K. S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SESSION: 2023-2024 (ODD SEMESTER)

CO-PO MAPPING

Course: Electromagnetic Waves			
Type: Core		Course Code: 21EC54	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
3	0	4	40
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	3

Aim/Objectives of the Course:

1. Study the different coordinate systems, Physical signifiance of Divergence, Curl and Gradient.
2. Understand the applications of Coulomb's law and Gauss law to different charge distributions and the applications of Laplace's and Poisson's Equations to solve real time problems on capacitance of different charge distributions.
3. Understand the physical significance of Biot-Savart, Ampere's Law and Stokes' theorem for different current distributions.
4. Infer the effects of magnetic forces, materials and inductance.
5. Know the physical interpretation of Maxwell' equations and applications for Plane waves for their behaviour in different media
6. Acquire knowledge of Poynting theorem and its application of power flow.

Course Learning Outcomes
After completing the course, the students will be able to

CO1	**Solve** the problems on electric field due to point, linear, volume charges by applying conventional methods or by Coulombs law.	**Applying (K3)**
CO2	**Choose** Gauss law, potential and energy to determine the energy expended and potential difference with respect to point charge.	**Applying (K3)**
CO3	**Develop** the capacitances using Laplace equations and determine the current distributions in electromagnetic field	**Applying (K3)**
CO4	**Utilize** the concepts of magnetic Forces and Materials to determine magnetic fields, forces, and potential energy.	**Applying (K3)**
CO5	**Make use of** time varying fields, Maxwell's Equations and Poynting theorem to calculate power in EM waves	**Applying (K3)**

Syllabus Content	
Module 1 Revision of Vector Calculus – **(Text 1: Chapter 1)** **Coulomb's Law, Electric Field Intensity and Flux density**: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Numerical Problems. **(Text: Chapter 2.1 to 2.5, 3.1)**. **LO**: At the end of this session the student will be able to, 1. Derive Coulomb's law with examples. 2. Compute Electric field intensity and field due to continuous charge column distribution. 3. Understand the concept of field of a line charge. 4. Make use of electric flux density to solve problems.	**CO1** 8hrs PO1-3 PO2-2 PO3-1 PO4-1 PO9-1 PO10 -1 PO12 -2
Module 2: **Gauss's law and Divergence**: Gauss 'law, Application of Gauss' law to point charge, line charge, Surface charge and volume charge, Point (differential) form of Gauss law, Divergence. Maxwell's First equation (Electrostatics), Vector Operator ▼ and divergence theorem, Numerical Problems (**Text: Chapter 3.2 to 3.7).** **Energy, Potential and Conductors**: Energy expended or work done in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Potential gradient, Numerical Problems **(Text: Chapter 4.1 to 4.4 and 4.6).** Current and Current density, Continuity of current. **(Text: Chapter 5.1, 5.2)** **LO**: At the end of this session the student will be able to, 1. Make use of Gauss law and divergence theorem to solve problems. 2. Understand Maxwell's first equation to solve the problems on electrostatistics. 3. Compute energy expended in moving a point charge in an electric field. 4. Define potential difference, potential, potential field of point charge, current density.	**CO2** 8 hrs. PO1-3 PO2-2 PO3-1 PO4-1 PO9-1 PO10 -1 PO12 -1
Module 3: **Poisson's and Laplace's Equations**: Derivation of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of Laplace's equation, Numerical problems on Laplace equation **(Text: Chapter 7.1 to 7.3)** **Steady Magnetic Field**: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Basic concepts Scalar and Vector Magnetic Potentials, Numerical problems. **(Text: Chapter 8.1 to 8.6)** **LO**: At the end of this session the student will be able to, 1. Derive poisson's and laplace equation. 2. Define Uniqueness theorem. 3. Understand Biot savarts law, Amperes circuital law, magnetic flux.	**CO3** 8 hrs PO1-3 PO2-2 PO3-1 PO4-1 PO9-1 PO10-1 PO12 -1

Module 4: **Magnetic Forces**: Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems **(Text: Chapter 9.1 to 9.3).** **Magnetic Materials**: Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual reactance, Numerical problems **(Text: Chapter 9.6 to 9.7).** Faraday' law of Electromagnetic Induction –Integral form and Point form, Numerical problems **(Text: Chapter 10.1)** **LO:** At the end of this session the student will be able to, 1. Analyse the force on a moving charge, differential current elements. 2. Understand the concepts of magnetization and permeability, magnetic boundary conditions. 3. Understand potential energy and forces on magnetic materials.	**CO4** 8 hrs PO1-3 PO2-2 PO3-1 PO4-1 PO9-1 PO10 -1 PO12 -1
Module 5: **Maxwell's equations** Continuity equation, Inconsistency of Ampere's law with continuity equation, displacement current, Conduction current, Derivation of Maxwell's equations in point form, and integral form, Maxwell's equations for different media, Numerical problems **(Text: Chapter 10.2 to 10.4)** **Uniform Plane Wave**: Plane wave, Uniform plane wave, Derivation of plane wave equations from Maxwell's equations, Solution of wave equation for perfect dielectric, Relation between E and H, Wave propagation in free space, Solution of wave equation for sinusoidal excitation, wave propagation in any conducting media (γ, α, β, η) and good conductors, Skin effect or Depth of penetration, Poynting's theorem and wave power, Numerical problems. **(Text: Chapter 12.1 to 12.4)** **LO:** At the end of this session the student will be able to, 1. Explain the Faradays law, displacement current. 2. Analyze maxwell's equation in point form and Maxwell's equation in integral form. 3. Understand wave propagation in free space and good conductors, poynting`s theorem and wave power.	**CO5** 8hrs PO1-3 PO2-2 PO3-1 PO4-1 PO9-1 PO10-1 PO12 -1
Text Books: W.H. Hayt and J.A. Buck, **"Engineering Electromagnetics",** 8th Edition, Tata McGraw-Hill, 2014, ISBN-978-93-392-0327-6.	
Reference Books (specify minimum two foreign authors text books) 1. Matthew N.O., Sadiku "**Elements of Electromagnetics**", Oxford university press, 4thEdn. 2. E. C. Jordan and K.G. Balman "**Electromagnetic Waves and Radiating systems**", PHI, 2nd Edition. 3. Joseph Edminister, Schaum "**Electromagnetics**" Outline Series, McGraw Hill. 4. N. Narayana Rao, "**Fundamentals of Electromagnetics for Engineering**", Pearson	
Useful Websites • https://onlinecourses.nptel.ac.in/noc16_ee01/announcements • https://archive.nptel.ac.in/courses/108/104/108104087/ • https://www.youtube.com/watch?v=ctqAcFPq2GM&list=PLm_MSClsnwm-WXH-IcaX-hMon-QHNvxh5	
Useful Journals 1. https://www.tandfonline.com/toc/tewa20/current 2. https://www.hilarispublisher.com/electrical-electronic-systems.html	

Teaching and Learning Methods

1. Lecture class: 40 hrs
2. Practical classes: 0

Assessment

Type of test/examination: Written examination

Continuous Internal Evaluation (CIE) : 50 marks (20 marks -Average of three tests + 10 marks Assignments+20 marks activity)

Semester End Exam (SEE): 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.

Test duration: 1:00 hours

Examination duration: 3 hours

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:** Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:** Environment and Society **PO8:** Ethics **PO9:** Individual & Team Work **PO10:** Communication **PO11:** Project Management & Finance **PO12:** Life-long Learning

At the end of the Program, the students should

PSO1: Be able to acquire knowledge and apply concepts in the field of engineering and interdisciplinary subjects.

PSO2: Be able to identify the existing problems, effectively utilize tools to provide solution, and disseminate the information.

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PS O1	PS
21EC 54	K-level														
CO1	K3	3	2	1	1	-	-	-	-	1	1	-	1	2	1
CO2	K3	3	2	1	1	-	-	-	-	1	1	-	1	2	1
CO3	K3	3	2	1	1	-	-	-	-	1	1	-	1	2	1
CO4	K3	3	2	1	1	-	-	-	-	1	1	-	1	2	1
CO5	K3	3	2	1	1	-	-	-	-	1	1	-	1	2	1

Course In charge

Head - Dept

Professor & Head
Dept. of Electronics & Communication Engineering
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Principal

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