COMPUTATIONAL ELECTROMAGNETICS

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TYPE OF COURSE : New | Elective | PG
COURSE DURATION : 12 weeks (29 Jul'19 - 18 Oct'19)
EXAM DATE : 17 Nov 2019

PRE-REQUISITES : Engineering Electromagnetics

INTENDED AUDIENCE : UG and PG students

INDUSTRIES APPLICABLE TO : ISRO, DRDO

COURSE OUTLINE :

This course on Computational Electromagnetics is targetted at senior undergraduate students and beginning graduate students who have taken a first course in Engineering Electromagnetics. The course covers the mathematical formulation of the main methods currently in use by the community, namely: Integral Equations Methods (and their solution by the Method of Moments), the Finite Element Method, and the Finite Difference Time Domain method. These methods are illustrated by their use in solving scattering problems and antenna radiation/impedance calculation problems. Additional topics include introduction to inverse problems, calculating the mutual coupling between antennas, finding the electromagnetic modes of a waveguide, and techniques to hybridize the Finite Element Method with the Integral Equation Method. Programming issues faced in the implementation of these methods will also be highlighted.

ABOUT INSTRUCTOR :

Prof. Uday K Khankhoje, completed his BTech in EE from IIT Bombay in 2001-05 and MS, PhD in EE (minors in Physics, Applied Physics) from Caltech (2005-10), He completed his Postdoc at Jet Propulsion Laboratory (NASA/Caltech) from 2011-12 and in University of Southern California from 2012-13. He was an Assistant Professor in Electrical Engineering at IIT Delhi from 2013-16 and he is currently an Assistant Professor, Department of Electrical Engineering (EE) Indian Institute of Technology Madras.

COURSE PLAN :

Week 1: Advanced concepts in electromagnetics: uniqueness theorem, volume/surface equivalence theorems. Introduction to integral equations methods (IEM) by using the Huygen's principle and the extinction theorem.
Week 2: Introduction to Green's functions in one and two dimensions
Week 3: Solving surface integral equations using the method of moments, how to deal with singularities, and use of quadrature rules
Week 4: Solving volume integral equations using the Method of moments
Week 5: Introduction to the Finite Element Method (FEM), basis functions in 1 and 2 dimensions
Week 6: FEM formulations in 1 and 2 dimensions
Week 7: Introduction to Finite Difference Time Domain methods (FDTD): Yee cells, update equations, stability
Week 8: FDTD - Accuracy Analysis, Dispersion, Material specifications and Dispersive media
Week 9: FDTD - Boundary conditions and their implementation
Week 10: Applications of computational electromagnetics (CEM): Antenna problems
Week 11: Applications of CEM: Phased array and Wireless System problems
Week 12: Applications of CEM: Inverse Scattering problems