INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING**
SEMESTER	**1**
COURSE TITLE	**NUMERICAL SOLUTION OF EV COMPONENTS**
COURSE CODE	**01EV1110**
COURSE CREDITS	**1**

Objective:

1 The objective of the course is to explore the Numerical solution of different components for electric vehicle.

Course Outcomes: After completion of this course, student will be able to:

1 Differentiate application of Analytical Vs Numerical techniques
2 Apply the numerical methods for the performance analysis EV components.
3 Simulate the EV components using software which supports FEM
4 Analyse the performance of EV components by varying the design parameters

Pre-requisite of course: Basics of Electromagnetic Fields and Electrical Machines

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
0	0	2	0	0	0	25	25

Contents : Unit	Topics	Contact Hours
Total Hours		

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Introduction:** Analytical Vs Numerical techniques for solving Partial Differential Equations (PDEs),, Revisiting important concepts in electromagnetics, Magnetic vector potential.	6
2	**Fundamentals : Finite element method:** PDEs in low frequency electromagnetics , Theory of eddy currents , Variational calculus and energy minimization approach , Variational approach to solve PDEs , Whole domain approximation.	8

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
3	**1-D and 2-D Tutorials:** Sub domain approximation , 1D FEM , Scilab code for 1D FEM – Tutorial , Error distribution,, 2D FEM – Formulation and shape functions , , 2D FEM – Formation of global coefficient matrix, , 2D FEM – Boundary conditions and solution, Scilab code – 2D FEM , Manual freeware meshing.	10
4	**Axisymmetric problem solution:** Permanent magnets – Theory , Permanent magnets – FE analysis , Current fed solid conductors: FE Theory , Skin and proximity effects in windings.	6
5	**FEM for rotating machines.** periodic boundary conditions, calculation of slot inductance of an induction motor , Force computations using maxwell stress sensor,, Torque Speed Characteristics of an Induction Motor and FE Analysis, and virtual work methods , FE analysis for force computations ,Voltage fed circuit-field coupled transient analysis: inrush current computation	6
Total Hours		**36**

Textbook :

1 Electromagnetics through the Finite element method, Jose Robeto, CRC Press, 2017

References:

1 Numerical Methods for Engineers, Numerical Methods for Engineers, Chapra, Steven C., and Raymond P. Canale., McGraw-Hill Higher Education, 2006

2 ntroductory Methods of Numerical Analysis, ntroductory Methods of Numerical Analysis, Sastry S S,, -, 2002

3 Partial Differential Equations for Scientists and Engineers", Partial Differential Equations for Scientists and Engineers", Stanley J Farlow , -, 1982

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	10.00	15.00	30.00	20.00	15.00

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Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc

2 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory

3 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

1 https://nptel.ac.in/courses/108/101/108101167/

2 https://www.cdeep.iitb.ac.in/slides/S20/EE725/EE725-L33.pdf

3 https://dspace.mit.edu/handle/1721.1/122702

4 https://web.mit.edu/kjb/www/Books/FEP_2nd_Edition_4th_Printing.pdf

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