

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING QUESTION BANK



I SEMESTER M.E. (COMMUNICATION SYSTEMS)

CU3164 - ADVANCED RADIATING SYSTEMS

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CU3164 - ADVANCED RADIATING SYSTEMS

UNIT-I: ANTENNA FUNDAMENTALS AND WIRE ANTENNAS				
Introduction, Types of Antennas, Radiation Mechanism, Current distribution on wire antennas, Maxwell's equations, Antenna fundamental parameters, Radiation integrals, Radiation from surface and line current distributions, Dipole, Monopole, Loop antenna.				
PART A				
Q.No	Questions	CO	BT Level	Competence
1.	Summarize the fundamental parameters of an antenna.	CO1	BTL1	Remembering
2.	Interpret directivity and evaluate for an isotropic antenna.	CO1	BTL2	Understanding
3.	State duality theorem.	CO1	BTL1	Remembering
4.	Differentiate Radian and Steradian.	CO1	BTL2	Understanding
5.	Sketch the line current distribution in an antenna.	CO1	BTL1	Remembering
6.	Identify how the radiation power density and radiation intensity related to antennas.	CO1	BTL2	Understanding
7.	Define beam solid angle or beam area.	CO1	BTL1	Remembering
8.	Differentiate linear, circular and elliptical polarization.	CO1	BTL2	Understanding
9.	“Antenna is a transitional Structure “- Discuss.	CO1	BTL2	Understanding
10.	List the CAD tools & their features for antenna analysis.	CO1	BTL 1	Remembering
11.	Formulate the polarization of the radiation, If a loop antenna of diameter $\lambda/15$ and the loop dipole are fed in phase with equal power.	CO1	BTL 2	Understanding
12.	Using Poincare Sphere categorize the polarization	CO1	BTL 2	Understanding
13.	What is an image theory ?	CO1	BTL 1	Remembering
14.	Discuss the significance of the impedance matching and effective aperture of an antenna.	CO1	BTL 1	Remembering
15.	Illustrate induction field and radiation field of an antenna.	CO1	BTL 2	Understanding
16.	Show the importance of BALUN in wave propagation.	CO1	BTL 2	Understanding
17.	Apply the knowledge of electromagnetics to show how radiation is accomplished?	CO1	BTL 2	Understanding
18.	Evaluate the directivity, if an antenna has a main lobe with both HPBW's of 20° .	CO1	BTL 1	Remembering
19.	Outline the impact of Polarization Mismatch.	CO1	BTL 1	Remembering
20.	Distinguish between FDM and MOM method in radiation analysis.	CO1	BTL 2	Understanding

21.	Assess the different types of matching techniques.	CO1	BTL 1	Remembering	
22.	State the condition to be satisfied with respect to current and charge for emitting radiation.	CO1	BTL 1	Remembering	
23.	Obtain the total power radiated by an antenna over an entire solid angle of 4π .	CO1	BTL 1	Remembering	
24.	Sketch the two-dimensional radiation pattern of a directional antenna.	CO1	BTL 2	Understanding	
PART B					
1.	Formulate the wave equation using Maxwell's equation for electromagnetic wave.	(16)	CO1	BTL4	Analyzing
2.	(i) How is radiation accomplished using two wire antennas? Explain.	(8)	CO1	BTL4	Analyzing
	(ii) Analyze the characteristics of omnidirectional, directional and an isotropic radiator.	(8)	CO1	BTL4	Analyzing
3.	Summarize radiation pattern with a three-dimension model. Also explain HPBW, FNBW and the other lobes.	(16)	CO1	BTL 3	Applying
4.	(i) Analyze the directivity of monopole antenna.	(8)	CO1	BTL 4	Analyzing
	(ii) Derive expressions for near field and far field region of a small dipole antenna.	(8)	CO1	BTL 4	Analyzing
5.	Explain the radiation mechanism with different configurations of single wire as radiator.	(16)	CO1	BTL 3	Applying
6.	Mention the antenna parameters and explain any four parameters in detail.	(16)	CO1	BTL 3	Applying
7.	Explain the line current distribution and obtain the radiation resistance of a simple dipole antenna.	(16)	CO1	BTL 4	Analyzing
8.	(i) Interpret the concept of radiation pattern and directivity of an antenna.	(8)	CO1	BTL 4	Analyzing
	(ii) Sketch the regions around an antenna and explain reactive near field region in detail.	(8)	CO1	BTL 4	Analyzing
9.	Discuss the relation between effective aperture and the directivity of an antenna.	(16)	CO1	BTL 3	Applying
10.	Demonstrate the concept of Polarization .Explain its types and derive its loss factor and efficiency.	(16)	CO1	BTL 3	Applying
11.	Describe the self-oscillation in a Hertzian dipole antenna.	(16)	CO1	BTL 4	Analyzing
12.	Estimate the expressions for the radiated field of a half wave dipole.	(16)	CO1	BTL 3	Applying
13.	Show that the impedance of a half wave dipole is 73 ohms and state how the impedance can be improved.	(16)	CO1	BTL 4	Analyzing
14.	Categorize the electric and magnetic field radiated by loop antenna.	(12)	CO1	BTL 3	Applying
15.	An antenna has a field pattern given by $E(\theta)=\cos\theta\cos2\theta$ for $0^\circ \leq \theta \leq 90^\circ$. Compute (a) HPBW (b) FNBW.	(16)	CO1	BTL 3	Applying

16.	For a source with a radiation intensity $U = 6 \cos\theta$, find the directivity and half power beamwidth when the radiation is unidirectional.	(16)	CO1	BTL 4	Analyzing
17.	An antenna receives a maximum power of $2 \mu\text{W}$ from a radio station. Estimate the maximum effective area if the antenna is located in the far field region of the station where $ E =50 \text{ mV/m}$.	(16)	CO1	BTL 4	Analyzing

UNIT-II: APERTURE ANTENNAS

Field equivalence principle, Radiation from rectangular and circular apertures, Babinet's principle, Slot antenna; Horn antenna; Reflector antenna, Aperture blockage and design consideration, Radiation mechanism and excitation techniques, Microstrip dipole; Patch, Rectangular patch, Circular patch, Feed network, Lens Antennas.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define the field equivalence principle.	CO2	BTL1	Remembering
2.	List the merits of offset feed reflector antenna.	CO2	BTL1	Remembering
3.	A parabolic antenna having a circular mouth is to have power gain of 1000 at $\lambda = 10 \text{ cm}$. Estimate the diameter of mouth and HPBW of the antenna.	CO2	BTL2	Understanding
4.	Mention the features of slot antenna.	CO2	BTL1	Remembering
5.	Differentiate linear, circular and elliptical polarization.	CO1	BTL2	Understanding
6.	State Huygen's principle.	CO2	BTL1	Remembering
7.	What is aperture blockage and mention how it can be prevented in reflector antenna.	CO2	BTL1	Remembering
8.	List the design considerations and the applications of an aperture antenna.	CO2	BTL2	Understanding
9.	How is the concept of aperture applied in an antenna?	CO2	BTL1	Remembering
10.	At 2.7GHz, the increase in antenna temperature from Cygnus A with a 20 m dish antenna is 51k. Compute the aperture efficiency of the antenna.	CO2	BTL 1	Remembering
11.	Exhibit the concept of spill over in parabolic reflector.	CO2	BTL 1	Remembering
12.	Summarize the significance of F/D ratio in reflector antenna.	CO2	BTL 1	Remembering
13.	Identify the limitations of reflector antenna? Name the methods to overcome them.	CO2	BTL 1	Remembering
14.	Find the diameter of aperture of a parabolic antenna to produce a null beam width of 10° at 3 GHz.	CO2	BTL 2	Understanding
15.	Asses the types of feed widely used for reflector antenna and slot antenna.	CO2	BTL 1	Remembering
16.	Outline the principle of Babinet used in slot antenna.	CO2	BTL 2	Understanding
17.	Classify the types of Horn antenna.	CO2	BTL 1	Remembering

18.	Interpret why the radiation pattern is symmetric in slot antenna?	CO2	BTL 2	Understanding
19.	Categorize the feeding methods of microstrip antenna.	CO2	BTL 1	Remembering
20.	Summarize the advantages of microstrip antennas.	CO2	BTL 2	Understanding
21.	Find the complementary slot impedance when the transmitting and receiving antennas are separated by 100 Km, while operating at a frequency of 10 GHz.	CO2	BTL 1	Remembering
22.	Write the expression for far electric field for a circular aperture.	CO2	BTL 1	Remembering
23.	What are the types of lens antenna?	CO2	BTL 2	Understanding
24.	List the advantages of Cassegrain feed system.	CO2	BTL 2	Understanding

PART B

1.	Derive the radiation components of field from a rectangular aperture with an illustration of field equivalence principle.	(16)	CO2	BTL4	Analyzing
2.	(i) Summarize the different types of horn antenna used for radiation.	(8)	CO2	BTL 3	Applying
	(ii) Explain the radiation mechanism of a slot antenna.	(8)	CO2	BTL 3	Applying
3.	A rectangular aperture with a constant field distribution with $a = 3 \lambda$ and $b = 2 \lambda$ is mounted on infinite ground plane. Compute HPBW, BWFN, FSLBW and FSLMM in E-plane.	(16)	CO2	BTL4	Analyzing
4.	(i) With necessary sketches, explain in detail the radiation mechanism of a microstrip patch antenna.	(8)	CO2	BTL 3	Applying
	(ii) With suitable figures, explain the various feed techniques of a microstrip antenna.	(8)	CO2	BTL 3	Applying
5.	Distinguish horn antenna from parabolic reflector. Bring out the design details of pyramidal horn antenna.	(16)	CO2	BTL 3	Applying
6.	(i) Analyze the working and design methodology of a slot antenna.	(8)	CO2	BTL4	Analyzing
	(ii) Illustrate the construction of the lens antenna and mention its merits and demerits.	(8)	CO2	BTL4	Analyzing
7.	Describe rectangular apertures and derive expressions for its uniform distribution on an infinite ground plane and space.	(5)	CO2	BTL 4	Analyzing
8.	(i) Explore the design and construction principles of a parabolic reflector antenna.	(8)	CO2	BTL 3	Applying
	(ii) Explain radiation mechanism of a microstrip antenna considering square microstrip antenna.	(8)	CO2	BTL 3	Applying
9.	The aperture dimension of a pyramidal horn is $10 \times 5 \text{ cm}^2$. It is operating at 6.6 GHz. Find Beamwidth, Power gain and directivity.	(16)	CO2	BTL 3	Applying
10.	Write short notes on Field equivalence principle, uniform aperture distribution on slot antenna and aperture blockage.	(16)	CO2	BTL 4	Analyzing
11.	State and explain Huygens principle for aperture antennas.	(16)	CO2	BTL 3	Applying
12.	What is reflector antenna? Explain with design procedure.	(16)	CO2	BTL 3	Applying

13.	Describe the working principle of reflector antenna and its types.	(16)	CO2	BTL 3	Applying
14.	Demonstrate the far electric field for a circular aperture.	(16)	CO2	BTL 4	Analyzing
15.	Describe the working of pyramidal horn antenna and derive the expression for directivity.	(16)	CO2	BTL 4	Analyzing
16.	Compare the flat reflector and corner reflector and “A horn antenna may be regarded as a flared-out waveguide”, Justify.	(16)	CO2	BTL 3	Applying
17.	Describe the radiation pattern and fields on the axis of an E-plane and H-plane sectoral horns.	(16)	CO2	BTL 4	Analyzing

UNIT-III: ARRAYS

Linear array, Uniform array, End fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques, Binomial and Chebyshev distributions; Two dimensional uniform arrays; Phased array antennas, Smart antennas, Switched beam and adaptive arrays, Mutual coupling in finite arrays.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	What do you understand by a uniform linear array?	CO3	BTL1	Remembering
2.	Write about pattern multiplication and its advantages.	CO3	BTL1	Remembering
3.	Interpret the meaning of array factor.	CO3	BTL2	Understanding
4.	Draw the radiation pattern for broad side and end fire array.	CO3	BTL1	Remembering
5.	Identify the feed networks used in a phased array antenna.	CO3	BTL2	Remembering
6.	Mention the different types of antenna arrays.	CO3	BTL1	Remembering
7.	Classify smart antennas.	CO3	BTL2	Understanding
8.	Compare beam steering and beamforming.	CO3	BTL2	Understanding
9.	Define phased array and frequency scanning array.	CO3	BTL 1	Remembering
10.	List the features of smart antennas and where it is employed?	CO3	BTL 2	Understanding
11.	Draw the radiation pattern of isotropic point sources of same amplitude and opposite phase that are $\lambda/2$ apart along X-axis symmetric with respect to the origin.	CO3	BTL 2	Understanding
12.	How to eliminate minor lobes?	CO3	BTL 1	Remembering
13.	Summarize the advantages and disadvantages of binomial array.	CO3	BTL 1	Remembering

14.	Write the basic principle of reconfigurable antennas.	CO3	BTL 1	Remembering
15.	Distinguish Binomial and Chebyshev distributions.	CO3	BTL 1	Remembering
16.	Write the expression that represents the pattern multiplication.	CO3	BTL 2	Understanding
17.	Mention the conditions to obtain end fire array antenna.	CO3	BTL 1	Remembering
18.	Illustrate the meaning and need for the binomial array.	CO3	BTL 3	Understanding
19.	Identify the active antennas towards the wide interest for industrial applications.	CO3	BTL 1	Remembering
20.	Find the directivity of a broadside array of length 10λ .	CO3	BTL 2	Understanding
21.	Find the directivity of broadside forms of arrays when a uniform linear array contains 50 isotropic radiations with an inter element spacing of $\lambda/2$.	CO3	BTL 2	Understanding
22.	Explore the need for phase shifter in phased array antennas.	CO3	BTL 2	Understanding
23.	A linear end fire, uniform array of 10 elements has a separation of $\lambda/4$ between elements. Calculate the directivity of an array.	CO3	BTL 1	Remembering
24.	Inspect the angle where the transmitted power has dropped by from the maximum power in the direction at which the antenna array is directing.	CO3	BTL 1	Remembering

PART B

1.	A linear broadside array consists of 4 equal isotropic in-phase point sources with $\lambda/3$ spacing. Identify the directivity and beamwidth.	(16)	CO3	BTL 4	Analyzing
2.	Derive the array factor of an uniform linear array. Explain the significance of array factor.	(16)	CO3	BTL 3	Applying
3.	Summarize the expression for the array factor of a linear array of four isotropic element spaced $\lambda/2$ apart fed with signals of equal amplitude and phase. Obtain the directions of maxima and minima.	(16)	CO3	BTL 4	Analyzing
4.	Deduce the expression for directions of pattern minima, pattern maxima, BWFN due to broad side array.	(16)	CO3	BTL 3	Applying
5.	Enumerate the principle of phased array antenna and frequency scanning arrays. Give account of beam forming networks for phased array antenna.	(16)	CO3	BTL 3	Applying
6.	Illustrate the radiation mechanisms of broad side antenna array and end fire antenna array with neat sketches.	(16)	CO3	BTL3	Applying
7.	Illustrate about the adaptive arrays and smart antennas.	(16)	CO3	BTL3	Applying
8.	(i) Derive expression for directivity of end fire array.	(8)	CO3	BTL 4	Analyzing

	(ii) Write the properties of end fire array and frequency scanning arrays.	(8)	CO3	BTL 4	Analyzing
9.	Find the expression for the field and the radiation pattern produced by a N element array of infinitesimal with distance of separation $\lambda/2$ and currents of unequal magnitude and phase shift 180° .	(16)	CO3	BTL 3	Applying
10.	Derive the expression for field pattern of broad side array of N point sources.	(16)	CO3	BTL 3	Analyzing
11.	For a 2-element linear antenna array separated by a distance $d=3\lambda/4$, derive the field quantities and draw its radiation pattern for the phase difference of 45° .	(16)	CO3	BTL 4	Analyzing
12.	Describe in detail about the resultant radiation pattern of two element array.	(16)	CO3	BTL 3	Applying
13.	What is binomial array? Draw pattern of 10 elements binomial array with spacing between the elements of $3\lambda/4$ and $\lambda/2$.	(16)	CO3	BTL 3	Applying
14.	Analyze in details the concept, design principles and types of phased arrays.	(8)	CO3	BTL 3	Applying
15.	Obtain the expression for the field produced by linear array and deduces it for an end fire array.	(16)	CO3	BTL 3	Applying
16.	Mention the properties of linear broadside array and Illustrate about the method of pattern multiplication.	(16)	CO3	BTL 3	Applying
17.	Examine how analog and digital beam forming is achieved with an antenna array with a neat diagram.	(16)	CO3	BTL 4	Analyzing

UNIT-IV: MODERN ANTENNAS AND MEASUREMENT TECHNIQUES

Base station antennas, PIFA, Antennas for WBAN, RFID Antennas, Automotive antennas, MIMO Antennas, Diversity techniques, Antenna Measurements-Test sites and anechoic chamber, Measurement of VSWR, Impedance, Polarization Gain, Radiation pattern.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Compare omnidirectional and sector base station antennas in terms of coverage.	CO4	BTL2	Understanding
2.	Summarize the differences between on-body and in-body antennas used in WBAN.	CO4	BTL2	Understanding
3.	List any two types of antenna test sites commonly used for radiation measurements.	CO4	BTL1	Remembering
4.	Why cross polarization measurement is important in antenna characterization?	CO4	BTL1	Remembering
5.	What is a Planar Inverted-F Antenna (PIFA)?	CO4	BTL1	Understanding
6.	How MIMO technology enhances the performance of modern automotive antenna systems?	CO4	BTL1	Understanding

7.	State the relationship between reflection coefficient and VSWR.	CO4	BTL1	Remembering
8.	Why is a reference antenna required in the gain comparison method?	CO4	BTL2	Remembering
9.	Define a base station antenna and list any two of its key functions.	CO4	BTL 1	Remembering
10.	Why is PIFA preferred over monopole antennas in compact wireless devices?	CO5	BTL 2	Understanding
11.	List the desirable characteristics of on-body antennas used in WBAN.	CO4	BTL 2	Understanding
12.	State the impact of human tissue dielectric properties on WBAN antenna behavior.	CO5	BTL 2	Understanding
13.	Define an RFID antenna and its role in an RFID system.	CO4	BTL 2	Understanding
14.	List any two types of antennas used in passive RFID tags.	CO4	BTL 2	Understanding
15.	Why vehicle body materials influence the radiation pattern of automotive antennas?	CO4	BTL 1	Remembering
16.	Differentiate between embedded antennas and external roof-mounted antennas used in cars.	CO4	BTL 2	Understanding
17.	State the purpose of diversity antennas in automotive communication systems.	CO4	BTL 1	Remembering
18.	Define a MIMO antenna system.	CO4	BTL 1	Remembering
19.	List any two advantages of using MIMO antennas in wireless communication.	CO4	BTL 2	Understanding
20.	How MIMO contributes to increased channel capacity in modern wireless standards?	CO4	BTL 1	Remembering
21.	Differentiate between pattern diversity and polarization diversity.	CO5	BTL 2	Understanding
22.	Why fading mitigation is essential in diversity antenna design?	CO4	BTL 2	Understanding
23.	State the purpose of impedance matching in antenna systems.	CO4	BTL 2	Understanding
24.	Differentiate between 2D and 3D radiation pattern measurements.	CO4	BTL 1	Remembering

PART B

1.	With neat diagrams, describe the construction, working principle, and characteristics of a PIFA. Include explanations of feed point, shorting mechanism, and current distribution.	(16)	CO4	BTL3	Applying
2.	Analyze the limitations of outdoor test sites such as OATS and examine how environmental factors affect accuracy in antenna measurements.	(16)	CO4	BTL4	Analyzing
3.	Illustrate the different antenna diversity methods (spatial,	(16)	CO4	BTL3	Applying

	pattern, polarization, frequency) and explain the working principle of each with neat diagrams.				
4.	Illustrate a typical radiation-pattern measurement setup used in an anechoic chamber and explain the operation of its components with neat diagrams.	(16)	CO4	BTL3	Applying
5.	Analyze the key parameters influencing the radiation pattern of a base station antenna. Discuss how factors such as height, tilt, array configuration, and operating frequency affect coverage and interference.	(16)	CO4	BTL4	Analyzing
6.	Illustrate the different types of antenna measurement test sites (Open area test site, Anechoic chamber) and explain their working principles with neat diagrams.	(16)	CO4	BTL3	Applying
7.	Analyze the major challenges in integrating multiple antennas within a vehicle and examine how mutual coupling, space constraints, and aesthetic considerations affect antenna performance.	(16)	CO4	BTL4	Analyzing
8.	Illustrate the commonly used antenna gain measurement techniques (comparison method, absolute gain method) and explain their principles with neat diagrams.	(16)	CO4	BTL3	Applying
9.	Evaluate the performance of different base station antenna types (monopole, Yagi, panel, and smart antennas) for cellular communication systems. Provide justification for selecting the most appropriate type for urban deployment.	(16)	CO4	BTL 4	Analyzing
10.	Illustrate the classification of WBAN antennas and explain the operational requirements of each type with neat diagrams.	(16)	CO4	BTL 4	Analyzing
11.	Illustrate the main types of RFID antennas (tag, reader, near-field, far-field) and explain their working principles with suitable diagrams.	(16)	CO5	BTL 4	Analyzing
12.	Illustrate the classification of automotive antennas (AM/FM, GPS, LTE/5G, V2X, satellite radio, etc.) and explain their operating principles with neat diagrams.	(16)	CO5	BTL 4	Analyzing
13.	Analyze the major factors affecting MIMO antenna performance of mutual coupling, ECC, channel fading, and radiation pattern and examine their impact on overall system efficiency.	(16)	CO5	BTL 4	Analyzing
14.	Illustrate the procedure for measuring VSWR using a slotted line and a network analyzer, and explain the underlying principles involved.	(16)	CO5	BTL 3	Applying
15.	Illustrate the commonly used impedance measurement techniques (network analyzer method, slotted-line method, and bridge method) and explain their operating principles with neat diagrams.	(16)	CO4	BTL 3	Applying
16.	Illustrate the measurement setup used to determine co-polarization and cross-polarization patterns of an antenna and	(16)	CO5	BTL 4	Analyzing

	explain the working principle involved with neat diagrams.				
17.	Analyze the factors that distort radiation pattern measurements such as reflections, mechanical misalignment, mutual coupling, and absorber imperfections and examine their impact on measurement accuracy.	(16)	CO4	BTL 3	Applying

UNIT-V: RECENT TRENDS IN ANTENNA DESIGN

UWB antenna arrays, Vivaldi antenna arrays, Artificial magnetic conductors/High impedance surfaces, Antennas in medicine, Plasma antennas, Optical antennas, Antennas for millimeter wave communication, Optimization techniques, Numerical methods.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define an Ultra-Wideband (UWB) antenna array.	CO5	BTL1	Remembering
2.	Pointout any two advantages of using Vivaldi antennas in array configurations.	CO5	BTL2	Understanding
3.	Why tissue dielectric properties must be considered while designing medical antennas?	CO5	BTL1	Remembering
4.	Find any two commonly used materials for fabricating optical antennas.	CO5	BTL1	Remembering
5.	Find the frequency range allotted for UWB systems according to FCC.	CO5	BTL1	Remembering
6.	How AMCs help in reducing surface-wave propagation?	CO5	BTL1	Remembering
7.	What is the role of SAR in evaluating medical antenna safety?	CO5	BTL1	Remembering
8.	Justify, how atmospheric absorption affects mmWave antenna design considerations?	CO5	BTL1	Remembering
9.	List any two advantages of using arrays instead of a single UWB antenna.	CO6	BTL 2	Understanding
10.	What is Vivaldi antenna and state its key operating principle.	CO6	BTL 1	Remembering
11.	Differentiate between Perfect Electric Conductor (PEC) and Artificial Magnetic Conductor (AMC).	CO6	BTL 2	Understanding
12.	State any two advantages of High-Impedance Surfaces in antenna design.	CO6	BTL 2	Understanding
13.	List typical unit-cell structures used to realize High-Impedance Surfaces.	CO6	BTL 2	Understanding
14.	State plasma antenna its primary operating principle.	CO6	BTL 1	Remembering
15.	How electron density in plasma affects the resonance frequency of the antenna?	CO6	BTL 1	Remembering
16.	Why metals behave differently at optical frequencies compared to RF frequencies?	CO6	BTL 2	Understanding

17.	Find millimeter-wave frequency range and mention its typical bandwidth.	CO6	BTL 1	Remembering	
18.	Why antenna miniaturization becomes easier at millimeter-wave frequencies?	CO6	BTL 1	Remembering	
19.	Infer the role of antenna arrays in overcoming path loss at mmWave frequencies.	CO6	BTL 2	Understanding	
20.	Why optimization is necessary in miniaturized antenna design?	CO6	BTL 2	Remembering	
21.	List any two classical optimization techniques used in antenna engineering.	CO6	BTL 2	Understanding	
22.	Why discretization is essential in numerical electromagnetic methods?	CO6	BTL 1	Remembering	
23.	Suggest an antenna scenario where the Finite Element Method (FEM) is more suitable than MoM.	CO6	BTL 1	Remembering	
24.	How mesh density affects the accuracy of FDTD simulations?	CO6	BTL 2	Understanding	
1.	Analyze the impact of array geometry (linear, circular, and planar) on beam steering and bandwidth performance of UWB antenna arrays.	(16)	CO5	BTL4	Analyzing
2.	Analyze the role of high-impedance surfaces in enhancing antenna gain and front-to-back ratio. Include discussions on surface-wave suppression and resonance behavior.	(16)	CO5	BTL4	Analyzing
3.	Explain the working principles of optical nano-patch antennas and discuss how they confine and radiate optical energy at the nanoscale.	(16)	CO5	BTL4	Analyzing
4.	Analyze and compare FDTD, FEM, and MoM in terms of computation time, memory usage, versatility, and accuracy for complex antenna structures.	(16)	CO5	BTL4	Analyzing
5.	Discuss the operation of tapered slot antennas and explain the radiation mechanism in Vivaldi arrays using field distribution diagrams.	(16)	CO5	BTL3	Applying
6.	Discuss the working principle of plasma-based reconfigurable antenna arrays. Explain how beam steering, shaping, and ON/OFF switching are achieved.	(16)	CO5	BTL3	Applying
7.	Explain the working principles of mmWave MIMO antennas. Discuss their role in capacity enhancement and spatial multiplexing with suitable diagrams.	(16)	CO5	BTL3	Applying
8.	Analyze and compare different global optimization techniques of GA, PSO, and Differential Evolution (DE) for antenna array synthesis. Highlight strengths, limitations, and application suitability.	(16)	CO5	BTL4	Analyzing

9.	Describe the design steps, element arrangement, taper profile, and feeding network required to achieve stable broadband performance.	(16)	CO6	BTL 3	Applying
10.	Describe the working principle of Electromagnetic Band-Gap (EBG) / HIS structures and explain their influence on antenna performance with suitable diagrams.	(16)	CO6	BTL 4	Analyzing
11.	Discuss the working principles of microwave imaging systems used for breast cancer detection. Explain the role of antenna array configurations in improving resolution and penetration.	(16)	CO6	BTL 3	Applying
12.	Analyze the effects of human tissue layers (skin, fat, muscle) on antenna impedance, gain, and radiation pattern. Provide suitable diagrams and justify how multilayer modeling improves accuracy.	(16)	CO6	BTL 3	Applying
13.	Compare different types of optical antennas (dipole, bow-tie, Yagi-Uda, monopole) in terms of directivity, field enhancement, fabrication difficulty, and operational bandwidth. Evaluate which design is most suitable for high-resolution sensing applications.	(16)	CO6	BTL 4	Analyzing
14.	Analyze the challenges of mmWave propagation (path loss, blockage, atmospheric attenuation, alignment issues). Explain how high-gain phased arrays and beamforming antennas address these limitations.	(16)	CO6	BTL 4	Analyzing
15.	Apply Genetic Algorithm (GA) to optimize a microstrip patch antenna for maximum bandwidth. Explain chromosome representation, selection, crossover, mutation, and termination criteria.	(16)	CO6	BTL 3	Applying
16.	Evaluate the effectiveness of hybrid numerical methods (FEM–MoM, FDTD–MoM) for electrically large antennas. Compare their advantages and limitations for multi-scale modeling.	(16)	CO6	BTL 4	Analyzing
17.	Discuss the working principle of Finite Difference Time Domain (FDTD) method.	(16)	CO6	BTL 3	Applying