ELECTRICAL EQUIPMENT AND MACHINES: FINITE ELEMENT ANALYSIS

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TYPE OF COURSE : New | Core_Elective | UG/PG
COURSE DURATION : 8 weeks (20 Jul' 20 - 11 Sep' 20)
EXAM DATE : 27 Sep 2020

PRE-REQUISITES : Basics of Electromagnetic Fields and Electrical Machines

INTENDED AUDIENCE : Electrical and Electronics Engineering Students, Electrical Industry Professionals

INDUSTRIES APPLICABLE TO : Companies manufacturing electrical and electronic products consisting of magnetic and insulating components

COURSE OUTLINE :

The course consists of theory and applications of Finite Element Method (FEM). This numerical technique, applied for solving partial differential equations, is popularly used by researchers and practicing engineers for design, development and optimization of electrical equipment and machines. A course of FEM is being included in many universities in India at UG and PG level.

ABOUT INSTRUCTOR :

Dr. S. V. Kulkarni is INAE (Indian National Academy of Engineering) Chair Professor in the Department of Electrical Engineering, Indian Institute of Technology Bombay. He is a Fellow of IEEE and INAE. He was Editor of IEEE Transactions on Power Delivery (2012-2019).

COURSE PLAN :

Week 1: Introduction to the course need for finite element analysis , Analytical Vs Numerical techniques for solving Partial Differential Equations (PDEs) , Revisiting important concepts in electromagne tics - 1 , Revisiting important concepts in electromagneti cs - 2 , Magnetic vector potential

Week 2: PDEs in low frequency electromagnetics , Theory of eddy currents , Variational calculus and energy minimization approach , Variational approach to solve PDEs , Whole domain approximation

Week 3: Tutorial , Sub domain approximation , 1D FEM , Scilab code for 1D FEM – Tutorial , Error distribution

Week 4: 2D FEM – Formulation and shape functions , 2D FEM – Formation of global coefficient matrix, 2D FEM – Boundary conditions and solution , Scilab code – 2D FEM , Gmsh based freeware meshing

Week 6: Tutorial on 1D and 2D FEM , Solution of diffusion equation (time - harmonic problems) , Application: bar – plate , eddy current problem Eddy current loss in windings , Induction motor: torque – speed characteristics

Week 7: Axisymmetri c problem , Permanent magnets – Theory , Permanent magnets – FE analysis , Current fed solid conductors: FE Theory , Skin and proximity effects in windings

Week 8: Voltage fed stranded conductors: FE theory and applications , FEM for rotating machines: periodic boundary conditions, calculation of slot inductance of an induction motor , Force computations : J×B, stress tensor, and virtual work methods , FE analysis for force computations , Voltage fed circuit-field coupled transient analysis: inrush current computation