GUJARAT TECHNOLOGICAL UNIVERSITY

BE 6 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Antennas and Propagation - 3161003

Chapter 1: Basic antenna concepts

Repeated Questions:

1. Types of Antennas and Apertures:

- **Q.** Classify/enlist different types of antenna based on radiation pattern. **(WINTER 2022, 3 Marks; WINTER 2025, 4 Marks)**
- **Q.** Enlist/explain different types of antenna apertures. **(WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks)**

2. Antenna Field Zones:

- **Q.** Explain/discuss antenna field zones with necessary figures. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks - combined with antenna aperture and radiation resistance; SUMMER 2024, 4 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Definition and Types of Antennas:

- **Q.** Define the antenna term in different ways. **(SUMMER 2023, 3 Marks)**
- **Q.** Define antenna and list down various types of antennas. **(WINTER 2023, 3 Marks)**
- **Q.** Write a short note on types of antennas with necessary figures. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** Explain various types of antennas with their applications. **(SUMMER 2023, 7 Marks)**

2. Radiation Pattern and Isotropic Radiator:

- **Q.** Draw and explain different parts of radiation pattern. [Diagram required – refer to the original question paper] **(SUMMER 2023, 3 Marks)**
- **Q.** What do you mean by isotropic radiator? Compare it with omnidirectional radiator. **(SUMMER 2023, 3 Marks)**

3. Antenna as a Radiator:

- **Q.** Derive the condition when an antenna acts as a radiator. Also discuss its different cases. **(WINTER 2022, 4 Marks)**

4. Numerical Problems:

- **Q.** Calculate the percentage power reflected, if antenna input impedance is (30+j40)Ω and characteristic impedance of transmission line is 50Ω. **(SUMMER 2022, 3 Marks)**

Chapter 2: Radiation of Electric dipole

Repeated Questions:

1. Fields of a Short Dipole / Current Element (Derivations):

- **Q.** Derive/obtain electric and magnetic field components or their ratio for a short dipole/current element in spherical coordinates using Maxwell's equations. / Starting from retarded current, derive expressions for electric and magnetic components of a short dipole antenna if the spherical system is defined in r, θ and ϕ. / Derive expression for electric and magnetic components of a short dipole antenna if spherical system is defined in r, θ and ϕ. / Derive expression of Eθ and Hϕ of a small current element. / Obtain the ratio of Eθ and Hϕ field components of a current element at a distance point in free space with necessary derivations using Maxwell's equation. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks)**

2. Half-Wave Dipole:

- **Q.** Derive the expression for radiation resistance of a half-wave dipole / λ/2 dipole antenna. **(WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**

3. Reciprocity Theorem:

- **Q.** What is meant by reciprocity theorem? **(WINTER 2022, 3 Marks; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Derivations of Dipole and Monopole Parameters:

- **Q.** Show that the directivity of an infinitesimal dipole is 1.76 dB. **(WINTER 2025, 4 Marks)**
- **Q.** Derive the far field components of a half-wave dipole antenna. **(WINTER 2025, 7 Marks)**
- **Q.** Derive the far field components of a monopole antenna. **(WINTER 2025, 7 Marks OR)**

2. Numerical Problems:

- **Q.** Find the radiation resistance of a Hertzian dipole of length λ/60. **(SUMMER 2026, 3 Marks)**
- **Q.** Determine the distance from short dipole operating at 1 MHz at which radiation field is equal to the induction field. **(WINTER 2022, 4 Marks OR)**

Chapter 3: Antenna parameters and definitions

Repeated Questions:

1. Friis Transmission Formula:

- **Q.** Derive/explain Friis transmission formula / radio communication link using Friis transmission formula / Friis transmission theory. **(SUMMER 2022, 4 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2026, 7 Marks)**

2. Directivity and Beam Area:

- **Q.** Show that directivity is inversely proportional to beam area / derive relation between directivity and beam area. **(SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks)**

3. Polarization:

- **Q.** Explain/describe polarization and its types / concept of polarization for an antenna. **(WINTER 2023, 4 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Definitions of Antenna Terms:

- **Q.** Define the following terms: (i) Beam solid angle (ii) Directivity (iii) Antenna Aperture. **(SUMMER 2022, 3 Marks)**
- **Q.** Define: (1) FNBW (2) HPBW (3) Gain of antenna. **(WINTER 2023, 3 Marks)**
- **Q.** Define the following terms (draw necessary figures and write equations if any): i) Beam solid angle ii) FNBW and HPBW. [Diagram required – refer to the original question paper] **(SUMMER 2024, 4 Marks)**
- **Q.** Define the following terms (draw necessary figures and write equations if any): i) Half Power Beamwidth ii) Radiation intensity iii) Antenna radiation efficiency iv) Effective length. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks)**
- **Q.** Define: 1. Antenna Radiation Efficiency 2. Radiation Resistance of Antenna 3. HPBW of Antenna. **(WINTER 2025, 3 Marks)**
- **Q.** Define: (i) Radiation Intensity (ii) Antenna Gain (iii) Antenna Resolution. **(SUMMER 2026, 3 Marks)**
- **Q.** Define: i) Radiation intensity ii) Antenna Efficiency iii) MUF. **(SUMMER 2024, 3 Marks OR)**

2. Derivations and Comparisons:

- **Q.** Derive the mathematical expression for the radiation intensity of an isotropic radiator. **(WINTER 2025, 3 Marks)**
- **Q.** Derive the mathematical expression between maximum effective aperture and directivity. **(WINTER 2025, 7 Marks)**
- **Q.** Differentiate Gain and Directivity. **(SUMMER 2024, 3 Marks OR)**

3. Circular Polarization:

- **Q.** Define circular polarization and discuss its advantages. **(SUMMER 2024, 4 Marks)**

4. Numerical Problems:

- **Q.** Calculate the maximum effective aperture of a microwave antenna which has a directivity of 800. Frequency of operation is 6 GHz. **(WINTER 2022, 3 Marks OR)**
- **Q.** The measured Half Power Beam widths of an antenna in the two orthogonal planes are 30° and 20°. Antenna efficiency is 100%. Calculate the approximate gain of the antenna. **(WINTER 2022, 4 Marks)**
- **Q.** The radiation resistance of an antenna is 80Ω and the loss resistance is 10Ω. What is the directivity in dB if the power gain is 16? **(SUMMER 2023, 3 Marks)**

- **Q.** Answer the following: (1) What is the value of directivity, if beam area is $2\pi/3$? (2) Sketch the radiation pattern with necessary indications. [Diagram required – refer to the original question paper] **(WINTER 2023, 3 Marks)**
- **Q.** In a microwave link, two identical antennas operating at 10 GHz are used with power gain of 40 dB. If the transmitter power is 1W, find received power, if the range of link is 30 km. **(SUMMER 2023, 7 Marks)**
- **Q.** The maximum radiation intensity of a 90% efficiency antenna is 200 mW/unit solid angle. Find the directivity and gain (dimensionless and in dB) when the input power is 125.66 mW. **(SUMMER 2022, 3 Marks)**
- **Q.** Calculate the directivity of an antenna with circular aperture of diameter 3 meter at frequency 5 GHz. **(SUMMER 2022, 3 Marks OR)**

Chapter 4: Arrays of point sources

Repeated Questions:

1. Pattern Multiplication:

- **Q.** Explain the principle/statement of pattern multiplication for antenna arrays / in working of array antennas. **(WINTER 2022, 7 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; WINTER 2025, 4 Marks)**

2. Broadside and Endfire Arrays:

- **Q.** Differentiate between broadside array and endfire array / distinguish broadside and end fire array. **(WINTER 2022, 4 Marks - also asks need for antenna array; WINTER 2025, 3 Marks OR; SUMMER 2026, 4 Marks)**

3. Binomial Array:

- **Q.** Explain Binomial array / write short note on binomial array / advantages and disadvantages. **(SUMMER 2022, 7 Marks - with pattern multiplication; WINTER 2023, 7 Marks OR; SUMMER 2026, 4 Marks)**

4. Dolph-Tchebysheff Distribution:

- **Q.** Discuss Dolph-Tchebysheff distribution for linear arrays. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2024, 7 Marks OR - combined with pattern multiplication)**

5. N-Element Uniform Array:

- **Q.** With necessary figure and derivations explain N element array of equal amplitude and spacing. Write the equation for array factor. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks - second set; SUMMER 2026, 7 Marks OR)**

6. Schelkunoff Theorems:

- **Q.** Explain Schelkunoff theorems for linear arrays / Schelkunoff theorems and its usefulness. **(SUMMER 2023, 7 Marks OR - combined with Binomial arrays; SUMMER 2024, 4 Marks OR)**

Other Important Questions:

1. General Array Concepts:

- **Q.** What do you mean by array? Discuss its types in brief. **(SUMMER 2023, 3 Marks)**
- **Q.** Explain the effect of ground on ungrounded antenna. **(SUMMER 2022, 3 Marks)**

2. Special Arrays and Patterns:

- **Q.** Explain in detail about frequency scanning arrays. **(SUMMER 2022, 7 Marks OR)**
- **Q.** Describe the properties of Endfire array. **(SUMMER 2022, 7 Marks OR)**
- **Q.** Draw field pattern of an array of 4 isotropic point sources separated by half wave length. [Diagram required – refer to the original question paper] **(SUMMER 2023, 4 Marks OR)**

Chapter 5: Loop Antenna

Repeated Questions:

1. Small Loop Antenna Fields (Derivation):

- **Q.** Derive field components / far field components of a small loop / small circular loop antenna. **(WINTER 2023, 7 Marks OR - also show directivity of loop same as dipole; SUMMER 2024, 7 Marks OR; WINTER 2025, 7 Marks OR)**

Other Important Questions:

1. Working and Comparison:

- **Q.** Explain the working principle of small loop antenna. **(SUMMER 2022, 4 Marks OR)**
- **Q.** Compare the far field equations of small loop with short dipole. **(WINTER 2022, 4 Marks)**

2. Numerical Problems:

- **Q.** Calculate the radiation resistance of a single turn small circular loop having radius $\lambda/25$. **(SUMMER 2023, 4 Marks OR)**

Chapter 6: Helical antenna

Repeated Questions:

1. Helical Geometry:

- **Q.** Explain/sketch helical geometry of helical antenna with necessary diagram/dimensions and relationship between circumference, spacing, turn length and pitch angle. [Diagram required – refer to the original question paper] **(WINTER 2023, 4 Marks; WINTER 2025, 7 Marks - also axial mode)**

2. Modes of Radiation:

- **Q.** Explain/describe modes of radiation of helical antenna — normal and axial mode / compare performance in terms of geometry. [Diagram required – refer to the original question paper] **(WINTER 2023, 4 Marks OR; SUMMER 2024, 4 Marks; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Design and Parameters:

- **Q.** Explain practical design consideration for the helical antenna. **(SUMMER 2022, 7 Marks OR)**
- **Q.** Define pitch angle and axial ratio for helical antenna. **(SUMMER 2023, 3 Marks OR)**

Chapter 7: Arrays of dipoles & apertures

Repeated Questions:

1. 3-Element Yagi-Uda Antenna:

- **Q.** Explain/describe construction/working of 3-element Yagi-Uda antenna. [Diagram required – refer to the original question paper] **(SUMMER 2023, 3 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 7 Marks OR - working, improvement, applications)**

2. 4-Element Yagi-Uda Antenna:

- **Q.** Explain and design 4-element Yagi-Uda antenna. **(WINTER 2022, 7 Marks OR; SUMMER 2024, 4 Marks OR)**

3. Folded Dipole:

- **Q.** Explain principle/working of Folded dipole / folded dipole antenna. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks; SUMMER 2024, 4 Marks OR; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**

Other Important Questions:

1. Yagi-Uda Features:

- **Q.** Explain the features of Yagi-Uda antenna. **(SUMMER 2022, 4 Marks)**

2. Antenna Feeding:

- **Q.** Explain different antenna feeding methods. **(SUMMER 2024, 3 Marks)**

Chapter 8: Reflector antennas

Repeated Questions:

1. Cassegrain Feed:

- **Q.** Explain Cassegrain feed (with required figure). [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2024, 3 Marks; SUMMER 2026, 3 Marks OR)**

2. Parabolic Reflector Antenna:

- **Q.** Explain working principle/short note of parabolic reflector antenna / feed techniques and role of f/d ratio. **(WINTER 2022, 7 Marks; WINTER 2023, 4 Marks OR; WINTER 2025, 7 Marks OR; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Types of Reflector Antennas:

- **Q.** Discuss the different types of reflector antennas. **(SUMMER 2023, 4 Marks)**

2. Numerical Problems:

- **Q.** Calculate the diameter of parabolic dish antenna, for given value of gain G = 40 dB and operating frequency 11 GHz. **(SUMMER 2022, 3 Marks OR)**

Chapter 9: Slot patch & Horn antennas

Repeated Questions:

1. Babinet's Principle:

- **Q.** State/explain Babinet's principle and discuss/illustrate its application to slot antennas and complementary antennas. **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 4 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks - also log-periodic wideband justification)**

2. Slot Antenna:

- **Q.** Explain/draw and explain working principle of slot antenna / explain in brief slot antennas. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks; SUMMER 2026, 3 Marks)**

3. Horn Antenna:

- **Q.** Describe various forms/types of basic horn antenna / design equations of horn antenna. [Diagram required – refer to the original question paper] **(SUMMER 2022, 3 Marks; WINTER 2022, 7 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Horn Antenna Design:

- **Q.** Enumerate the steps for the design of pyramidal horn. **(SUMMER 2024, 3 Marks)**

Chapter 10: Microstrip (patch) antennas

Repeated Questions:

1. Microstrip Patch Antenna:

- **Q.** Explain working principle/radiation mechanism/short note on microstrip patch antenna, including advantages, disadvantages and applications. **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks OR - rectangular microstrip patch design and applications; WINTER 2023, 7 Marks; SUMMER 2024, 3 Marks OR; WINTER 2025, 7 Marks)**

Other Important Questions:

1. Feeding Methods:

- **Q.** List the feeding methods of microstrip patch antenna. Explain microstrip line feed in detail. **(SUMMER 2026, 4 Marks OR)**

Chapter 11: Lens antennas

Repeated Questions:

1. Types of Lens Antennas:

- **Q.** Enlist/classify/explain different types of lens antenna. **(WINTER 2022, 3 Marks OR; WINTER 2023, 3 Marks OR; WINTER 2025, 4 Marks OR)**

Other Important Questions:

1. Dielectric and Artificial Dielectric Lens Antennas:

- **Q.** Explain Non-metallic Dielectric lens and artificial dielectric lens antennas in detail. **(SUMMER 2022, 7 Marks)**
- **Q.** Explain the working of Artificial dielectric Lens antenna and derive the expression for Effective Refractive Index of such a lens formed by conducting sphere. **(SUMMER 2024, 7 Marks OR)**
- **Q.** Explain the Lens antenna with merits and demerits of lens antenna. **(SUMMER 2026, 4 Marks OR)**

Chapter 12: Broadband & Frequency Independent antennas

Repeated Questions:

1. Log Periodic Antenna:

- **Q.** Explain log periodic antenna / structure / design equations / frequency independent operation / wideband operation. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks OR; WINTER 2022, 7 Marks; SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks; WINTER 2025, 7 Marks)**

Other Important Questions:

None identified.

Chapter 13: Antennas for special applications

Repeated Questions:

1. Ultra-Wideband (UWB) Antenna:

- **Q.** Define/explain Ultra-wideband (UWB) antenna / UWB for digital application. **(WINTER 2023, 3 Marks OR; SUMMER 2024, 4 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks OR)**

Other Important Questions:

1. Satellite Communication Antennas:

- **Q.** Explain in brief about antennas for satellite communication. **(SUMMER 2023, 3 Marks OR)**

Chapter 14: Antenna measurements

Repeated Questions:

1. Gain Measurement:

- **Q.** Describe procedure/experimental setup/methods for measurement of gain of antenna under test; enlist gain methods and explain. **(WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**

2. Phase Measurement:

- **Q.** Explain any one antenna phase measurement method / phase measurement method used in antenna system. **(WINTER 2023, 3 Marks; SUMMER 2024, 7 Marks; WINTER 2025, 3 Marks OR)**

Other Important Questions:

None identified.

Chapter 15: Radio wave propagation

Repeated Questions:

1. Modes of Radio Wave Propagation:

- **Q.** Explain/enlist/differentiate different modes of radio wave propagation (ground wave, sky wave, space wave). **(SUMMER 2022, 4 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks; WINTER 2025, 3 Marks)**

2. Ionosphere Structure:

- **Q.** Explain structure of ionosphere / different layers of ionosphere / ionization layers / atmosphere and ionosphere regions with figure. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks - second set; WINTER 2022, 7 Marks OR; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks OR)**

3. MUF, Virtual Height and Skip Distance:

- **Q.** Define/explain MUF, virtual height and skip distance. **(WINTER 2022, 3 Marks OR - virtual height only; WINTER 2023, 3 Marks OR; WINTER 2025, 3 Marks OR; SUMMER 2026, 7 Marks OR - skip distance and virtual height)**

4. Multi-Hop Propagation:

- **Q.** Explain multi-hop propagation briefly. **(SUMMER 2022, 3 Marks - second set; WINTER 2025, 4 Marks OR; SUMMER 2026, 3 Marks OR)**

5. Super Refraction:

- **Q.** Explain Super refraction briefly / with wave propagation phenomenon. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks; SUMMER 2024, 7 Marks OR - combined with multi-hop propagation and skip zone)**

Other Important Questions:

1. Propagation Terms and Definitions:

- **Q.** Define the following terms: i) Pitch angle of helical antenna ii) Isotropic point source iii) Skip zone iv) Critical frequency. **(WINTER 2022, 4 Marks OR - spans Chapters 1, 6 and 15, placed here because skip zone and critical frequency are propagation terms)**
- **Q.** Define the following terms with figure: i) Duct propagation ii) Linear polarization. [Diagram required – refer to the original question paper] **(SUMMER 2023, 4 Marks)**

2. Surface Wave Propagation:

- **Q.** Describe Surface wave propagation briefly. **(SUMMER 2024, 3 Marks)**

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