

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication
Engineering NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)
V Semester

ELECTROMAGNETIC WAVES

Course Code	21EC54	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: This course will enable students to :

- Study the different coordinate systems, Physical significance of Divergence, Curl and Gradient.
- 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.
- Understand the physical significance of Biot-Savart's, Amperes's Law and Stokes's theorem for different current distributions.
- Infer the effects of magnetic forces, materials and inductance.
- Know the physical interpretation of Maxwell's equations and applications for Plane waves for their behavior in different media.
- Acquire knowledge of Poynting theorem and its application of power flow.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
3. Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
4. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
5. Using videos for demonstration of the fundamental principles to students for better understanding of concepts.

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)

Teaching-Learning Process	Chalk and Talk would be helpful for the quantitative analysis. Videos of the Basic principles of the devices would help students to grasp better. RBT Level: L1, L2, L3
Module-2	
<p>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).</p> <p>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)</p>	
Teaching-Learning	Chalk and Talk, PowerPoint Presentation
Process	RBT Level: L1, L2, L3
Module-3	
<p>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)</p> <p>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)</p>	
Teaching-Learning Process	Chalk and talk method, Power point presentation and videos. RBT Level: L1, L2, L3
Module-4	
<p>Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems (Text: Chapter 9.1 to 9.3).</p> <p>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).</p> <p>Faraday' law of Electromagnetic Induction –Integral form and Point form, Numerical problems (Text: Chapter 10.1)</p>	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation RBT Level: L1, L2, L3
Module-5	
<p>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)</p> <p>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</p>	

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)

Teaching-Learning Process

Chalk and Talk, PowerPoint Presentation

RBT Level: L1, L2, L3

Course Outcomes

At the end of the course the student will be able to:

- Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume.
- Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.
- Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations
- Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
- Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Text Book:**

1. W.H. Hayt and J.A. Buck, —Engineering Electromagnetics||, 8th Edition, Tata McGraw-Hill, 2014, ISBN-978-93-392-0327-6.

Reference Books:

1. Elements of Electromagnetics – Matthew N.O., Sadiku, Oxford university press, 4thEdn.
2. Electromagnetic Waves and Radiating systems – E. C. Jordan and K.G. Balmain, PHI, 2ndEdn.
3. Electromagnetics- Joseph Edminister, Schaum Outline Series, McGraw Hill.
4. N. NarayanaRao, —Fundamentals of Electromagnetics for Engineering||, Pearson

Web links and Video Lectures (e-Resources):

- <https://archive.nptel.ac.in/courses/108/104/108104087/>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes, Seminars


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