**SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES**
**(AUTONOMOUS)**

## QUESTION BANK

**Year / Semester: III B.Tech VI Semester** **Regulation: R23**

**Subject and Code: Electromagnetic Fields and Transmission Lines 23ECE362T**

## SYLLABUS

### UNIT –1: ELECTROSTATICS (9)

Review of Co-ordinate Systems, Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

### UNIT –2: MAGNETOSTATICS (9)

Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems.

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements, Conditions at a Boundary Surface, Illustrative Problems.

### UNIT –3: EM WAVE CHARACTERISTICS (9)

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossy dielectrics, lossless dielectrics, free space, wave propagation in good conductors, skin depth, Polarization & Types, Illustrative Problems.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem, Illustrative Problems.

### UNIT –4: TRANSMISSION LINES - I (9)

Types, Parameters, T & π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Illustrative Problems.

### UNIT –5: TRANSMISSION LINES – II (9)

Input Impedance Relations, Reflection Coefficient, VSWR, Average Power, Shorted Lines, Open Circuited Lines, and Matched Lines, Low loss radio frequency and UHF Transmission lines, UHF Lines as Circuit Elements, Smith Chart – Construction and Applications, Quarter wave transformer, Single Stub Matching, Illustrative Problems.

**Total Hours: 45**

### TEXT BOOKS:

1.Elements of Electromagnetics, Matthew N.O. Sadiku, 4th Edition, Oxford University Press, 2008.
2.Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, 2nd Edition, PHI, 2000.

### REFERENCE BOOKS:

1.Electromagnetic Field Theory and Transmission Lines, G. S. N. Raju, 2nd Edition, Pearson Education, 2013.
2.Engineering Electromagnetics, William H. Hayt Jr. and John A. Buck, 7th Edition, Tata McGraw Hill, 2006.
3.Electromagnetics, John D. Krauss, 3rd Edition, McGraw Hill, 1988.
4.Networks, Lines, and Fields, John D. Ryder,2nd Edition, PHI publications, 2012.

Prepared by Prof. R.Mynuddin Sulthani

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**Max Marks: 10**

| S.No. | CO | Questions | BT |
|---|---|---|---|
| | | **Unit I: (ELECTROSTATICS)** | |
| 1 | **1** | Explain about various Coordinates systems & conversions | **L1** |
| 2 | **1** | Explain Coulomb's Law and define Electric Field Intensity. | **L1** |
| 3 | **1** | State and explain Gauss's Law with applications. | **L1** |
| 4 | **1** | Explain Electric Potential and its relation with Electric Field | **L3** |
| 5 | **1** | Define and derive electric energy density | **L1,L3** |
| 6 | **1** | Derive Poisson's and Laplace's equations. | **L3** |
| 7 | **1** | Explain Parallel Plate and Coaxial Capacitors. | **L2** |
| 8 | **1** | Explain conduction and convection currents & derive for their current densities | **L1,L3** |
| 9 | **1** | Write and derive Maxwell's 4 equations | **L3** |
| 10 | **1** | Two point charges of q1=5 μCq_1 = 5\,\mu Cq1=5μC and q2=10 μCq_2 = 10\,\mu Cq2=10μC are separated by a distance of 20 cm in free space. Find the force between them. | **L4** |
| 11 | **1** | The electric field between two parallel plates is 3×104 V/m3 \times 10^4 \, V/m3×104V/m. Find the electric flux density in free space. | **L4** |

| S.No. | CO | Questions | BT |
|---|---|---|---|
| | | **Unit II: (MAGNETOSTATICS)** | |
| 1 | **2** | Derive **Biot–Savart Law** and obtain an expression for the magnetic field at a point due to a long straight current carrying conductor. | **L3** |
| 2 | **2** | a. State and explain **Ampere's Circuital Law**.<br>b. Derive the magnetic field intensity for an **infinitely long current-carrying conductor**. | **L1, L3** |
| 3 | **2** | a.Explain **magnetic flux density (B)** and **magnetic field intensity (H)**.<br>b.Derive the relation between **B and H** in magnetic materials. | **L1, L4** |
| 4 | **2** | Derive **Maxwell's equations for magnetostatic fields** and explain their physical significance. | **L4** |

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| | | | |
|---|---|---|---|
| 5 | **2** | Explain **magnetic scalar potential** and **magnetic vector potential**. Derive the relation between **magnetic vector potential (A) and magnetic flux density (B)**. | **L1,L4** |
| 6 | **2** | Derive the expression for **force on a current-carrying conductor placed in a magnetic field** (Ampere's force law). | **L4** |
| 7 | **2** | Define an Inductance, explain the concept of **self-inductance and mutual inductance**.<br>Derive the expression for **energy stored in a magnetic field**. | **L1,L3** |
| 8 | **2** | State and derive **Faraday's Law of Electromagnetic Induction**.<br>Explain **motional EMF** and **transformer EMF**. | **L4** |
| 9 | **2** | Explain the **inconsistency of Ampere's Law** and show how **Maxwell introduced displacement current** to correct it. | **L1,L4** |
| 10 | **2** | Write **Maxwell's equations for time-varying fields** in<br>a) Differential form<br>b) Integral form and explain the physical meaning of each equation. | **L2** |
| 11 | **2** | Derive the **boundary conditions** for electromagnetic fields at the interface between two media | **L4** |

| **S.No.** | **CO** | **Questions** | **BT** |
|---|---|---|---|
| **Unit III: (EM WAVE CHARACTERISTICS)** | | | |
| 1 | **3** | Explain the propagation of electromagnetic waves in:<br>a) Free space b) Lossless dielectric c) Lossy dielectric | **L1** |
| 2 | **3** | Derive wave equations for conducting and perfect dielectric media | **L3** |
| 3 | **3** | Explain **skin depth** and derive its expression. Discuss its significance in good conductors. | **L1,L4** |
| 4 | **3** | Explain reflection and refraction of plane waves at normal and oblique incidence. Derive Brewster angle. | **L1,L3** |
| 5 | **3** | Define and explain **Poynting vector and Poynting theorem** with physical significance. | **L1,L4** |

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| | | | |
|---|---|---|---|
| 6 | **3** | A plane wave in air ($\eta_1$ = 377 Ω) is normally incident on a dielectric medium with $\eta_2$ = 754 Ω. Calculate the reflection coefficient. | **L4** |
| 7 | **3** | If the incident electric field amplitude is 10 V/m and reflection coefficient is 0.2, find the reflected field amplitude. | **L4** |
| 8 | **3** | An electromagnetic wave has E = 50 V/m and H = 0.133 A/m. Calculate the magnitude of the Poynting vector. | **L4** |
| 9 | **3** | In a nonmagnetic medium, $H = 0.2e^{-y}\cos(2\pi \times 10^8 t - 5y)a_z$ A/m. Find (i) Direction of propagation (ii) $\varepsilon_r$ (iii) σ (iv) η (v) E field | **L4** |
| 10 | **3** | Explain the causes for attenuation in Parallel plane wave guides. (b) Define and explain the significance of the following terms as applicable to parallel plane guides: i. Wave impedance. ii. Phase and group velocities iii. Principal wave and its characteristics | **L2** |

| S.No | CO | Questions | BT |
|---|---|---|---|
| **Unit IV: (TRANSMISSION LINES - I)** | | | |
| 1 | **4** | Explain the types of transmission lines with neat diagrams. | **L1** |
| 2 | **4** | Derive the transmission line equations using the distributed parameter model. | **L3** |
| 3 | **4** | Explain the T and □equivalent circuits of transmission lines. | **L2** |
| 4 | **4** | Define primary and secondary constants of a transmission line and explain their significance. | **L2** |
| 5 | **4** | Derive the expression for characteristic impedance of a transmission line. | **L3** |
| 6 | **4** | Derive the propagation constant o f a transmission line and explain attenuation and phase constants. | **L1, L4** |
| 7 | **4** | Explain the conditions for a distortionless transmission line. | **L4** |
| 8 | **4** | Explain lossless transmission lines and derive the expression for characteristic impedance. | **L1, L4** |
| 9 | **4** | Define and explain phase velocity and group velocity. | **L1** |
| 10 | **4** | Explain the concept of infinite transmission line and its properties. | **L1** |

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| S.No. | CO | Questions | BT |
|---|---|---|---|
| **Unit V: (TRANSMISSION LINES – II)** | | | |
| 1 | 5 | Derive the input impedance equation of a transmission line.. | L4 |
| 2 | 5 | Explain reflection coefficient and standing waves. | L1 |
| 3 | 5 | Derive the relation between reflection coefficient and VSWR. | L3 |
| 4 | 5 | Explain short circuited and open circuited transmission lines. | L2 |
| 5 | 5 | Explain matched transmission lines and their properties. | L2 |
| 6 | 5 | Explain low loss RF and UHF transmission lines. | L2 |
| 7 | 5 | Explain UHF transmission lines as circuit elements. | L2 |
| 8 | 5 | Explain construction and working of Smith Chart. | L1 |
| 9 | 5 | Explain applications of Smith Chart. | L1 |
| 10 | 5 | Explain quarter wave transformer and single stub matching | L1 |

Note: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, and L6-Creating

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## Instruction to Faculty Members:

## The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).
2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).
3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).
5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).