

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK



III SEMESTER M.E. (Communication Systems)

PCU304 – ADVANCED ANTENNA DESIGN

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PCU304 – ADVANCED ANTENNA DESIGN

Unit I - ANTENNA FUNDAMENTALS				
Physical concept of radiation, Antenna parameters, Reciprocity theorem, Friis transmission equation, communication link budget and radar range equation. Review of Electromagnetic Wave equations, Radiation integrals, Radiation from surface and line current distributions- monopole, dipole.				
PART – A				
Q.No	Questions	CO	BT Level	Competence
1.	Define antenna.	CO1	BTL 1	Remembering
2.	List the antenna parameters.	CO1	BTL 1	Remembering
3.	Write the significance of radiation resistance.	CO1	BTL 1	Remembering
4.	Define the term Half Power Beam Width.	CO1	BTL 1	Remembering
5.	Relate the Gain and Directivity of an antenna through proper expression.	CO1	BTL 2	Understanding
6.	Define Radiation pattern	CO1	BTL 1	Remembering
7.	What are the two types of radiation pattern. Field pattern	CO1	BTL 1	Remembering
8.	Define Radiation pattern	CO1	BTL 1	Remembering
9.	Interpret dB and dBi in antenna measurements.	CO1	BTL 2	Understanding
10.	An antenna has a field pattern described by $E_{\phi} = \cos^2 \phi$ for $0^\circ \leq \phi \leq 90^\circ$. Find the Half Power Beam Width (HPBW) of the antenna.	CO1	BTL 2	Understanding
11.	State Reciprocity theorem.	CO1	BTL 1	Remembering
12.	A radio link has a 15W transmitter connected to an antenna of 2.5 m ² effective aperture at 5 GHz. The receiving antenna has an effective aperture of 0.5 m ² and is located at a 15 km Line-of-sight distance from the transmitting antenna. Assuming lossless, matched antennas, estimate the power delivered to receiver.	CO1	BTL 2	Understanding
13.	Write the Friis transmission equation.	CO1	BTL 1	Remembering
14.	A communication system operates at 500 MHz. The transmitted power is 100 W, both antennas have unity gain, and the antennas are separated by 1 km. Calculate the received power.	CO1	BTL 2	Understanding
15.	What is meant by a communication link budget?	CO1	BTL 1	Remembering
16.	Mention any four parameters that influence the maximum detection range of a radar.	CO1	BTL 2	Understanding
17.	Write the wave equation for the electric field in a source-free medium.	CO1	BTL 1	Remembering
18.	The radial component of the radiated power density of an antenna is given by $W_{\text{rad}} = W_r \hat{r} = (A_0 \sin \theta / r^2) \hat{r}$ (W/m ²) where A_0 is the peak value of the power density, θ is the usual spherical coordinate and $\hat{r}$ is the radial unit vector. Determine the total radiated power of the antenna.	CO1	BTL 2	Understanding
19.	Interpret the terms near field and far field region.	CO1	BTL 2	Understanding
20.	What is the vector magnetic potential?	CO1	BTL 1	Remembering
21.	Differentiate between line current distribution and surface current distribution.	CO1	BTL 2	Understanding

22.	Compare half-wave dipole and quarter-wave monopole antennas in terms of radiation characteristics	CO1	BTL 2	Understanding	
23.	Outline the working of a quarter-wave monopole antenna.	CO1	BTL 2	Understanding	
24.	Why a half-wave dipole commonly used?	CO1	BTL 2	Understanding	
PART – B					
1.	Explain the terms “Radiation Resistance”, “gain”, ”directivity”, and “polarization” of an antenna	(16)	CO1	BTL 3	Applying
2.	How radiation is accomplished using two wire antenna?	(16)	CO1	BTL 3	Applying
3.	(i) 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.	(8)	CO1	BTL 3	Applying
	(ii) Interpret the concept of radiation pattern and directivity of an antenna.	(8)			
4.	Show that the directivity of an antenna depends on the power radiated. Using the expression obtained for directivity determine the maximum directivity of the antenna for an infinitesimal linear dipole of length $l \ll \lambda$ for which the radial component of the power density is $W_{av} = W_r = A_o (\sin^2 \theta / r^2)$ (W/m ²)	(16)	CO1	BTL 3	Applying
5.	Analyze the conditions under which the reciprocity theorem holds for an antenna system.	(16)	CO1	BTL 4	Analyzing
6.	Deduce the Friis transmission equation for a communication link between a transmitting and a receiving antenna.	(16)	CO1	BTL 4	Analyzing
7.	A transmitting antenna with a gain of 20 dB radiates 50 W of power at 6 GHz. Calculate the power received by a receiving antenna of gain 15 dB located 25 km away, using the Friis transmission equation.	(16)	CO1	BTL 3	Applying
8.	Explain the concept of a communication link budget, listing all the gain and loss terms involved from transmitter to receiver.	(16)	CO1	BTL 3	Applying
9.	Derive the radar range equation relating the maximum detection range to transmitted power, antenna gain, target radar cross-section, and receiver sensitivity.	(16)	CO1	BTL 3	Applying
10.	Illustrate the radiated fields of a center fed $\lambda/2$ dipole antenna with an appropriate expression. Sketch the radiation pattern.	(16)	CO1	BTL 4	Analyzing
11.	Summarize the principle of radiation from an oscillating electric dipole. Derive the near field and far field expressions.	(16)	CO1	BTL 3	Applying
12.	Analyze how far-field electric and magnetic fields are obtained from the magnetic vector potential radiation integral.	(16)	CO1	BTL 4	Analyzing
13.	Derive the expression for the field quantities radiated from a $\lambda/2$ dipole and prove that the radiation resistance to be 73Ω .	(16)	CO1	BTL 4	Analyzing
14.	Analyze the electric and magnetic field components of a finite length dipole antenna and show its current distribution with respect to its length in terms of the wavelength.	(16)	CO1	BTL 4	Analyzing
15.	An electric field strength $10 \mu\text{V/m}$ is to be measured at an observation point $\theta = \pi/2$, 500 km from a half wave dipole antenna operating in air at 50 MHz (a) What is the length of dipole? (b) Calculate the current that must be fed to antenna	(16)	CO1	BTL 3	Applying

	(c) Find the average power radiated by antenna				
16.	Determine the field equations for a Hertzian dipole to produce the purely resistive intrinsic impedance.	(16)	CO1	BTL 3	Applying
17.	Deduce an expression for the power radiated by the current element and calculate the radiation resistance .	(16)	CO1	BTL 4	Analyzing

UNIT II LINEAR ANTENNAS AND ARRAYS					
Infinitesimal dipole, finite-length dipole, dipoles for mobile communication, small circular loop, N-Element Linear Array, Linear broadside array and End fire array with uniform spacing, Planar array, Binomial array antennas.					
PART – A					
Q.No	Questions	CO	BT Level	Competence	
1.	Define an infinitesimal dipole antenna	CO2	BTL 1	Remembering	
2.	An infinitesimal dipole of length $\lambda/50$ carries a uniform current. Calculate its radiation resistance.	CO2	BTL 2	Understanding	
3.	Write the expression for the far-field electric field of an infinitesimal dipole.	CO2	BTL 1	Remembering	
4.	Compare an infinitesimal dipole and a finite-length dipole,	CO2	BTL 2	Understanding	
5.	Name two common dipole configurations used as mobile communication antennas.	CO2	BTL 2	Understanding	
6.	Why a quarter-wave monopole is preferred over a half-wave dipole in handheld mobile units.	CO2	BTL 2	Understanding	
7.	Define a small circular loop antenna.	CO2	BTL 1	Remembering	
8.	A small circular loop of radius $\lambda/25$ carries a uniform current. Determine its radiation resistance.	CO2	BTL 2	Understanding	
9.	Outline the characteristics of an antenna array.	CO2	BTL 2	Understanding	
10.	What is meant by an N-element linear array?	CO2	BTL 1	Remembering	
11.	Illustrate the basic principle of pattern multiplication.	CO2	BTL 2	Understanding	
12.	What is an "array factor" for an N-element linear array?	CO2	BTL 1	Remembering	
13.	Outline the term "grating lobe" in the context of linear arrays.	CO2	BTL 1	Remembering	
14.	Define a broadside array.	CO2	BTL 1	Remembering	
15.	State the condition for maximum radiation in a broadside array.	CO2	BTL 1	Remembering	
16.	Interpret the planar array antenna.	CO2	BTL 2	Understanding	
17.	List the advantages of planar arrays over linear arrays.	CO2	BTL 1	Remembering	
18.	Mention the progressive phase condition required for ordinary end-fire radiation.	CO2	BTL 2	Understanding	
19.	Write the array factor expression of a rectangular planar array with M×N elements.	CO2	BTL 1	Remembering	
20.	Draw the radiation pattern for broad side and end fire array.	CO2	BTL 1	Remembering	
21.	Compare end fire and broad side array.	CO2	BTL 2	Understanding	
22.	Mention the advantages and disadvantages of binomial array.	CO2	BTL 2	Understanding	
23.	Illustrate the concept of binomial array.	CO2	BTL 1	Remembering	

24.	Illustrate the relative excitation levels of a binomial array of 2 and 3 elements.	CO2	BTL 2	Understanding	
PART – B					
1.	Derive the expressions for the far-zone electric and magnetic fields of an infinitesimal dipole starting from the magnetic vector potential.	(16)	CO2	BTL 3	Applying
2.	An infinitesimal dipole of length $\lambda/40$ carries a uniform current of 5 A at 100 MHz. Determine its radiation resistance, radiated power, and the maximum value of the far-zone electric field at a distance of 1 km.	(16)	CO2	BTL 3	Applying
3.	Derive the radiation field expressions for a finite-length dipole. Explain the effect of antenna length on the radiation pattern.	(16)	CO2	BTL 3	Applying
4.	Describe the design and radiation characteristics of dipole-based antennas used in mobile and handheld communication devices.	(16)	CO2	BTL 3	Applying
5.	Analyze the impact of ground plane size, antenna height, and human-body proximity on the performance of a monopole/dipole antenna used in a mobile handset.	(16)	CO2	BTL 4	Analyzing
6.	Deduce the radiation field expressions of a small circular loop antenna and explain its radiation characteristics.	(16)	CO2	BTL 4	Analyzing
7.	A small circular loop antenna of radius $\lambda/30$ carries a uniform current of 2 A. Calculate its radiation resistance, total radiated power, and directivity.	(16)	CO2	BTL 4	Analyzing
8.	Derive the array factor expression for an N-element uniform linear array with equal amplitude excitation, uniform spacing, and progressive phase shift.	(16)	CO2	BTL 3	Applying
9.	(i)Derive the expression for field pattern of broad side array of N point sources. (ii)A linear broadside array consists of 4 equal isotropic in-phase point sources with $\lambda/3$ spacing. Identify the directivity and beamwidth.	(8) (8)	CO2	BTL 4	Analyzing
10.	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)	CO2	BTL 4	Analyzing
11.	Derive the array factor of a broadside array. Explain the condition for maximum radiation and discuss its radiation characteristics.	(16)	CO2	BTL 4	Analyzing
12.	(i) Deduce the expression for the field produced by linear array and deduce it for an end fire array. (ii) Express the properties of linear broadside array.	(8) (8)	CO2	BTL 3	Applying
13.	Identify the direction of maximum and minimum radiation from the resultant radiation of two identical radiators which are spaced $d = 3 \lambda/4$ meters apart and fed with currents of equal magnitude but with 180° phase difference.	(16)	CO2	BTL 4	Analyzing
14.	Derive the progressive phase condition for ordinary end-fire	(16)	CO2	BTL 3	Applying

	radiation in a uniform linear array and obtain the corresponding radiation pattern with necessary conditions.				
15.	Explain the construction and working principle of a planar array antenna and analyze its radiation characteristics and applications.	(16)	CO2	BTL 4	Analyzing
16.	For an end fire consisting of several half wave length isotropic radiator is to have a directive gain of 30° . Evaluate the array length and width of the major lobe. What will be these values for a broadside array.	(16)	CO2	BTL 4	Analyzing
17.	Explain the design procedure of a binomial array. Derive the excitation coefficients using Pascal's triangle and discuss its radiation characteristics.	(16)	CO2	BTL 3	Applying

UNIT III - LOW PROFILE ANTENNAS				
Microstrip Antenna Elements, Microstrip arrays, Microstrip Leaky Wave antennas, Fundamental limits on antenna size, Antennas for compact devices, Dielectric resonator antennas, Near field of a uniform rectangular aperture, Human body effects on Antenna performance.				
PART – A				
Q.No	Questions	CO	BT Level	Competence
1.	Define a microstrip patch antenna and list its basic structural layers.	CO3	BTL 1	Remembering
2.	List two advantages and two disadvantages of microstrip antennas.	CO3	BTL 1	Remembering
3.	Define a microstrip antenna array.	CO3	BTL 1	Remembering
4.	What is meant by a corporate feed network?	CO3	BTL 1	Remembering
5.	Differentiate between series-fed and corporate-fed microstrip arrays.	CO3	BTL 2	Understanding
6.	Define a leaky wave antenna.	CO3	BTL 1	Remembering
7.	What is meant by leaky-wave radiation in microstrip structures?	CO3	BTL 1	Remembering
8.	Mention the type of leaky mode that is primarily responsible for radiation in a microstrip leaky wave antenna.	CO3	BTL 2	Understanding
9.	Differentiate "fast wave" and a "slow wave" structure in the context of leaky wave radiation.	CO3	BTL 2	Understanding
10.	Define the "radian sphere" concept used in establishing fundamental limits on antenna size.	CO3	BTL 1	Remembering
11.	Define quality factor (Q) of an antenna and state its relation to bandwidth.	CO3	BTL 1	Remembering
12.	How does antenna size affect bandwidth?	CO3	BTL 1	Remembering
13.	Why are compact antennas required in modern wireless devices?	CO3	BTL 2	Understanding
14.	Interpret the effect of using a high dielectric constant substrate on antenna size reduction.	CO3	BTL 2	Understanding
15.	Outline the features of Planar Inverted-F Antenna.	CO3	BTL 2	Understanding
16.	Outline the operating principle of a dielectric resonator antenna (DRA).	CO3	BTL 2	Understanding

17.	Mention the two key parameters of the dielectric material that determine DRA performance.	CO3	BTL 2	Understanding
18.	Compare a DRA with a microstrip patch antenna	CO3	BTL 2	Understanding
19.	Illustrate the near-field (Fresnel) region of an antenna.	CO3	BTL 2	Understanding
20.	Write the expression used to determine the Fraunhofer (far-field) distance for a rectangular aperture of maximum dimension D.	CO3	BTL 1	Remembering
21.	A rectangular aperture has a maximum dimension of 0.5 m and operates at 10 GHz. Calculate the Fraunhofer distance.	CO3	BTL 2	Understanding
22.	Define Specific Absorption Rate (SAR).	CO3	BTL 1	Remembering
23.	Mention any four effects of the human body on mobile device antennas.	CO3	BTL 2	Understanding
24.	How does hand placement influence the impedance of a smartphone antenna?	CO3	BTL 1	Remembering

PART – B

1.	Frame the structure of a rectangular microstrip patch antenna and derive the expressions for its resonant length and width,	(16)	CO3	BTL 4	Analyzing
2.	Illustrate the various feeding techniques used for microstrip patch antennas, highlighting their impedance matching characteristics.	(16)	CO3	BTL 4	Analyzing
3.	A rectangular microstrip antenna is designed to operate at 2.45 GHz on a substrate with relative permittivity $\epsilon_r = 4.4$ and thickness 1.6 mm. (i) Calculate the patch width. (ii) Determine the effective dielectric constant. (iii) Estimate the effective patch length.	(16)	CO3	BTL 3	Applying
4.	(i) Explain the construction and working principle of microstrip antenna arrays. (ii) Mention the advantages of arrays over a single patch antenna.	(16)	CO3	BTL 3	Applying
5.	Compare the series-fed and corporate-fed microstrip array configurations,	(16)	CO3	BTL 4	Analyzing
6.	Explain the principle of operation of a microstrip leaky wave antenna and describe the leaky mode propagation.	(16)	CO3	BTL 4	Analyzing
7.	Describe the design considerations of a microstrip leaky wave antenna, including open and shielded structures, with the radiation characteristics.	(16)	CO3	BTL 4	Analyzing
8.	Mention the advantages, limitations, and applications of microstrip leaky wave antennas in modern wireless and radar systems.	(16)	CO3	BTL 3	Applying
9.	Outline the concept of the radian sphere and derive the Chu limit relating antenna size (ka) to the minimum achievable quality factor Q .	(16)	CO3	BTL 3	Applying
10.	(i) Summarize the fundamental limitations of electrically small antennas. (ii) Express the relationship between antenna size, bandwidth, radiation efficiency, and Q -factor.	(8) (8)	CO3	BTL 3	Applying
11.	Analyze the Chu limit and its significance in compact antenna	(16)	CO3	BTL 4	Analyzing

	design.				
12.	Explain the structure and working principle of a Planar Inverted-F Antenna (PIFA).	(16)	CO3	BTL 3	Applying
13.	Analyze the design challenges associated with antennas for compact devices.	(16)	CO3	BTL 4	Analyzing
14.	Describe the construction and operating principle of a Dielectric Resonator Antenna (DRA).	(16)	CO3	BTL 3	Applying
15.	Derive the near-field radiation integral for a uniform rectangular aperture and explain the significance of the Fresnel and Fraunhofer approximations.	(16)	CO3	BTL 4	Analyzing
16.	Illustrate the concept of Specific Absorption Rate (SAR) and describe the standard procedures used to evaluate SAR compliance for handset antennas.	(16)	CO3	BTL 3	Applying
17.	Examine various techniques used to minimize human body effects on antennas used in smartphones, wearable devices, and IoT systems.	(16)	CO3	BTL 4	Analyzing

UNIT IV - RADIATION STRUCTURES AND NUMERICAL METHODS				
Auxiliary vector potential, Huygens source approximation, Boundary conditions, Physical optics, Method of Moments, Finite Difference Time Domain Method, Ray Optics and the Geometric theory of Diffraction.				
Q.No	Questions	CO	BT Level	Competence
1.	Define the auxiliary vector potential used in electromagnetic field analysis.	CO4	BTL 1	Remembering
2.	State the relationship between the magnetic vector potential A and magnetic flux density B.	CO4	BTL 1	Remembering
3.	Why is the auxiliary vector potential introduced in solving antenna radiation problems?	CO4	BTL 1	Remembering
4.	State Huygens Principle.	CO4	BTL 1	Remembering
5.	Mention the assumptions made in the Huygens source approximation.	CO4	BTL 2	Understanding
6.	Write the significance of the Huygens source approximation in aperture antenna analysis.	CO4	BTL 1	Remembering
7.	Write the boundary conditions for tangential E field at the interface between two dielectric media.	CO4	BTL 1	Remembering
8.	Identify the boundary condition for the tangential component of the magnetic field.	CO4	BTL 1	Remembering
9.	State the boundary condition applied to the normal component of D at a conductor surface carrying surface charge.	CO4	BTL 1	Remembering
10.	Illustrate the physical optics (PO) approximation,	CO4	BTL 2	Understanding
11.	Summarize about the Physical Optics (PO) method.	CO4	BTL 2	Understanding
12.	List four applications of Physical Optics in antenna engineering.	CO4	BTL 1	Remembering
13.	Differentiate between Geometrical Optics (GO) and Physical Optics (PO).	CO4	BTL 2	Understanding
14.	Define the Method of Moments (MoM).	CO4	BTL 2	Understanding

15.	What is the purpose of using the Method of Moments in computational electromagnetics?	CO4	BTL 2	Understanding	
16.	What are basis functions in the Method of Moments?	CO4	BTL 2	Understanding	
17.	Mention the steps involved in the Method of Moments.	CO4	BTL 2	Understanding	
18.	Define the Finite Difference Time Domain (FDTD) method.	CO4	BTL 2	Understanding	
19.	Interpret about Yee cell in the FDTD method.	CO4	BTL 2	Understanding	
20.	Why is the FDTD method called a time-domain technique?	CO4	BTL 2	Understanding	
21.	Define Ray Optics.	CO4	BTL 1	Remembering	
22.	State the laws of reflection used in Ray Optics.	CO4	BTL 1	Remembering	
23.	Outline the Geometric Theory of Diffraction (GTD).	CO4	BTL 1	Remembering	
24.	Why was GTD introduced as an extension of Geometrical Optics?	CO4	BTL 2	Understanding	
PART – B					
1.	Derive the wave equation for the auxiliary magnetic vector potential (A) starting from Maxwell's equations.	(16)	CO4	BTL 4	Analyzing
2.	How the vector potential is used to determine the radiated electromagnetic fields?	(16)	CO4	BTL 3	Applying
3.	Explain Huygens' Principle and derive the Huygens source approximation for aperture antennas.	(16)	CO4	BTL 3	Applying
4.	Analyze the differences between the Huygens source approximation and the exact field equivalence principle,	(16)	CO4	BTL 3	Applying
5.	Examine the electromagnetic boundary conditions at the interface between two dielectric media.	(16)	CO4	BTL 4	Analyzing
6.	Analyze the boundary conditions at the interface of a perfect conductor and free space.	(16)	CO4	BTL 4	Analyzing
7.	Explain the physical optics (PO) approximation and derive the induced surface current expression on a perfectly conducting reflector surface under plane-wave illumination.	(16)	CO4	BTL 3	Applying
8.	Summarize the application of physical optics to compute the radiation pattern of a parabolic reflector antenna.	(16)	CO4	BTL 3	Applying
9.	Analyze the applications of Physical Optics in reflector antennas.	(16)	CO4	BTL 4	Analyzing
10.	Interpret the Method of Moments (MoM) for solving electromagnetic integral equations.	(16)	CO4	BTL 4	Analyzing
11.	(i)Outline the computational procedure of the Method of Moments. (ii) Explain matrix formulation, convergence, and numerical accuracy.	(8) (8)	CO4	BTL 3	Applying
12.	Compare the Method of Moments (MoM) with Finite Difference Time Domain (FDTD).	(16)	CO4	BTL 4	Analyzing
13.	Explain the Finite Difference Time Domain (FDTD) method.	(16)	CO4	BTL 3	Applying
14.	(i) Interpret the principles of Ray (Geometrical) Optics. (ii)Derive the laws of reflection and refraction and discuss their applications in antenna engineering.	(8) (8)	CO4	BTL 4	Analyzing
15.	Discuss the applications of Ray Optics in reflector antennas, dielectric lenses, satellite communication, and microwave propagation.	(16)	CO4	BTL 3	Applying

16.	Explain the Geometric Theory of Diffraction (GTD) and derive Keller's law governing the direction of diffracted rays at an edge.	(16)	CO4	BTL 3	Applying
17.	Analyze the role of diffraction coefficients in GTD for computing fields near shadow and reflection boundaries.	(16)	CO4	BTL 4	Analyzing

UNIT V - MODERN ANTENNAS					
Frequency independent antenna, Phased array antenna, Frequency scanned array antenna, Satellite terminal antenna, smart antenna, Adaptive and Spatial filtering antenna, Wearable antenna, Reconfigurable antenna, Printed antenna, Antenna for wireless charging systems.					
PART A					
Q.No	Questions	CO	BT Level	Competence	
1.	Define a frequency independent antenna.	CO5	BTL 1	Remembering	
2.	Give two examples of frequency independent antennas.	CO5	BTL 1	Remembering	
3.	Outline the characteristics of phased array antenna.	CO5	BTL 2	Understanding	
4.	State the role of phase shifters in a phased array antenna system.	CO5	BTL 1	Remembering	
5.	How is beam scanning achieved in a frequency scanned array?	CO5	BTL 1	Remembering	
6.	Express the relation between the operating frequency and beam-pointing angle in a frequency-scanning array.	CO5	BTL 2	Understanding	
7.	Mention one advantage and one limitation of frequency scanned arrays.	CO5	BTL 2	Understanding	
8.	Summarize the features of a satellite terminal antenna.	CO5	BTL 2	Understanding	
9.	Mention the characteristics required for satellite communication antennas.	CO5	BTL 2	Understanding	
10.	Name any four types of antennas used in satellite terminals.	CO5	BTL 1	Remembering	
11.	Define a smart antenna.	CO5	BTL 1	Remembering	
12.	Differentiate between switched-beam antennas and adaptive array antennas.	CO5	BTL 2	Understanding	
13.	How smart antennas is used to improve the system capacity in cellular networks?	CO5	BTL 1	Remembering	
14.	Outline the characteristics of an adaptive antenna.	CO5	BTL 2	Understanding	
15.	Define spatial filtering.	CO5	BTL 1	Remembering	
16.	State the purpose of beamforming in adaptive antennas.	CO5	BTL 1	Remembering	
17.	Illustrate the significant feature of wearable antenna.	CO6	BTL 2	Understanding	
18.	Mention two commonly used materials for wearable antenna fabrication.	CO6	BTL 2	Understanding	
19.	List the design requirements of wearable antennas.	CO6	BTL 1	Remembering	
20.	Interpret the effect of the human body on wearable antenna performance.	CO6	BTL 2	Understanding	
21.	Name the different types of antenna reconfiguration.	CO5	BTL 1	Remembering	
22.	Differentiate between printed antennas and wire antennas.	CO6	BTL 2	Understanding	
23.	What is the role of an antenna in a wireless charging system?	CO6	BTL 1	Remembering	
24.	Illustrate the principle of wireless power transfer (WPT).	CO6	BTL 2	Understanding	

PART B					
1.	Explain the principle of frequency independent antennas. Describe the construction, radiation characteristics, advantages, limitations, and applications of log-periodic dipole array (LPDA) and spiral antennas.	(16)	CO5	BTL 3	Applying
2.	Analyze the radiation mechanism of an LPDA in terms of the "active region" concept, and examine how element spacing factor (τ) and relative spacing (σ) determine gain and bandwidth.	(16)	CO5	BTL 4	Analyzing
3.	A log-periodic dipole array is designed with a scale factor $\tau = 0.9$ and the longest dipole length of 0.5 m. (i) determine the length of the next three dipole elements. (ii) estimate the corresponding resonant frequencies.	(16)	CO5	BTL 3	Applying
4.	Describe the construction and working principle of a phased array antenna.	(16)	CO5	BTL 3	Applying
5.	Explain the principle of frequency scanning in a linear array and derive the relationship between operating frequency and the resulting beam-pointing angle.	(16)	CO5	BTL 4	Analyzing
6.	Compare frequency scanned arrays and phased arrays with respect to beam steering mechanism, bandwidth, scanning speed, complexity, and practical applications.	(16)	CO5	BTL 4	Analyzing
7.	Categorize the factors influencing the performance of satellite terminal antennas.	(16)	CO5	BTL 4	Analyzing
8.	Identify the design requirements and typical antenna configurations used in VSAT satellite terminal systems.	(16)	CO5	BTL 4	Analyzing
9.	Explain the architecture and operating principle of a switched-beam smart antenna system, describing how beam selection is performed based on signal strength.	(16)	CO5	BTL 3	Applying
10.	Analyze the advantages of smart antennas in modern wireless communication systems and interpret their role in interference suppression, capacity enhancement, and coverage improvement.	(16)	CO5	BTL 3	Applying
11.	Explain the concept of spatial filtering in an adaptive antenna array and describe the working of the Least Mean Squares (LMS) algorithm for adaptive weight updating.	(16)	CO5	BTL 4	Analyzing
12.	Analyze the performance of an adaptive array using the Minimum Variance Distortion less Response (MVDR) criterion in nulling interference,	(16)	CO5	BTL 3	Applying
13.	(i) Analyze the design trade-offs involved in reducing SAR while maintaining adequate gain and bandwidth for a body-worn antenna,.	(8)	CO6	BTL 4	Analyzing

	(ii)Examine techniques such as ground plane shielding and electromagnetic band-gap (EBG) structures.	(8)			
14.	Explain the design requirements of wearable antennas.	(16)	CO6	BTL 3	Applying
15.	Interpret the concept of a reconfigurable antenna and describe how frequency reconfigurability is achieved using PIN diode or RF MEMS switches, with an example design.	(16)	CO6	BTL 4	Analyzing
16.	Illustrate the design and fabrication process of a printed monopole/dipole antenna, describing its radiation characteristics and typical applications.	(16)	CO6	BTL 3	Applying
17.	Summarize the working principle of antennas used in wireless charging systems.	(16)	CO6	BTL 3	Applying