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Total No. of Questions : 09

B.Tech. (Electrical & Electronics Engg./Electronics & Electrical ENgg.)
(2018 Batch) (Sem.–3)

ELECTROMAGNETIC FIELDS

Subject Code : BTEEE-304-18
M.Code : 76466

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

1. Write briefly :

a) Find $\vec{D}$ at P (6, 8, –10) due to a uniform line charge ρ_L = 30 μC/m on z-axis.

b) Prove using unit vector concept that cylindrical and spherical co-ordinate systems are orthogonal.

c) For a solenoidal vector field $\vec{F}$ show that $\nabla \times \nabla \times \nabla \times \nabla \times \vec{F} = \nabla^4 \vec{F}$.

d) State and derive Poynting theorem.

e) Define an electric dipole. Obtain the potential at a point P due to an electric dipole.

f) Write down the geometrical significance of cross product of two vectors.

g) If a potential V = $x^2yz + Ay^3z$, (i) find A so that Laplace's equation is satisfied (ii) with the value of A, determine electric field at (2, 1, –1).

h) Distinguish between transformer and motional emf.

i) Derive the expression for curl of a vector field in spherical coordinate system.

j) Define skin depth.

SECTION-B

2. Prove that : $(\vec{B}\times\vec{C}).(\vec{A}\times\vec{D})+(\vec{C}\times\vec{A}).(\vec{B}\times\vec{D})+(\vec{A}\times\vec{B}).(\vec{C}\times\vec{D})=0$.

   Hence show that, $\sin(\theta+\phi)\sin(\theta-\phi)=\sin^2\theta-\sin^2\phi$.

3. State and prove Stoke's theorem.

4. If $\vec{A}$ and $\vec{B}$ are irrotational, prove that $\vec{A}\times\vec{B}$ is solenoidal.

5. Show that E and H are in time phase with each other for a lossless dielectric medium.

6. Obtain the intrinsic impedance for an EM wave propagating through free space.

SECTION-C

7. Verify the divergence theorem

$$\oint_S A.dS=\int_v \nabla.A\,dv$$

   For each of the following cases :

   a) $A = xy^2a_x + y^3a_y + y^2za_z$ and S is the surface of the cuboid defined by $0 < x < 1$, $0 < y < 1$, $0 < z < 1$

   b) $A = 2\rho z a_\rho + 3z \sin\phi a_\phi - 4\rho\cos\phi a_z$ and S is the surface of the wedge $0 < \rho < 2$, $0 < \phi < 45^\circ$, $0 < z < 5$.

   c) $A = r^2a_r + r\sin\theta\cos\phi\, a_\theta$ and S is the surface of a quarter of a sphere defined by $0 < r < 3$, $0 < \phi < \pi/2$, $0 < \theta < \pi/2$.

8. What is magnetic vector potential? Discuss its physical significance. Derive Biot Savart's law and Ampere's Circuital law from the concept of magnetic vector potential.

9. Develop the Maxwell's equations for time-varying and time-harmonic fields. Explain the concept of displacement current in this context.

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.