EMTL Question Bank - II-ECE (2025-26)

(A). Short answer questions

1. Define Coulomb's Law.
2. Write the mathematical expression for Coulomb's Law.
3. Define Electric Field Intensity.
4. What is the unit of Electric Field Intensity?
5. Define Electric Flux.
6. What is Electric Flux Density?
7. Write the relation between electric field intensity (E) and electric flux density (D).
8. State Gauss's Law.
9. Define Electric Potential.
10. What is the unit of Electric Potential?
11. What is Dielectric Constant?
12. Define Conduction Current.
13. Define Convection Current.
14. What is Energy Density of an Electric Field?
15. Write Poisson's Equation.
16. Write Laplace's Equation.
17. Define Capacitance.
18. What is the unit of Capacitance?
19. Name two types of capacitors.
20. What happens to capacitance when a dielectric is inserted between the plates?

(B). Short Numerical questions

Problem 1
Two point charges of $q_1 = 5\,\mu C$ and $q_2 = 10\,\mu C$ are separated by a distance of 20 cm in free space. Find the force between them.

Problem 2
Find the electric field intensity at a point 10 cm away from a point charge of $2\,\mu C$ in free space.

Problem 3
A charge of $6\,\mu C$ is placed at the center of a sphere. Find the electric flux through the surface of the sphere.

Problem 4
Calculate the electric potential at a point 5 cm away from a charge of $4\,\mu C$ in free space.

Problem 5
A parallel plate capacitor has plate area $0.02\,m^2$ and separation of 2 mm. Find its capacitance in free space.

Problem 6
A dielectric of relative permittivity 4 is inserted between the plates of the capacitor in Problem 5. Find the new capacitance.

Problem 7
The electric field between two parallel plates is $3 \times 10^4\,V/m$. Find the electric flux density in free space.

(C). Descriptive questions

Q1. Explain Coulomb's Law and define Electric Field Intensity.

Q2. State and explain Gauss's Law with applications. *(10 Marks)*

Q3. Explain Electric Potential and its relation with Electric Field. *(5 Marks)*

Q4. Derive Poisson's and Laplace's equations. *(10 Marks)*

Q5. Explain Parallel Plate and Coaxial Capacitors. *(10 Marks)*

Q6. Explain conduction and convection currents & derive for their current densities *(10 Marks)*

EMTL UNIT-2 (Question Bank)

(A).Short Answer Questions (2 Marks)
1. State Biot–Savart Law.
2. Define magnetic flux density.
3. Write Ampere's circuital law.
4. What is magnetic vector potential?
5. Define magnetic flux.
6. What is Faraday's law of electromagnetic induction?
7. What is displacement current?
8. Write any one Maxwell's equation for time-varying fields.
9. What is magnetic energy?
10. What is transformer EMF?

(B). Short numerical problems questions:
1. A long straight conductor carries a current of 5 A. Find the magnetic field intensity at a point 10 cm away from it. $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$μ0=4π×10−7 H/m
2. A circular coil of radius 0.1 m carries a current of 2 A. Find the magnetic flux density at the center.
3. Two long parallel conductors 5 cm apart carry currents of 10 A and 20 A in the same direction. Find the force per meter length between them.
4. An inductor of 2 H carries a current of 3 A. Calculate the energy stored.
5. A coil having 500 turns is linked with a magnetic flux of 0.01 Wb. Find the flux linkage.
6. A magnetic flux of 0.02 Wb changes to zero in 0.01 s in a coil of 100 turns. Find the induced EMF.
7. A magnetic field of 0.4 T acts on a conductor of length 0.2 m carrying a current of 5 A at right angles to the field. Find the force.
8. A toroid has a mean radius of 10 cm and carries a current of 2 A. Find the magnetic field intensity inside the toroid.
9. A solenoid has 1000 turns, length 0.5 m and carries a current of 1 A. Find the magnetic field inside it.
10. A displacement current of 2 mA flows through a capacitor. Find the rate of change of electric flux.

(C). Descreptive Questions:
1.Derive **Biot–Savart Law** and obtain an expression for the magnetic field at a point due to a **long straight current carrying conductor**.
2.State and explain **Ampere's Circuital Law**.
Derive the magnetic field intensity for an **infinitely long current-carrying conductor**.
3.Explain **magnetic flux density (B)** and **magnetic field intensity (H)**.
Derive the relation between **B and H** in magnetic materials.
4.Derive **Maxwell's equations for magnetostatic fields** and explain their physical significance.
5.Explain **magnetic scalar potential** and **magnetic vector potential**.
Derive the relation between **magnetic vector potential (A) and magnetic flux density (B)**.

6. Derive the expression for **force on a current-carrying conductor placed in a magnetic field** (Ampere's force law).

7. Define an Inductance, explain the concept of **self-inductance and mutual inductance**.

Derive the expression for **energy stored in a magnetic field**.

8. State and derive **Faraday's Law of Electromagnetic Induction**.

Explain **motional EMF** and **transformer EMF**.

9. Explain the **inconsistency of Ampere's Law** and show how **Maxwell introduced displacement current** to correct it.

10. Write **Maxwell's equations for time-varying fields** in

a) Differential form

b) Integral form and explain the physical meaning of each equation.

11. Derive the **boundary conditions** for electromagnetic fields at the interface between two media

EMTL- UNIT-3 (question Bank)

(A). Short Answer Question:
. Define a **uniform plane wave**.
2. Write the relation between electric field **E** and magnetic field **H** in a uniform plane wave.
3. What is meant by **intrinsic impedance** of a medium?
4. Define the **propagation constant (γ)** and name its components.
5. What is the condition for a medium to be a **lossless dielectric**?
6. Define **skin depth**.
7. How does skin depth vary with frequency in a good conductor?
8. What is meant by **polarization of an electromagnetic wave**?
9. State the condition for **circular polarization**.
10. What happens to electromagnetic waves inside a **perfect conductor**?

(B). Short Numerical Questions:
1. Intrinsic Impedance in Free Space
Calculate the intrinsic impedance of free space given:

$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}, \quad \epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$

2. Wavelength in Free Space
An EM wave in free space has frequency 100 MHz.
Find its wavelength.
3. Phase Constant
For a wave of frequency 50 MHz in free space, calculate the phase constant β.
4. Skin Depth in Copper
Calculate the skin depth in copper at 1 MHz.

$$\sigma = 5.8 \times 10^7 \text{ S/m}, \quad \mu = \mu_0$$

Given:
5. Attenuation Constant in Good Conductor
Find attenuation constant α in copper at 1 MHz.
6. Wave Velocity in Dielectric

7. Intrinsic Impedance of Lossless Dielectric
8. Electric Field from Magnetic Field

$$H = 2 \text{ A/m}$$

In free space,
Find electric field intensity.
9. If

$$E = 100 \text{ V/m}$$

in free space, calculate average power density.

10. Skin Depth Frequency Effect
If skin depth at 1 MHz is 66 μm, what is skin depth at 4 MHz?

UNIT:3 [Part-2]

(A). Short Answer Questions

1. Define reflection coefficient for normal incidence.
2. Write expressions for reflected and transmitted electric fields at normal incidence.
3. Define Poynting vector.
4. What is average Poynting vector for a time-harmonic field?
5. State Poynting theorem in words.

(B). Short Numerical Problems

1. A plane wave in air ($\eta_1 = 377\ \Omega$) is normally incident on a dielectric medium with $\eta_2 = 754\ \Omega$. Calculate the reflection coefficient.

2. If the incident electric field amplitude is 10 V/m and reflection coefficient is 0.2, find the reflected field amplitude.

3. An electromagnetic wave has E = 50 V/m and H = 0.133 A/m. Calculate the magnitude of the Poynting vector.

(C). Descriptive questions:

EMTL-UNIT-4 (Question Bank)

1. Short Answer Questions (10)

1. Define a transmission line.
2. List the primary constants of a transmission line.
3. What are the secondary constants of a transmission line?
4. Define characteristic impedance.
5. What is propagation constant?
6. Define attenuation constant.
7. Define phase constant.
8. What is a lossless transmission line?
9. What is meant by distortionless transmission line?
10. Define phase velocity and group velocity.

11. Numerical Problems (10)

12. A transmission line has L=0.5mH/km and C=0.02μF/km. Calculate the characteristic impedance for a lossless line.
13. A transmission line has R=5Ω/km, L=2mH/km, G=0.01S/km, C=0.05μF/km. Find the propagation constant.
14. For a lossless line with L = 1 mH/km and C = 0.01 μF/km, calculate phase velocity.
15. A transmission line has R=4Ω/km, L=1mH/km, G=0.02S/km, C=0.04μF/km. Determine characteristic impedance.
16. Calculate propagation velocity if L = 0.25 mH/km and C = 0.01 μF/km.
17. A distortionless line has R/L = G/C = 2000. Find the attenuation constant.
18. For a transmission line L = 2 μH/m and C = 5 pF/m, determine characteristic impedance.
19. If α= 0.02 Np/m and β= 0.5 rad/m, calculate the propagation constant.
20. A transmission line has Z0 = 50 Ω and load impedance = 50 Ω. Determine if reflection occurs.
21. For a lossless line with L=0.4mH/km and C=0.02μF/km, calculate characteristic impedance and velocity.

22. Descriptive Questions (10)

1. Explain the types of transmission lines with neat diagrams.
2. Derive the transmission line equations using the distributed parameter model.
3. Explain the T and π equivalent circuits of transmission lines.
4. Define primary and secondary constants of a transmission line and explain their significance.
5. Derive the expression for characteristic impedance of a transmission line.
6. Derive the propagation constant of a transmission line and explain attenuation and phase constants.
7. Explain the conditions for a distortionless transmission line.
8. Explain lossless transmission lines and derive the expression for characteristic impedance.
9. Define and explain phase velocity and group velocity.
10. Explain the concept of infinite transmission line and its properties.

EMTL-UNIT-5 (QuestionBank)

11.   Short Answer Questions

1.   Define input impedance of a transmission line.
2.   What is reflection coefficient?
3.   Define Voltage Standing Wave Ratio (VSWR).
4.   What is a matched transmission line?
5.   Define open circuited transmission line.
6.   Define short circuited transmission line.
7.   What is a quarter wave transformer?
8.   What is stub matching?
9.   What is a Smith Chart?
    10. Write the expression for reflection coefficient.

12.   Numerical Problems

1.   A transmission line has Z0 = 50 Ω and ZL = 100 Ω. Calculate the reflection coefficient.
2.   A line has Z0 = 75 Ω and ZL = 75 Ω. Find the VSWR.
3.   A line has reflection coefficient Γ = 0.5. Calculate the VSWR.
4.   A transmission line has Z0 = 50 Ω and ZL = 25 Ω. Calculate the reflection coefficient.
5.   Findthecharacteristicimpedanceofaquarterwavetransformerusedtomatch100Ωloadto 50 Ωline.
6.   A transmission line carries voltage 100 V and current 2 A. Calculate average power.
7.   Calculate VSWR if Γ = 0.2.
8.   A lossless transmission line has Z0 = 60 Ω and ZL = 120 Ω. Calculate reflection coefficient.
9.   If Vmax = 20 V and Vmin = 5 V, calculate VSWR.
    10. Find the reflection coefficient when ZL = Z0.

13.   Descriptive Questions

1.   Derive the input impedance equation of a transmission line.
2.   Explain reflection coefficient and standing waves.
3.   Derive the relation between reflection coefficient and VSWR.
4.   Explain short circuited and open circuited transmission lines.
5.   Explain matched transmission lines and their properties.
6.   Explain low loss RF and UHF transmission lines.
7.   Explain UHF transmission lines as circuit elements.
8.   Explain construction and working of Smith Chart.
9.   Explain applications of Smith Chart.
    10. Explain quarter wave transformer and single stub matching.