**Techno India NJR Institute of Technology**



**Course File**

**Session 2023-24**

**Electromagnetic Waves (5EC4-02)**

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**Course Overview:**

Student will learn fundamentals of Electromagnetic waves from this 40-hour course. In this course, student will study the fundamental concepts and application of electromagnetic radiations. Also, they will studyvector calculus, coordinate systems, maxwell’s equation and fundamentals of waveguide and antennas.

**Course Outcomes:**

|  |  |  |
| --- | --- | --- |
| **CO.NO.** | **Cognitive Level** | **Course Outcome**  |
| 1 | Knowledge | Describe the concepts of coordinate system. |
| 2 | Analysis | Analyze the basic laws of electromagnetic field. |
| 3 | Synthesis | Explain the concepts of EMI & EMC. |
| 4 | Knowledge | Describe the complete overview of microwave components |
| 5 | Analyse | Analyze different types of microwave components |

**Prerequisites:**

1. Fundamentals of various orthogonal coordinate systems.
2. Must have completed the course on electrostatics and magnetostatics.
3. Student should be able to solve the problems of vector calculus.

**Course Outcome Mapping with Program Outcome:**

|  |  |
| --- | --- |
| **Course Outcome**  | **Program Outcomes (PO’s)** |
| **CO. NO.** | **Domain Specific**  | **Domain Independent**  |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 2 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO2** | 2 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO3** | 1 | 2 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO4** | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO5** | 1 | 2 | 3 | 1 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 1 |
| 1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)  |

**Course Coverage Module Wise:**

|  |  |  |
| --- | --- | --- |
| **Lecture No.** | **Unit** | **Topic** |
|  | **1** | **INTRODUCTION: Objective, scope and outcome of the course** |
|  | **2** | **TRANSMISSION LINES:-** Equations of Voltage and Current on TX line |
|  | 2 | Propagation constant and characteristic impedance |
|  | 2 | Reflection coefficient and VSWR |
|  | 2 | Impedance Transformation on Loss-less and Low loss Transmission line |
|  | 2 | Power transfer on TX line, Numerical |
|  | 2 | Smith Chart |
|  | 2 | Admittance Smith Chart |
|  | 2 | Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements. |
|  | **3** | **MAXWELL’S EQUATIONS-**Basics of Vectors, Vector calculus |
|  | 3 | Basic laws of electromagnetics, Maxwell's Equations |
|  | 3 | Boundary conditions at Media Interface |
|  | **4** | **UNIFORM PLANE WAVE:-** Propagation of wave |
|  | 4 | Wave polarization |
|  | 4 | Poincare’s Sphere |
|  | 4 | Wave propagation in conducting medium |
|  | 4 | Phase and group velocity |
|  | 4 | Power flow and Poynting vector |
|  | 4 | Surface current |
|  | 4 | Power loss in a conductor |
|  | **5** | **PLANE WAVES AT A MEDIA INTERFACE** |
|  | 5 | Plane wave in arbitrary direction |
|  | 5 | Reflection and refraction at dielectric interface |
|  | 5 | Reflection and refraction at dielectric interface |
|  | 5 | Total internal reflection |
|  | 5 | wave polarization at media interface |
|  | 5 | Reflection from a conducting boundary |
|  | **6** | **WAVEGUIDES** |
|  | 6 | Wave propagation in parallel plate waveguide |
|  | 6 | Analysis of waveguide general approach |
|  | 6 | Rectangular waveguide |
|  | 6 | Modal propagation in rectangular waveguide |
|  | 6 | Surface currents on the waveguide walls |
|  | 6 | Field visualization |
|  | 6 | Attenuation in waveguide |
|  | **7** | **RADIATION FROM ANTENNA** |
|  | 7 | Radiation-Solution for potential function |
|  | 7 | Radiation from the Hertz dipole |
|  | 7 | Radiation Parameters of antenna |
|  | 7 | Receiving antenna |

**TEXT/REFERENCE BOOKS**

1.Electromagnetic Field Theory, Sadiku, Oxford.

2. Principles of Electromagnetics, Mahapatra, TMH.

3. Electromagnetic Field Theory and Transmission Lines, Rao, Wiley

**Teaching and Learning resources:**

* **MOOC (NPTEL): -** https://nptel.ac.in/courses/117/101/117101056/

**Assessment Methodology:**

1. Practical exam using lab instruments.
2. Two Midterm exams where student have to showcase subjective learning.
3. Final Exam (subjective paper) at the end of the semester.





