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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech.

SEM: V - THEORY EXAMINATION (2022 - 2023)

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

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1. Attempt all parts:-

- 1-a. Which of the following theorem convert line integral to surface integral? (CO1) 1
- (a) Divergence theorem
 - (b) Stoke's theorem
 - (c) Both Divergence and Stoke's theorem
 - (d) None of the above
- 1-b. The total outward flux of a vector field A through the closed surface S is the same as the volume integral of the divergence of A, is known as (CO1) 1
- (a) Gauss theorem
 - (b) Stokes theorem
 - (c) Divergence theorem
 - (d) Poisson theorem
- 1-c. Which of the following laws do not form a Maxwell equation? (CO2) 1
- (a) Planck's law
 - (b) Gauss's Law

- (c) Faraday's law
- (d) Ampere's Law
- 1-d. The total electric flux through any closed surface is equal to the total charge enclosed by that surface, is known as (CO2) 1
- (a) Faraday's law
- (b) Lenz law
- (c) Ampere's law
- (d) Gauss's Law
- 1-e. The radiation resistance of current element, whose overall length is $\lambda/10$, is (CO3) 1
- (a) 0.078Ω
- (b) 0.789Ω
- (c) 78.95Ω
- (d) 7.895Ω
- 1-f. The directivity of half wave dipole antenna is (CO3) 1
- (a) 1.76 dB
- (b) 2.15 dB
- (c) 2.04 dB
- (d) 5.2 dB
- 1-g. The directivity of an isotropic antenna is (CO4) 1
- (a) 1
- (b) 1.5
- (c) 2
- (d) 1.64
- 1-h. The power pattern of an antenna is (CO4) 1
- (a) Directly proportional to the square of the field pattern
- (b) Inversely proportional to the field pattern
- (c) Directly proportional to the field pattern
- (d) Inversely proportional to the square of the field pattern
- 1-i. ____ antenna is used for direction finder. (CO5) 1
- (a) Horn
- (b) Helical

- (c) Loop
- (d) None of these
- 1-j. Any antenna can be considered practically independent of frequency, provided its following parameters remain constant over a wide range of frequency (CO5) 1
- (a) Temperature, radiation resistance, radiation pattern and directivity
- (b) Impedance, radiation resistance, radiation pattern and directivity
- (c) Signal to noise ratio, radiation resistance, radiation pattern and directivity
- (d) Impedance, signal to noise ratio, radiation pattern and directivity

2. Attempt all parts:-

- 2.a. Express the point Q (3, 0, 5) in spherical coordinate. (CO1) 2
- 2.b. Explain the significance of ampere's circuit law. (CO2) 2
- 2.c. Write the Maxwell electromagnetic equations in time-varying fields.(CO3) 2
- 2.d. The radiation resistance of an antenna is 72Ω and loss resistance is 8Ω . Find the directivity, if the gain is 16. (CO4) 2
- 2.e. Explain the applications of Loop Antenna.(CO5) 2

SECTION B

30

3. Answer any five of the following:-

- 3-a. Find the Laplacian of the scalar field of $U = x^3y^2e^{xz}$ and compute the value at the (1, -1, 1). (CO1) 6
- 3-b. Prove that, the curl of the gradient of any scalar field vanishes.(CO1) 6
- 3-c. Derive the expression for the electric field intensity for an infinite line charge having uniform charge density ρ_L .(CO2) 6
- 3-d. If $D = 4xa_x - 10y^2a_y + z^2a_z$ C/m², find the charge density at P (1,2,3).(CO2) 6
- 3.e. Show that the directivity of an electric current element is 3/2.(CO3) 6
- 3.f. Explain Half Power Beam width and First Null beam width and write its practical significance. (CO4) 6
- 3.g. A Paraboloid reflector antenna with diameter 20 m, is designed to operate at frequency of 6 GHz and illumination efficiency of 0.54. Calculate the antenna gain in decibels.(CO5) 6

SECTION C

50

4. Answer any one of the following:-

- 4-a. Illustrate Stokes theorem and Divergence Theorem.(CO1) 10

- 4-b. Find the flux of $B = 2xy\mathbf{a}_x + z^2y\mathbf{a}_y + 3x^2y\mathbf{a}_z$ over the surface defined by $z=1, 0 < x < 1, 0 < y < 2$. (CO1) 10
5. Answer any one of the following:-
- 5-a. State and explain Faraday's law of induction. Express Faraday's law and Ampere's law in different forms. (CO2) 10
- 5-b. Explain Coulomb's law of electrostatic and also explain the factors that influence the forces. (CO2) 10
6. Answer any one of the following:-
- 6-a. In a certain medium, $E = 10\cos(2\pi \times 10^7 t - \beta x)(\mathbf{a}_y + \mathbf{a}_z)$ V/m. If $\mu = 50\mu_0$, $\epsilon = 2\epsilon_0$ and $\sigma = 0$, find (CO3) 10
- (a) Direction of wave propagation,
 (b) Attenuation constant,
 (c) Phase constant
 (d) η and
 (e) H.
- 6-b. Obtain expression for the field and power radiated by a half wave antenna and calculate the radiation resistance of the antenna. (CO4) 10
7. Answer any one of the following:-
- 7-a. Discuss radio communication link and derive the Friis transmission formula mathematically and also path loss. (CO4) 10
- 7-b. An antenna is fed with 200π W power. The efficiency of the antenna is 75%. If the radiation pattern of the antenna is $P(\theta, \phi) = \sin^2\theta \cdot \sin^2\phi$ for $0 \leq \theta \leq \pi$ (azimuth angle) & $0 \leq \phi \leq \pi$ (elevation angle) and zero elsewhere. Find the radiation intensity in the direction of maximum radiation. (CO4) 10
8. Answer any one of the following:-
- 8-a. With neat diagram explain helical antenna and describe its operation for getting circular polarization characteristics & also write its applications. (CO5) 10
- 8-b. What is the condition of frequency independence in antennas. Explain the log periodic antenna using proper diagram and expressions. (CO5) 10