AEEE319 - Computational Methods for Electrical Engineers

<table>
<tr><td>Course Title</td><td colspan="5">Computational Methods for Electrical Engineers</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE319</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2 / 2</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Prof Christos Themistos</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td></td></tr>
<tr><td>Course Purpose</td><td colspan="5">The aim of the course is to familiarize the students with the concepts and the principles of numerical methods, in order to apply numerical techniques for the solution of electrical engineering problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
1. Understand the concepts of interpolation for curve fitting and apply this techniques to obtain the interpolation polynomials for given data sets and various functions
2. Apply numerical integration techniques for the solutions of integral functions and calculate the approximate solutions of first and second order differential equations.
3. Describe the electromagnetic field evolution in terms of Maxwell’s equation and the various approaches used for its numerical analysis.
4. Comprehend the principles of the Finite Element Method and apply the above techniques to formulate engineering problems
5. Apply Finite Difference approach to formulate Engineering problems in the frequency and time domain.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">None</td><td colspan="2">Corequisites</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">• Application of interpolation methods for curve fitting.
• Use of numerical approaches for integration and differentiation.
• Review of Ritz and Galerkin methods for formulating variational problems. Introduction to Finite Element Analysis for Electromagnetic field problems. Discretisation of variational formulations generated using Maxwell’s equations. Development of discretised variational formulation with the use of shape functions. Assembly of finite element matrices and standard eigenvalue problem formulation.
• Understanding of explicit time-dependent partial differential equations solution methods. Introduction of basic finite difference techniques for the solution of Electromagnetic field problems in the time domain. Finite Difference Approximation of the Transmission Line Equations.</td></tr>
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	• Application of the Yee-algorithm for the solution of time dependent Maxwell equations for vector electromagnetic fields
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. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or 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. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally.
Bibliography	**Textbooks:** • S.C Chapra and R.P. Canale, "Numerical Methods for Engineers", Mc Graw Hill, Sixth Ed., 2010. **References:** • B.M.A. Rahman and A. Agrawal, "Finite element Modeling Methods for Photonics, Artech House, 2013 • A. Taflove and S.C. Hagness, "Computational Electrodynamics: The Finite-Difference Time-Domain Method, Artech House, 3rd Ed., 2005.
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 40% and 60%, respectively, 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, oral exam, quizzes, design assignments, design projects and laboratory experiments. 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 10% • Homework 10% • Mid-Term written exams 40% • Design Project 30% • Quizzes 10% 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 30%, 40% and 30%, 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**