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Printed Page:-4 **Subject Code:- AEC0503**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: V - THEORY EXAMINATION (2025 - 2026)
Subject: Electromagnetic Field Theory and Antenna

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. Line integral is used to calculate(CO1,K1) 1

(a) Volume
(b) Area
(c) Length
(d) None of the above

1-b. The Laplacian of the scalar field U= x^2y+xyz is (CO1,K3) 1

(a) 2x+2z
(b) 2x
(c) 2y
(d) 2xy+yz

1-c. Coulomb law is employed in (CO2,K2) 1

(a) Electrostatics
(b) Magnetostatics
(c) Maxwell theory
(d) None of the above

1-d. The electric field intensity is defined as (CO2,K2) 1

(a) force per unit charge
(b) force per unit area
(c) force per unit volume
(d) force per unit length

1-e. The concept of displacement current was a major contribution attributed to (CO3, 1

K3)

(a) Faraday
(b) Lenz
(c) Maxwell
(d) Lorenz

1-f. The unit of magnetic field intensity is (CO3,K1) 1

(a) V/Sq m
(b) V/m
(c) A/m
(d) A/Sq m

1-g. An ideal source in which the power is radiated equally in all directions is known as ____radiator.(CO4, K1) 1

(a) Isotropic
(b) Omni-directional
(c) Directional
(d) Transducer

1-h. The directivity of an isotropic antenna is (CO4,K2) 1

(a) 1
(b) 1.5
(c) 2
(d) 1.64

1-i. The gain of helical antenna is proportional to (CO5, K2) 1

(a) HPBW
(b) $(HPBW)^2$
(c) 1/HPBW
(d) $1/(HPBW)^2$

1-j. The directivity of a uniformly illuminated square aperture with a side of 12λ, is (CO5, K3) 1

(a) 31.56 dBi
(b) 32.58 dBi
(c) 30 dBi
(d) 33.6 dBi

2. Attempt all parts:-

2.a. Convert f (x,y,z) = x^2+3y^3 z into cylindrical coordinates. (CO1,K3) 2

2.b. Define electric flux density. (CO2,K2) 2

2.c. Define polarization of an electromagnetic wave.(CO3,K2) 2

2.d. Briefly describe Antenna Resolution.(CO4, K2) 2

2.e. Why are helical antennas widely used for satellite communication?. (CO5, K2) 2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	Find the Laplacian of the scalar field of $U= \rho^2 z \cos 2\phi$. (CO1, K3)	6
3.a.(ii)	Explain Divergence of Vector and write the equation of Divergence in Cartesian, cylindrical and spherical coordinates.(CO1,K3)	6

3.b. Answer any one of the following:-

3.b.(i)	State Gauss's law for electric fields and explain its significance. (CO2, K3)	6
3.b.(ii)	Explain and Derive the Biot-Savart's law in brief. (CO2,K4)	6

3.c. Answer any one of the following:-

3.c.(i)	Find the ratio of skin depths of an electromagnetic wave inside the conductor for the corresponding frequencies at 16 GHz & 25 GHz, considering the same material properties for both the frequencies. (CO3, K3)	6
3.c.(ii)	Explain radiation resistance in antennas and derive the expression for the radiation resistance of a half-wave dipole . (CO3, K4)	6

3.d. Answer any one of the following:-

3.d.(i)	Discuss the different types of antennas based on their frequency and radiation characteristics, highlighting their advantages and limitations.. ((CO4, K3)	6
3.d.(ii)	The radiation resistance of the antenna is 100 ohms and loss resistance is 20 ohms. Calculate directivity of an antenna, if power gain is 12 dB.(CO4,K3)	6

3.e. Answer any one of the following:-

3.e.(i)	Describe in detail the salient features, construction, operating principles, advantages, and typical applications of different types of antenna reflectors.(CO5, K3)	6
3.e.(ii)	Discuss about the applications of loop antenna and 180-degree ambiguity? (CO5, K2)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	State the Divergence Theorem and derive it, showing how the flux of a vector field across a closed surface equals the volume integral of its divergence. (CO1, K4)	10
4-b.	Find the divergence of a vector $B = 10x^2 a_x - 5x^2y^2 a_y + xyz^3 a_z$. (CO1,K3)	10

5. Answer any one of the following:-

5-a.	State and explain boundary conditions at the Conductor-Free space interface in an electrostatic field.(CO2,K3)	10
5-b.	State and explain Maxwell's equation for static fields in differential and integral form with their significance.(CO2,K3)	10

6. Answer any one of the following:-

6-a.	Prove that the net power flowing out of a given volume v is equal to the time rate of decrease in energy stored within volume v minus the conduction losses. (CO3, K4)	10
6-b.	Derive an expression for attenuation constant, propagation constant and intrinsic impedance of an EM wave when it is propagating through a lossy dielectric medium.(CO3,K4)	10

7. Answer any one of the following:-

7-a.	Define the Antenna gain and also discuss various types of directional parameters of	10

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an antenna. Corelate them in terms of Antenna efficiency. (CO4, K3)

7-b.	Discuss in detail the operation of a radio communication link, explaining each block involved in transmission and reception, and mathematically derive the Friis transmission formula. (CO4, K3)	10

8. Answer any one of the following:-

8-a.	Explain in detail the structure, fundamental characteristics, and various applications of a microstrip antenna.(CO5,K3)	10
8-b.	Describe in detail the structure, working principle, and characteristics of a log-periodic antenna, and derive the suitable design equations for its elements and spacing. (CO5, K3)	10