CENTRAL INSTITUTE OF TECHNOLOGY, KOKRAJHAR (Deemed to be University, MHRD, Govt. of India) KOKRAJHAR:: BTAD:: ASSAM :: 783370 END – SEMESTER EXAMINATION

Session: July-Dec 2024 Semester: 5th Time: 3Hr Full Marks: 100

Course Code: UECE501

Course Title: Electromagnetic Waves

Answers any five questions

5 X 20 =100

- 1. (a) Let $E = 3a_v + 4a_z$ and $F = 4a_x 10a_v + 5a_z$
 - (i) Find the component of E along F
 - (ii) Determine the unit vector perpendicular to both E and F

Central Institute Of Technology

- (b) Express the vector $A = \rho z \sin \varphi a_{\rho} + 3\rho \cos \varphi a_{\varphi} + \rho \cos \varphi \sin \varphi a_{z}$ in Cartesian coordinate. (10+10)
- 2. (a) State and prove Uniqueness Theorem
- (b) A charge distribution in free space has $\rho_v = 2r nC/m^3$ for $0 \le r \le 10 m$ and zero otherwise. Determine E at r = 2m and r = 12m. (10+10)
- 3.(a) Prove that the electric field at a point $(r \ge a)$ due to a uniformly charged sphere of radius *a* is the same as the whole charge is located at the centre of the sphere.
 - (b) A circular disk of radius a uniformly charged with $\rho_s C/m^2$. If the disk lies on the z = 0 plane with its along the z-axis,
 - (i) Show that at point (0,0, h) $E = \frac{\rho_s}{2\varepsilon_0} \left\{ 1 - \frac{h}{[h^2 + \sigma^2]^{\frac{1}{2}}} \right\} a_z$
 - (ii) From this, derive the E field due to an infinite sheet of charge on the z = 0 plane.
 - (iii) If $a \ll h$ show that E is similar to the field due to a point charge.

(8+(8+2+2))

- 4. (a) Derive the expressions of the electric and magnetic fields of an electromagnetic wave propagating in a lossy dielectric medium.
 - (b) What do you understand by the term loss tangent and what is its physical significance.
 - (c) Obtain the Poynting theorem for the conservation of energy in an electromagnetic field and discuss the physical significance of each term in resulting equation. (8+4+8)