Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 18

B.Tech.(EE) (2020 Batch) (Sem.–3)

ELECTROMAGNETIC FIELDS

Subject Code : BTEE-304-20

M.Code : 76384

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Write briefly :

1. Obtain the expression for Laplacian of a scalar field for cylindrical coordinate system.

2. State the significance of displacement current in the context of Maxwell's equations.

3. If a lightning stroke with current 50 kA occurs 100 m away from your house, calculate the magnetic flux density at your house due to the lightning stroke.

4. Show that in a good conductor, skin depth is always much shorter than its wavelength.

5. Find $\nabla \cdot (\vec{A} \times \vec{B})$

6. Infinite line $x = 3$, $z = 4$ carries 16 nC/m and is located in free space above the conducting plane $z = 0$. Use method of images to obtain the induced surface charge density on the conducting plane at (5, –6, 0).

7. State Gauss's law.

8. Express Coulomb's law in vector form.

9. Find the equivalent inductance of two coils connected in series. Assume the fluxes to be opposing each other.

10. Distinguish between transformer and motional emf.

SECTION-B

11. If $\vec{r} = x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$ is the position vector of (x, y, z), $r = |\vec{r}|$ and 'n' is an integer, evaluate-

a) $\nabla (r^n \vec{r})$ b) $\nabla^2 (\ln r)$

12. Find $\vec{D}$ at P (6, 8, –10) because of –

(i) Point charge of 50 mC at origin

(ii) A uniform line charge $\rho_L = 30$ nC/m on z-axis.

(iii) A uniform surface charge density $\rho_s = 27.2$ nC/m^2 on a plane $x = 12$.

13. Prove that :

$$(\vec{A} \times \vec{B}).(\vec{C} \times \vec{D}) = \begin{vmatrix} \vec{A}.\vec{C} & \vec{B}.\vec{C} \\ \vec{A}.\vec{D} & \vec{B}.\vec{D} \end{vmatrix}$$

14. Derive Biot Savart's law and Ampere's Circuital law from the concept of magnetic vector potential.

15. Obtain the intrinsic impedance for an EM wave propagating through perfect conductor.

SECTION-C

16. State Divergence theorem and verify the same for the vector field $r^2 \hat{a}_r + r \sin\theta \cos\phi \hat{a}_\theta$ over the surface of a quarter of a hemisphere defined by $0 < r < 3$, $0 < \theta < \frac{\pi}{2}$, $0 < \phi < \frac{\pi}{2}$.

17 If $\vec{A} = 2\hat{a}_x + 4\hat{a}_y$ and $\vec{B} = 6\hat{a}_y - 4\hat{a}_z$. Find the smaller angle between them using cross product. Verify it using dot product. Apply triangle law of vector addition to establish Coulomb's law of force between two-point charges.

18. If $\vec{F} = 2\rho z \hat{a}_\rho + 3z \sin\phi \hat{a}_\phi + 4\rho \cos\phi \hat{a}_z$ verify Stoke's theorem for the open surface defined by $z = 1$, $0 < \rho < 2$, $0 < \phi < 45°$. What is a time harmonic field? Derive Ampere's circuital law for time harmonic fields.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.