INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td>Computational Electromagnetics</td><td>Course No</td><td colspan="4">ELE6XX</td></tr>
<tr><td>Specialization</td><td>ECE</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>DD, PG, and Ph.D.</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Faculty Proposing the course</td><td>Dr. Prerna Saxena</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td rowspan="2">Date of DAC</td><td rowspan="2">22nd July 2019</td><td>Members Present in DAC</td><td colspan="4">All Dept. Members</td></tr>
<tr><td>External Member</td><td colspan="4">Dr. Uday Khankhoje, EE, IITM</td></tr>
<tr><td>Pre-requisite</td><td>CoT</td><td>Submitted for approval</td><td colspan="4">41st Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is to provide a strong foundation and hands-on experience with contemporary numerical approaches in modeling electromagnetic systems for applications in RF-microwave-millimeter wave communications, and antenna analysis and design.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will be able to understand the ideas behind computational methods used for electromagnetic simulations. They will be able to apply various computational electromagnetic methods such as Finite Difference Method, Finite Difference Time Domain method, Method of Moments, and Finite Element Method to EM simulation of various components and systems.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours)</td><td colspan="6">Module 1: Fundamental Concepts
Review of electromagnetic theory: Vector calculus, electrostatic fields, magnetostatic fields, Gauss and Stokes theorems, boundary conditions, Maxwell's equations, wave equation, Poynting vector. Classification of EM problems: classification of solution regions, classification of differential equations. Surface and volume equivalence theorems, applications of computational electromagnetics. [8 hrs.]

Module 2: Finite Difference Method (FDM)
Finite difference schemes, finite differencing of parabolic, hyperbolic, and elliptic PDEs, accuracy and stability of FD solutions, Finite Difference Time Domain method (FDTD), Yee cell, Yee algorithm for 3D formulation. [10 hrs.]

Module 3: Finite Element Method (FEM)
Finite element discretization, basis functions in one and two dimensions, FEM formulations in one and two dimensions, automatic mesh generation, higher order elements. [10 hrs.]

Module 4: Method of Moments (MoM)
Variational methods, integral formulation, Green's functions and numerical integration, surface and volume integral solutions using the method of moments. [10 hrs.]

Module 5: Applications
Applications of computational electromagnetics: antenna problems, scattering problems, radiation problems, computation of radar cross-section, EM absorption in human body. [4 hrs.]</td></tr>
<tr><td>Text Books</td><td colspan="6">1. M. N. O. Sadiku, Numerical techniques in electromagnetics, CRC Press, 2009, ISBN: 978-1420063097.
2. Andrew F. Peterson, Scott L. Ray, Raj Mittra, Computational Methods for Electromagnetics, IEEE Press Series on Electromagnetic Wave Theory,1998, ISBN: 9780470544303.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. M. V. K. Chari and S. J. Salon, Numerical methods in electromagnetism, Academic Press, 2000, ISBN: 9780126157604.
2. S. R. H. Hoole, Computer aided analysis and design of electromagnetic devices, Elsevier Science Publishing Co., 1989, ISBN: 978-0444013279.
3. J. Jin, The Finite Element Method in electromagnetics, John Wiley and Sons, 2014, ISBN: 9781118571361.
4. P. P. Silvester and R. L. Ferrari, Finite elements for electrical engineers, Cambridge University Press, 1996, ISBN: 978-0521449533.
5. A. Taflove and SC Hagness, Computational Electrodynamics: The Finite Difference Time Domain Method, Artech House, 2005, ISBN: 978-1580538329.
6. D.B. Davidson, Computational Electromagnetics for RF and Microwave Engineering, Cambridge University Press, 2010, ISBN: 978-0521518918.
7. Walton C. Gibson: The Method of Moments in Electromagnetics, Chapman and Hall, 2014, ISBN: 978-1482235791.</td></tr>
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