

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**ELECTRONICS AND COMMUNICATION (11)**  
**ELECTROMAGNETIC THEORY**  
**SUBJECT CODE: 2911102**  
**1<sup>st</sup> SEMESTER**

**Type of Course:** Electromagnetic Theory and Wave Propagation

**Prerequisite:** Basic knowledge of vector calculus, Electric and Magnetic fields and its laws.

**Rationale:** This course provides strong foundation for understanding the fundamental principles and laws of electromagnetism to understand transmission, radiation and propagation theory. Students can understand the physical interpretation and application of various laws and theorems of electric and magnetic fields. The students can also understand the principles of transmission lines.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
4	0	0	6	70	30	0	0	100

Sr. No.	Course Content	Teach-ing hours	Module weightage
1	<b>Review of Vector Calculus</b> Over view of Vector Algebra, Dot Product, Cross Product, Coordinate Systems, Conversion of a Vector from One Coordinate system to another, Del Operator, Divergence, Gradient and Curl.	<b>05</b>	<b>10%</b>
2	<b>Overview of Electrostatic &amp; Steady Magnetic Fields</b> Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume Charge Distributions, Gauss law, Divergence Theorem, Electric potential, Potential Gradient, Biot-Savart Law, Magnetic Flux and Magnetic Flux Density, Ampere's Circuital Law, , Stoke's theorem Scalar and Vector Magnetic potentials, Lorentz Force equation.	<b>12</b>	<b>20%</b>
3	<b>Time Varying Fields and Maxwell's Equations (6 Hours)</b> Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form, The Retarded Potentials.	<b>09</b>	<b>20%</b>
4	<b>Uniform Plane Wave (6 Hours)</b> Wave Propagation in Free Space, Wave Propagation in Die-Electric, The Poynting Vector and Power Considerations, Propagation in Good Conductors: Skin Effect, Wave Polarization.	<b>12</b>	<b>20%</b>
5	<b>Plane Waves at Boundaries and in Dispersive Media</b> Reflection of Uniform Plane Wave at Normal Incidence, Standing Wave Ratio, Wave Reflection from Multiple Interfaces, Plane Wave Propagation in General Directions, Plane Wave Reflection at Oblique Incidence Angle.	<b>10</b>	<b>15%</b>
6	<b>Transmission Lines</b> Transmission lines parameters, Equations of Voltage and Current on TX line, Propagation Constant and Characteristic Impedance, Input Impedance, and Reflection Coefficient and VSWR, Power Transfer, Lossless and Distortionless	<b>12</b>	<b>15%</b>

Transmission Lines, Smith Chart, Applications of Transmission Lines, Impedance Matching: Single and Double Stub Lines.		
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**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>05</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>05</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

- 1 W. Hayt, "Engineering Electromagnetics", Seventh Edition, McGraw Hill Education, 2012.
- 2 M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
- 3 R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
- 4 A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
- 5 Electrimagnetics Fields and Waves Third Edition by Simon Ramo, John Whinnery Wiley India Edition.
- 6 Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
- 7 E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand the basic concepts of Electromagnetic theory
2. Correlate the basic theorems to determine E and H field
3. Interpret the relevance of Maxwell's equations for applications in communication
4. Use sections of transmission line sections for realizing circuit elements
5. Characterize uniform plane wave
6. Calculate reflection and transmission of waves at media interface
7. Understand characteristics and wave propagation on high frequency transmission lines
8. Carryout impedance transformation on TL
9. Analyse load conditions on transmission lines
10. Get insight into Transmission line problems using Smith Chart

**List of Open Source Software/learning website:**

1. CD available with first reference book.
2. nptel.ac.in