JHARKHAND UNIVERSITY OF TECHNOLOGY

Diploma 3rd Semester Examination

ELECTRONIC MEASUREMENT TECHNIQUE (EMTT)

Time: 3 Hours **Full Marks: 70** **SET: 1**

INSTRUCTIONS:

1. Question No. 1 is Compulsory.
2. Answer any **FOUR** questions from the remaining (Q.2 to Q.7).
3. **Important:** Students are advised to draw relevant diagrams (Coordinate systems, Gaussian surfaces, T-Line models) on their own.

Q.1. Multiple Choice Questions [2 × 7 = 14]

(i) The divergence of the curl of any vector field is always:

(a) One (b) Zero

(c) Infinite (d) Depends on vector

(ii) The unit of Electric Flux Density (D) is:

(a) C/m (b) C/m^2

(c) Farad/m (d) $Weber/m^2$

(iii) Which law states that the total electric flux leaving a closed surface is equal to the charge enclosed?

(a) Coulomb's Law (b) Ampere's Law

(c) Gauss's Law (d) Faraday's Law

(iv) In a perfect dielectric, the conductivity (σ) is:

(a) Infinite (b) Zero

(c) Unity (d) Negative

(v) The intrinsic impedance of free space (η_0) is approximately:

(a) 50 Ω (b) 75 Ω

(c) 120π Ω (377Ω) (d) 300 Ω

(vi) For a transmission line to be distortionless, the condition is:

(a) RG = LC
(b) RC = LG
(c) R/C = G/L
(d) RL = GC

(vii) Point form of Ohm's Law in Electromagnetics is:

(a) V = IR
(b) J = σE
(c) D = εE
(d) B = μH

SECTION B (LONG ANSWER TYPE)

Q.2. (a) State and explain **Coulomb's Law** of Electrostatics. Express it in vector form. [7]

Q.2. (b) Derive the relationship between **Electric Field Intensity (E)** and **Electric Potential (V)** (i.e., $E = -\nabla V$). [7]

Q.3. (a) State **Gauss's Law**. Apply it to find the Electric Field Intensity due to an **Infinite Line Charge** having uniform charge density ρ_L. [7]

Q.3. (b) Explain the different **Coordinate Systems** (Cartesian, Cylindrical, Spherical). Write the differential length (dl), area (dS), and volume (dv) for the Cylindrical system. [7]

Q.4. (a) State **Biot-Savart Law**. Using this law, derive the expression for Magnetic Field Intensity (H) due to an infinitely long straight conductor carrying current I. [7]

Q.4. (b) What are **Boundary Conditions**? Derive the boundary conditions for **Electric Field (E and D)** at the interface between two different dielectric media. [7]

Q.5. (a) Write down **Maxwell's Equations** in both **Differential (Point)** and **Integral** forms for **Time-Varying Fields**. [7]

Q.5. (b) Explain the concept of **Displacement Current**. Derive the expression $J_d = \partial D/\partial t$. Why was it added by Maxwell? [7]

Q.6. (a) Derive the **General Transmission Line Equations** (Telegrapher's Equations) for Voltage and Current. [7]

Q.6. (b) Define **Characteristic Impedance (Z_0)** and **Propagation Constant (γ)**. Derive their expressions in terms of primary constants (R, L, G, C). [7]

Q.7. Write Short Notes on (Any FOUR): **[3.5 × 4 = 14]**

a. Poisson's and Laplace's Equations
b. Skin Depth (Depth of Penetration)
c. Continuity Equation of Current
d. Vector Triple Product
e. Physical Significance of Divergence

Diploma Wallah: Solution Key

MCQ: (i) b, (ii) b, (iii) c, (iv) b, (v) c, (vi) b, (vii) b.

Q2(b) Hint: Work done $dW = -Q\ E \cdot dl$. Also $V = W/Q$. Thus $dV = -E \cdot dl \Rightarrow E = -\text{Grad}(V)$.

Q6(b) Formula: $Z_0 = \sqrt{((R+j\omega L)/(G+j\omega C))}$, $\gamma = \sqrt{((R+j\omega L)(G+j\omega C))}$.