Bihar Engineering University, Patna

End Semester Examination - 2022

Course: B.Tech.	*Semester: III*	*Time: 03 Hours*
Code: 100308	*Subject: Electromagnetic Fields*	*Full Marks: 70*

Instructions:-

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No. 1 is compulsory.

Q.1 *Choose the correct option of the following: (Answer any seven)* **[2 x 7 = 14]**

(a) If the curl of the magnetic field is $2.0a_x$ A/m^2, the current density is

(i) $2.0a_x$ A/m^2 (ii) $1.0a_x$ A/m^2

(iii) 2.0 A /m (iv) $1.0a_x$ A/m

(b) Poynting vector gives the

(i) rate of energy flow

(ii) direction of polarization

(iii) intensity of electric field

(iv) intensity of magnetic field

(c) The frequency in rad/sec of a wave with velocity of that of light and phase constant of 20 units (in GHz) is

(i) 6 (ii) 60 (iii) 600 (iv) 0.6

(d) The example of polar type of dielectric is

(i) Oxygen (ii) Water

(iii) Hydrogen (iv) Nitrogen

(e) Using volume integral, which quantity can be calculated?

(i) Area of cube (ii) Area of cuboid

(iii) Volume of cube (iv) Distance of vector

(f) One end of a lossless transmission line having the characteristic impedance of 75 ohm and length of 1 cm is short circuited. At 3 GHz, the input impedance at the other end of the transmission line is.

(i) 0 (ii) resistive (iii) capacitive (iv) inductive

(g) For any scalar function 'f', $\nabla \times (\nabla f)$ is:

(i) 1 (ii) 0 (iii) depends on 'f' (iv) not defined

(h) Stoke's Theorem states that every vector having its effects over a closed line can be related to its effects over

(i) Volume enclosed (ii) Surface enclosed

(iii) Both (i) and (ii) (iv) None of these

(i) Electric flux enclosed by a surface surrounding a charge is equal to the amount of charge enclosed "this is statement of:

(i) Faraday's law (ii) Lenz's law (iii) Modified ampere's law (iv) Gauss's law

(j) Identify the nature of the field, if the divergence is zero and curl is also zero

(i) Solenoidal, irrotational (ii) Divergent, rotational

(iii) 0, irrotational (iv) Divergent, rotational

Q.2 (a) Derive dielectric-dieelectric boundary conditions. [7]

(b) The electric field intensity in polystyrene $E_p = 2.55$ filling the space between the plates of a parallel plate capacitor is 10 kV/m. The distance between the plates is 1.5 mm. Calculate- [7]

(i) The surface charge density of free charge on the plates;

(ii) The potential difference between the plastes.

(c) Discuss the boundary condition for electric field.

Q.3 (a) Write Maxwell's equations for vacuum and derive the wave equation for the electric and magnetic fields in vacuum. [7]

(b) For the copper coaxial cable of inner conductor of radius a = 2 mm and outer conductor of inner radius b= 6 mm and thickness t = 1mm, calculate the resitance of 2 m length of the cable at DC and at 100 MHz. [7]

Q.4 (a) Find the capacitance between two long cylindrical wire of radius. [7]

(b) What is dot and cross product? Explain its significance and application. [7]

Q.5 (a) State and explain the Maxwell's equations for time varying field. [7]

(b) Derive the expression for magnetic boundary conditions. [7]

Q.6 (a) State Gauss's law. Find the electric flux density at any point 'P' for infinite line charge using Gauss's law. [7]

(b) State Coulomb's law and field intensity. If point charges 1 mC and -2 mC are located at (3, 2, -1) and (-1, -1, 4) respectively. Calculate the electric force on a 10 nC charge located at (0, 3, 1) and the electric field intensity at that point. [7]

Q.7 (a) Derive the phasor vector wave equations(Helmholtz equations). [7]

(b) The electric field component of an EM wave propagating through a medium (characterized by $\epsilon = 2\epsilon_0$, $\mu = 2\mu_0$ and $\sigma = 0.05$ S/m is given by [7]

$\vec{E}(z,t) = 10e^{-\alpha z}\cos(2\pi \times 50 \times 10^6 t - \beta z)\hat{a}_x$ V/m. Compute:

(i) Propagation constant, γ

(ii) Attenuation constant, $\propto$

(iii) Phase constant, β

(iv) Intrinsic impedance

Q.8 (a) Derive the transmission line equations in time-domain as well as in frequency domain for a two-wire transmission line. [7]

(b) Derive the expression for input impedance of a transmission line for a simple connection of a source to a load through the transmission line. [7]

Q.9 Write short notes on any two of the following: **[7x2=14]**

(i) Polarization of waves

(ii) Faraday's law of electromagnetic induction

(iii) Skin Depth