MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Electronics and Communication Engineering

Name of the Subject	**ELECTROMAGNETIC FIELDS**	Name of the handling Faculty	**Dr. M.Sivakumar**
Subject Code	**EC8451**	Year / Sem	**II / IV**
Acad Year	**2021-2022**	Batch	**2020-2024**

Course Objective

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcome

CO1: Describe the fundamentals of electromagnetic concepts

CO2: Apply vector calculus to understand the behavior of static electric fields and how materials affect electric fields

CO3: Apply vector calculus to understand the behavior of magnetic fields in standard configurations

CO4: Explain how materials and forces affect the magnetic fields

CO5: Analyze the Maxwell's equation in different forms and Discuss the principles of electromagnetic wave propagation of uniform plane waves

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I: STATIC ELECTRIC FIELD							
1	Vector algebra	**T1**	**1**	**PPT**	**L1**	CO1	PO1,PO12
2	Coordinate Systems-Rectangular coordinate systems	**T1**	**1**	**MODEL**	**L1**	CO1	PO1,PO2,PO12
3	Cylindrical, Spherical coordinate systems	**T1, T2**	**1**	**MODEL**	**L2**	CO1	PO1,PO2, PO3,PO12
4	Vector differential operator, Gradient, Divergence, Curl, Divergence theorem,Stokes theorem	**T1, T2**	**1**	**BB**	**L2**	CO1	PO1,PO2, PO3
5	Coulombs law, Electric field intensity ,Point, Line, Surface and Volume charge distributions	**T1, R1**	**1**	**NPTEL**	**L2**	CO2	PO1,PO2,PO12
6	Electric flux density,Gauss law and its applications,Gauss divergence theorem	**T1, R1**	**1**	**PPT**	**L2**	CO2	PO1,PO2, PO3
7	Absolute Electric potential, Potential difference	**T1**	**1**	**BB**	**L2**	CO2	PO1,PO2, PO3
8	Calculation of potential differences for different configurations.	**T1**	**1**	**BB**	**L2**	CO2	PO1,PO2, PO3
9	Electric dipole	**T1 , T2**	**1**	**BB**	**L2**	CO2	PO1,PO2, PO3
10	Electrostatic Energy and Energy density.	**T1**	**1**	**BB**	**L2**	CO2	PO1,PO2, PO3
11	Problems- Vector , Gradient, Divergence, Curl, Stokes Theorem	**T1**	**1**	**BB**	**L3**	CO1	PO1,PO2, PO3
12	Problems- Coulombs Law. Electric Fields intensity, Electric Flux density, Potential, Energy	**T1**	**1**	**BB**	**L3**	CO2	PO1,PO2, PO3
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any.							
Evaluation method: Assignment and Tutorial problems / Quiz							
UNIT II: CONDUCTORS AND DIELECTRICS							
13	Conductors and dielectrics in Static Electric Field, Current and current density.	**T1**	**1**	**BB**	**L1**	CO2	PO1,PO2, PO3,PO12
14	Continuity equation, Polarization	**T1**	**1**	**BB**	**L1**	CO2	PO1,PO2

15	Boundary conditions- Free space to Conductor,Dielectric to c	**T1, T2**	**1**	**PPT**	**L2**	CO2	PO1,PO2
16	Boundary conditions-Dielectric to dielectric	**T1**	**1**	**PPT**	**L2**	CO2	PO1,PO2
17	Method of images, Resistance of a conductor.	**T1**	**1**	**BB**	**L2**	CO2	PO1,PO2
18	Capacitance, Parallel plate	**T1**	**1**	**PPT**	**L2**	CO2	PO1,PO2
19	Capacitance - cylindrical and spherical capacitors	**T1**	**1**	**PPT**	**L2**	CO2	PO1,PO2
20	Poisson˝s equation, Laplace˝s equation, Solution of Laplace equation.	**T1**	**1**	**PPT**	**L3**	CO2	PO1,PO2
21	Application of Poisson˝s and Laplace˝s equations	**T1**	**1**	**PPT**	**L3**	CO2	PO1,PO2
22	Problems-Current Dendity , Polarization	**T1 & T2**	**1**	**BB**	**L3**	CO2	PO1,PO2
23	Problems- Capacitance	**T1 & R1**	**1**	**BB**	**L3**	CO2	PO1,PO2
24	Problems- Boundary Conditions	**T1 & R2**	**1**	**BB**	**L3**	CO2	PO1,PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any							
Evaluation method: Assignment and Tutorial problems							
UNIT III: STATIC MAGNETIC FIELDS							
25	Biot -Savart Law, - Explanation	**T1**	**1**	**NPTEL**	**L1**	CO3	PO1,PO2
26	Magnetic field Intensity	**T1**	**1**	**NPTEL**	**L4**	CO3	PO1,PO2, PO3,PO6
27	Estimation of Magnetic field Intensity for straight and circular conductors.	**T1**	**1**	**BB**	**L2**	CO3	PO1,PO2
28	Estimation of Magnetic field Intensity for circular conductors and Sheet of Charge	**T1**	**1**	**BB**	**L2**	CO3	PO1,PO2
29	Ampere˝s Circuital Law, Point form of Ampere˝s Circuital Law, Stokes theorem	**T1**	**1**	**PPT**	**L2**	CO3	PO1,PO2
30	Applications of Ampere's Circuital law	**T1**	**1**	**PPT**	**L2**	CO3	PO1,PO2
31	Magnetic flux and magnetic flux density	**T1**	**1**	**BB**	**L2**	CO3	PO1,PO2 , PO12
32	The Scalar and Vector Magnetic potentials , Derivation of Steady magnetic field Laws.	**T1**	**1**	**BB**	**L2**	CO3	PO1,PO2
33	Problems - Biot Savert Law, Magnetic field intensity	**T1**	**1**	**BB**	**L3**	CO3	PO1,PO2
34	Problems - Applications of Magnetic field intensity	**T1**	**1**	**BB**	**L3**	CO3	PO1,PO2
35	Problems -Amperers circuital law	**T1**	**1**	**BB**	**L3**	CO3	PO1,PO2
36	Problems - Magnetic flux intensity, Vector magnetic potential	**T1**	**1**	**BB**	**L3**	CO3	PO1,PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any							
Evaluation method: Assignment and Tutorial problems							
UNIT IV: MAGNETIC FORCES AND MATERIALS							
37	Force on a moving charge, Force on a differential current element	**T1**	**1**	**BB**	**L1**	CO4	PO1,PO2
38	Force between current elements, Force and torque on a closed circuit	**T1 & T2**	**1**	**BB**	**L1**	CO4	PO1,PO2
39	The nature of magnetic materials, Magnetization and permeability	**T1**	**1**	**BB**	**L4**	CO4	PO1,PO2
40	Magnetic boundary conditions involving magnetic fields	**T1**	**1**	**BB**	**L2**	CO4	PO1,PO2
41	The magnetic circuit, Potential energy and forces on	**T1**	**1**	**BB**	**L1**	CO4	PO1,PO2
42	Inductance, Basic expressions for self and mutual inductances, Inductance evaluation for solenoid	**T1 & R1**	**1**	**PPT**	**L2**	CO4	PO1,PO2
43	Inductance evaluation for solenoid, toroid, coaxial cables and transmission lines	**T1 & R1**	**1**	**PPT**	**L2**	CO4	PO1,PO2

44	Energy stored in Magnetic fields	**T1**	**1**	**PPT**	**L2**	CO4	PO1,PO2
45	Problems - Force between current Element	**T1**	**1**	**BB**	**L3**	CO4	PO1,PO2
46	Problems - Magnetization and permeability	**T1**	**1**	**BB**	**L3**	CO4	PO1,PO2
47	Problems - Inductance	**T1**	**1**	**BB**	**L3**	CO4	PO1,PO2
48	Problems - Magnetic Energy	**T1**	**1**	**BB**	**L3**	CO4	PO1,PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any							
Evaluation method: The impactof Magnetic materials in Renewable energy							
UNIT V : TIME VARYING FIELDS AND MAXWELL'S EQUATIONS							
49	Fundamental relations for Electrostatic and Magnetostatic fields	**T1**	**1**	**BB**	**L1**	CO5	PO1,PO2
50	Faraday"s law for Electromagnetic induction, Transformers, Motional Electromotive forces	**T1**	**1**	**BB**	**L4**	CO5	PO1,PO2
51	Differential form of Maxwell"s equations, Integral form of Maxwell"s equations	**T1& T2**	**1**	**NPTEL**	**L2**	CO5	PO1,PO2
52	Potential functions, Electromagnetic boundary conditions	**T1**	**1**	**BB**	**L2**	CO5	PO1,PO2
53	Wave equations and their solutions- Plane Waves in Lossless medium	**T1**	**1**	**NPTEL**	**L2**	CO5	PO1,PO2
54	Wave equations and their solutions- Plane Waves in Lossy medium & Good Conductor	**T1 & R1**	**1**	**BB**	**L2**	CO5	PO1,PO2
55	Poynting"s theorem- Derivation	**T1**	**1**	**PPT**	**L2**	CO5	PO1,PO2
56	Poynting Vector for Coaxial Cable	**T1**	**1**	**BB**	**L3**	CO5	PO1,PO2
57	Problems - Faraday"s law for Electromagnetic induction	**T1, T2& R1**	**1**	**BB**	**L3**	CO5	PO1,PO2
58	Problems - Maxwell"s equations	**T1, T2 & R1**	**1**	**BB**	**L3**	CO5	PO1,PO2
59	Problems - Wave equations	**T1, T2 7 R1**	**1**	**BB**	**L3**	CO5	PO1,PO2
60	Problems - Poynting"s theorem	**T1 , T2 & R1**	**1**	**BB**	**L3**	CO5	PO1,PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any							
Evaluation method: Health Implications of Electromagnetic Fields - Case study							

Content Beyond the Syllabus Planned	
1	Null Identitities, Helmholtz theorem
2	Fundamental concepts of Antennas
Text Books	
1	W.H. Hayt and J.A. Buck, Engineering electrmagnetics, 7th ed., McGraw-Hill (India), 2006 (UNIT I-V)
2	M.H. Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford (Asian Edition), 2015
Reference Books	
1	David K Cheng, "Field and Wave Electromagnetics", Pearson Education Inc, Delhi, 2004
2	John D Kraus and Daniel A Fleisch, "Electromagnetics with Applications", Mc Graw Hill Book Co, 2005
3	Karl E Longman and Sava V Savov, "Fundamentals of Electromagnetics", Prentice Hall of India, New Delhi, 2006
4	Ashutosh Pramanic, "Electromagnetism", Prentice Hall of India , New Delhi, 2006
Website / URL References	
1	https://nptel.ac.in/courses/108/106/108106073/
2	https://nptel.ac.in/courses/117/103/117103065/

Blooms Level						
Level 1 (L1) : Remembering	Lower Order Thinking	Fixed Hour Exams	**Level 4 (L4) : Analysing**		Higher Order Thinking	Projects / Mini Projects
Level 2 (L2) : Understanding			**Level 5 (L5) : Evaluating**			
Level 3 (L3) : Applying			**Level 6 (L6) : Creating**			

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	Static Electric Fields	2	8	2	0	0	0	12	0	12
Unit 2	Conductors and Dielectrics	2	5	**5**	**0**	**0**	**0**	12	0	12
Unit 3	Static Magnetic Fields	1	6	**4**	**1**	**0**	**0**	11	1	12
Unit 4	Magnetic Forces & Materials	3	4	**4**	**1**	**0**	**0**	11	1	12
Unit 5	Time Varying Fields & Maxwell's Equations	1	5	**5**	**1**	**0**	**0**	11	1	12
Total		9	28	20	3	0	0	57	3	60
Total Percentage		15	46.667	33.333	5	0	0	95	5	100

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	1	0
CO2	**3**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	1	0
CO3	**3**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	1	0
CO4	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	1	0
CO5	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0	1	0
Avg	**3**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	1	0

Justification for CO-PO mapping	
CO1	PO1:Applying of engineering concept is more predominent, PO2: Applying the formulas and analyze the problems considered moderately, PO3: A small impact is given to the complex problems. PO12: Concepts helps in life long learning
CO2	PO1:Applying of engineering concept is more predominent, PO2: Applying the formulas and analyze the problems considered moderately, PO3: A small impact is given to the complex problems. PO12: Concepts helps in life long learning
CO3	PO1: Engineering concept contribution is moderate, PO2: Applying the basic fromulas and analyze the problem significantly, PO3: Less Impact of the solving complex problems , PO12: Concepts helps in life long learning
CO4	PO1:Understanding and applying the engineering concept is more, PO2: High degree of solving problems by analysing the data given data.
CO5	PO1:Understanding and applying the engineering concept is more, PO2: High degree of solving problems by analysing the data given data

3	**High level**	**2**	**Moderate level**	**1**	Low level
Name & Sign of Faculty Incharge : Dr. M.Sivakumar					
Name & Sign of Subject Expert :					
Head of the Department :					

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