Printed page: 4 **Subject Code: BEC0501**

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 question paper with 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. The unit of $\Delta x H$ (CO1,K3) 1

A) Ampere

B) Ampere/meter

C) Ampere/meter^2

D) Ampere-meter

1-b. The gradient of a scalar function f(x,y,z) gives: (CO1,K2) 1

A) A scalar field

B) A vector field pointing in the direction of maximum increase of f

C) A vector field pointing in the direction of minimum increase of f

D) The divergence of f

1-c. Continuity of charge ensures that: (CO2 ,K2) 1

A) Charge can be created or destroyed

B) Charge is conserved in a system

C) Electric field is zero everywhere

D) Magnetic field is constant H

1-d. Electric flux density in electric field is referred to as (CO2 ,K2) 1

A) Number of flux lines

B) Ratio of flux lines crossing a surface and the surface area

C) Direction of flux at a point

D) Flux lines per unit are

1-e. Radiation resistance of a short electric dipole depends primarily on: (CO3,K2) 1

A) The length of the dipole relative to the wavelength

B) The conductivity of the surrounding medium

C) The voltage applied to the dipole

D) The orientation of the dipole only

1-f. In conductors, which two parameters are same? (CO3,K3) 1

A) Wavelength and phase constant

B) Phase and attenuation constant

C) Attenuation constant and skin depth

D) Skin depth and wavelength

1-g. The ratio of radiation intensity in each direction from antenna to the radiation intensity over all directions is called as _____(CO4, K2) 1

A) Directivity

B) Radiation power density

C) Gain of antenna

D) Array Factor

1-h. The directivity of an antenna array can be increased by adding more antenna elements, as a larger number of elements (CO4, K2) 1

A) Improves the radiation efficiency

B) Increases the effective area of the antenna

C) Results in a better impedance matching

D) Allows more power to be transmitted by the antenna

1-i. Horn antennas are mainly used for: (CO5,K2) 1

A) Low-frequency communication

B) Microwave frequency applications and waveguides

C) Measuring static electric fields

D) Increasing current in a conductor

1-j. Applications of loop antennas include: (CO5,K2) 1

A) Direction finding and navigation systems

B) High-power broadcasting

C) Optical communication

D) Microwave ovens

2. Attempt all parts:-

2.a.	Evaluate points (0, -4, 3) into cylindrical coordinate system. (CO1,K3)	2
2.b.	Define electric flux density D and its relation with electric field E. (CO2,K2)	2
2.c.	Explain Ampere's circuital Law in statics magnetic field. (CO3,K3)	2
2.d.	Describe the Beam Area of an Antenna and give the formula. (CO4,K3)	2
2.e.	Explain the principle of operation of parabolic dish. (CO5,K2)	2

SECTION – B 30

3.a. Answer any <u>one</u> of the following-

3-a.i	Express $\mathbf{B}=10/r\mathbf{a}_r+r\cos\theta\mathbf{a}_\theta+\mathbf{a}_\phi$ into cylindrical co-ordinates at $(5, \pi/2, -2)$. (CO1,K4)	6
3-a.ii	State and prove Stoke's theorem. (CO1,K4)	6

3.b. Answer any <u>one</u> of the following-

3-b.i	Derive and explain Coulomb's law for point charges. (CO2,K4)	6
3-b.ii	Two point charges -4nC and 5nC are placed at (2, -1,3) and (0, 4, -2) respectively, find the potential at (1,0,1), assuming zero potential at infinity. Right-angle triangle. Find electric forces at the corners of the tringle.(CO2,K4)	6

3.c. Answer any <u>one</u> of the following-

3-c.i	Explain all forms of Maxwell's equations in time varying conditions with its physical significance. (CO3,K4)	6
3-c.ii	Explain how attenuation and phase constant appear in the EM wave equation for a good conductor.(CO3,K4)	6

3.d. Answer any <u>one</u> of the following-

3-d.i	Explain the difference between linear, circular, and elliptical polarization in antennas and their effect on radiation. (CO4,K3)	6
3-d.ii	Explain Antenna gain ,Directivity, and Beam efficiency (CO4,K2)	6

3.e. Answer any <u>one</u> of the following-

3-e.i	Explain the principle of operation of parabolic dish. Why is the parabolic shape used? (CO5,K3)	6
3-e.ii	Describe the working principle of a helical antenna and how its geometry affects its radiation characteristics. (CO5,K3)	6

SECTION – C 50

4.Answer any <u>one</u> of the following-

4-a.	Transform the vector $\mathbf{A}= r\,\mathbf{a}_r$ into Cartesian and cylindrical coordinate system. (CO1,K4)	10
4-b.	Derive the relationship between Cartesian**,** cylindrical, and spherical Coordinates system and show how differential operators transform between these systems. (CO1,K4)	10

5.Answer any <u>one</u> of the following-

5-a.	Demonstrate dielectric–dielectric and dielectric free space boundary conditions for Electric fields. (CO2,K4)	10
5-b.	State and explain Biot-Savart's law. Derive a relation for the force between two conductors carrying currents I_1 and I_2. (CO3,K4)	10

6.Answer any <u>one</u> of the following-

6-a.	Explain Poynting vector? Give the statement of Poynting theorem and Derive the formula for integral form of Poynting theorem and explain the physical interpretation of each term. (CO3,K4)	10
6-b.	Write the expressions for the electric and magnetic fields of a half-wave dipole and derive the expression of its radiation resistance. (CO3,K4)	10

7.Answer any <u>one</u> of the following-

7-a.	Explain Friss transmission formula mathematically.(CO4,K4)	10
7-b.	Explain the antenna efficiency. A directional antenna has an effective radiated power of 1.1 kW, when it is fed with a terminal input power of 90 W. Radiation resistance is 74 Ω at resonance and measured antenna current is 1.088 ampere rms. Find (i) The antenna efficiency, (ii) The antenna power loss, (iii) The directive gain in decibels over an isotropic radiator. (CO4,K4)	10

8.Answer any <u>one</u> of the following-

8-a.	Describe the working mechanism of a log-periodic antenna, explaining how it operates as a directional antenna with multiple elements. (CO5,K3)	10
8-b.	Make a detailed comparison between corner reflector and parabolic reflector. Also explain the feed method for parabolic reflectors. (CO5,K4)	10