BTECH
(SEM III) THEORY EXAMINATION 2021-22
ELECTROMAGNETIC FIELD THEORY

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

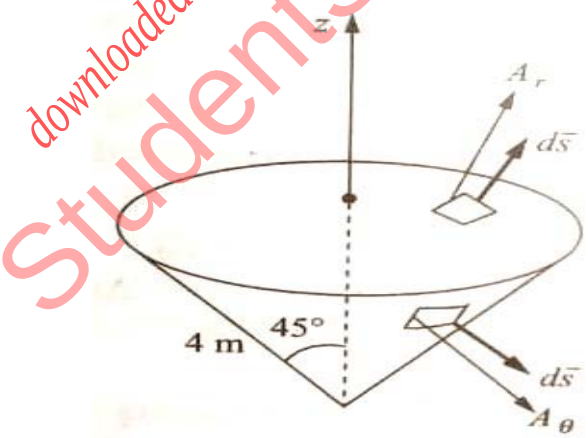
SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

Q no.	Question	Marks	CO
a.	Find the value of $(3\,\hat{a}_x + 6\,\hat{a}_y) \times (2\,\hat{a}_x + 3\,\hat{a}_y + 5\,\hat{a}_z)$, where X denotes cross product.	2	1
b.	Find the unit vector of the vector $\vec{A} = (7\,\hat{a}_x + 2\,\hat{a}_y + 8\,\hat{a}_z)$.	2	1
c.	Explain Electric Field Intensity.	2	2
d.	Prove that $\vec{\mathbf{E}} = -\,\mathbf{grad}\ \mathbf{V}$, where E is Electric Field Intensity and V is Electric Potential.	2	2
e.	Prove that curl $\vec{A}$=0, if $\vec{A} = (yz\,\hat{a}_x + zx\,\hat{a}_y + xy\,\hat{a}_z)$.	2	3
f.	Narrate the concept of electric dipole moment.	2	3
g.	Explain the term 'Inductance.'	2	4
h.	Explain the concept of Magnetic Flux Density.	2	4
i.	Explain the physical significance of Poynting vector.	2	5
j.	Explain the reflection of a plain wave in a normal incidence.	2	5

SECTION B

2. Attempt any *three* of the following: **3 x 10 = 30**

Q no.	Question	Marks	CO
a.	Given that $\vec{A} = \left(\frac{5r^2}{4}\right)\hat{a}_r$ is in spherical coordinates, solve both sides of the divergence theorem for the volume enclosed by r = 4m, and $\theta = \frac{\pi}{4}$ shown in below figure. 	10	1
b.	Derive the mathematical expression for energy stored in electric field. If $V = yx^2 + zx + xy$ **V**, Do the analysis of $\vec{E}$ at (2, 3, 7) and the electrostatic energy stored in a cube of side 4m centered at origin.	10	2
c.	Explain Biot-Savart's Law. Find the magnetic field intensity for infinite line current.	10	3
d.	Explain the ampere circuital law. Derive two applications of ampere circuital law. Also, derive modified maxwell's equations.	10	4
e.	Derive the mathematical equation for Poynting vector.	10	5

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SECTION C

3. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Investigate the values of X, Y, and Z. If $\vec{A}$= (2 $\hat{a}_x$ +4 $\hat{a}_y$ + 5 $\hat{a}_z$) is transformed as $\vec{A}$= (X $\hat{a}_r$ +Y $\hat{a}_\theta$ + Z $\hat{a}_\phi$)	10	1
b.	Derive the Poisson's and Laplace equation in all coordinate systems.	10	1

4. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	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.	10	2
b.	Given the potential $V = \frac{560}{3r^2}\ \sin 2\theta \cos\phi$, Find the electric flux density D at (2, 90^0, 0). Also calculate the work done in moving a 10 µC charge from point A (1, 30^0, 120^0) to B (2, 60^0, 30^0).	10	2

5. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Explain convection and conduction currents. Derive mathematical equations also. Also derive the magnetic vector potential.	10	3
b.	What is magnetic dipole? Find magnetic vector potential. Explain the complete Magnetic boundary conditions. Derive all tangential and normal components.	10	3

6. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Explain transformer and motional electromotive forces with necessary mathematical expressions. If vector $\mathbf{A} = yx^2\mathbf{ax} + zx\,\mathbf{ay} + xy\,\mathbf{az}$ is expressed as, where **ax**, **ay**, and **az** are the unit vectors. Find the vector B.	10	4
b.	A charged particle of mass 2 kg and charge 3 C starts at point (1, -2, 0) with velocity 4 $\mathbf{a}_x$ +3 $\mathbf{a}_z$ m/s in an electric field 12 $\mathbf{a}_x$ +10 $\mathbf{a}_y$ V/m. At time t=1 sec, determine- the acceleration of the particle, its velocity, kinetic energy of the particles and its position.	10	4

7. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Explain uniform plane wave. Derive uniform plane waves in lossless dielectrics. What is skin effect? Explain the Smith chart in detail.	10	5
b.	What is transmission line. Derive all the supporting mathematical equations of the transmission line.	10	5