficient calculations through Fresnel equations. Critical angle. Flat non-uniform wave properties and total reflection.

General skills

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Autonomous work
- Teamwork
- Search, analysis and synthesis of data and information, using the necessary technologies.
- Decision making
- Promoting liberal, creative, and inductive/deductive thinking
- Work in an interdisciplinary environment

(3) SYLLABUS

Electromagnetic induction: Faraday's law. Induced electromotive force. Mutual induction. Energy and induced currents. Magnetic materials: Magnetism and magnetic permeability. Ferromagnetic materials. Magnetization curve. Loop and lag losses. Magnetic circuits. Kirchhoff's laws in magnetic circuits. Non-linear magnetic circuits. Energy and forces in a magnetic circuit.
Electromagnetic field: Time-varying electromagnetic field. Maxwell Equations. State equations. Boundary conditions. Conductivity and displacement current. Lorentz Treaty. General wave equation. Diffusion equation.
Harmonic change of time. Instantaneous values and complex representation of quantities of the electromagnetic field. Helmholtz equation. Scalar electric and vector magnetic potential. Vector and Poynting theorem.
Plane uniform wave: Definition and origin. Flat wave propagation in with or without losses. Polarization. Disseminated power. Spread to random address. Phase velocity and group velocity.
Plane Wave Reflection and Refraction: Definitions. Incident wave. Parallel and vertical polarization. Snell's law. Fresnel equations. Brewster angle and critical angle. Total reflection. Non-homogeneous waves. Energy factors of reflection and refraction. Vertical and lateral incidence in perfect conductors and dielectrics.

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	▪ Use of ICTs in lecturing ▪ Use of ICTs in weekly tests. ▪ Use of ICTs for the communication with students via the e-class platform
TEACHING ORGANIZATION	

Method description/Activity	**Semester Workload**
Lectures	72
Non-guided personal study	33
Electronic test	75
Total Contact Hours	**180**

ASSESSMENT METHODS

All announcements for the course regulations and complementary reading material are permanently posted in the course web page. The course grade incorporates the following evaluation procedures:

1. Weekly tests (10 %)
   - Short answer questions
2. Written examination I (40 %)
   - Problem solving.
   - Short answer questions
3. Final written examination (50 %)
   - Problem solving.
   - Short answer questions
   - Multiple choice questions

(5) RECOMMENDED BIBLIOGRAPHY

J. R. Jackson, Classical Electrodynamics, 3rd edition, Wiley, 1998