AEEE312 - Introduction to Electromagnetic Fields

Course Title	Introduction to Electromagnetic Fields				
Course Code	AEEE312				
Course Type	Compulsory				
Level	BSc (1st Cycle)				
Year / Semester	3rd / 1st				
Teacher's Name	Associate Prof Symeon Nikolaou				
ECTS	6	Lectures / week	3	Laboratories/week	0
Course Purpose	The aim of the course is to familiarize the students with the concepts and principles of time-invariant Electric and Magnetic fields, their sources and the study of the phasor domain Maxwell's equations. The students will be in position to analyze the induced Electric field from random static electric charge distributions based on the analytical expressions derived for a point charge, an infinite linear charge distribution and an infinite plane charge distribution. They should be able to analyze the induced Magnetic field from DC current distributions and to explain the operation of simple AC motors and generators using time harmonic EM fields.				
Learning Outcomes	By the end of the course, students must be able to: 1. Examine the use of vector and scalar operators in Maxwell's equations 2. Apply Gauss' and Stokes' theorems to calculate vector integrals. 3. Associate the use of boundary conditions between dielectric media with metal dielectric interface 4. Apply Gauss' law to calculate E field from discrete and continuous charge distributions. 5. Analyze the capacitance from planar and cylindrical structures, calculate electrostatic forces and torques on charge distributions. 6. Explain the development of magnetic forces on current currying conductors using Biot-Savart's law. 7. Calculate self and mutual inductance for coaxial cables and random shape circuits in the presence of magnetic fields. 8. Analyze the operation principles for AC generators and electric motors using time harmonic EM fields.				
Prerequisites	PHY112	Corequisites	None		
Course Content	• **Vector analysis:** Definition of Cartesian, cylindrical and spherical coordinates system. Vector calculations, use of gradient, divergence, rotation and laplacian operators.				

	• **Electrostatics:** Gauss' law, Coulomb's law, integral and differential form of Maxwell's equation for electrostatics. Derivation of Ohm's law using Maxwell's equations. Calculation of E field caused by discrete and continuous charge distribution. Calculation of capacitance for parallel plate and cylindrical capacitors. Comparison between boundary conditions between two dielectric media and between a metal and a dielectric. • **Magnetostatics:** Use of Ampere's law, Biot – Savart's law, calculation of inductance and self-inductance using the concept of magnetic flux. Magnetic boundary conditions, forces between current carrying conductors and moments on current currying loops in the presence of magnetic fields. • **Time harmonic electrodynamics:** Use of Maxwell's time dependent equations for the operation explanation of AC voltage generator and of an electric motor. Forces and torques on loops or linear conductors in the presence of time-varying B field.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Topic notes are compiled by students, during the lecture can also be downloaded from the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours
Bibliography	**(m) <u>Textbooks:</u>** • Fawwaz T. Ulaby, "Fundamentals of Applied Electromagnetics, 7th Edition Pearson, 2015 **(n) <u>References:</u>** • David K. Cheng, Field and Wave Electromagnetics, 2nd Edition, Addison-Wesley, 2002. • W. H. Hayt, Jr. Engineering Electromagnetics, 6th Edition, McGraw-Hill, 2001.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 50% each, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, quizzes. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments/Quizzes 20% • Mid-Term written exams 80% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable.

	The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 20%, 60% and 20%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**