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)

1911101 - ADVANCED RADIATION SYSTEM

Regulation – 2019

Academic Year 2019 – 20 (Odd Semester)

Prepared by

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

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QUESTION BANK

SUBJECT : 1911101 - ADVANCED RADIATION SYSTEM

SEM / YEAR : I / I year M.E.,Communication Systems

UNIT I - ANTENNA FUNDAMENTAL			
Wave equations, radiation pattern, HPBW,FNBW, gain and directivity, polarization, equivalent circuit, radiation resistance, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna, Image theory; Induction, reciprocity theorem, Balance to unbalance transformer, Introduction to numerical techniques.			
PART – A			
Q.No.	**Questions**	**Bloom's Taxonomy Level**	**Domain**
1	"Antenna is a transitional Structure "- Discuss.	**BTL -2**	Understanding
2	Summarize the fundamental parameters of an antenna.	**BTL -2**	Understanding
3	Sketch the line current distribution in an antenna.	**BTL -3**	Applying
4	List the CAD tools & their features for antenna analysis.	**BTL -1**	Remembering
5	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,	**BTL -6**	Creating
6	Interpret Directivity and evaluate for an isotropic antenna.	**BTL -5**	Evaluating
7	Using Poincare Sphere categorize the polarization	**BTL -6**	Creating
8	What is an image theory ?	**BTL -1**	Remembering
9	Discuss the significance of the impedance matching and effective aperture of an antenna.	**BTL -2**	Understanding
10	Illustrate induction field and radiation field of an antenna.	**BTL -2**	Understanding
11	Identify how the radiation power density and radiation intensity related to antennas.	**BTL -4**	Analyzing

12	Define beam solid angle or beam area.	**BTL -1**	Remembering
13	Differentiate linear, circular and elliptical polarization.	**BTL -4**	Analyzing
14	State duality theorem.	**BTL -1**	Remembering
15	Show the importance of BALUN in wave propagation.	**BTL -1**	Remembering
16	Apply the knowledge of electromagnetics to show how radiation is accomplished?	**BTL -3**	Applying
17	Evaluate the directivity, if an antenna has a main lobe with both HPBWs of 20^o .	**BTL -5**	Evaluating
18	Outline the impact of Polarization Mismatch.	**BTL -1**	Remembering
19	Distinguish between FDM and MOM method in radiation analysis.	**BTL -4**	Analyzing
20	Assess the different types of matching techniques.	**BTL -3**	Applying
	PART – B		
1	(i) Review the principle of reciprocity as applied to antenna. (6) (ii) Describe the self-oscillation in a Hertzian dipole antenna. (7)	**BTL -2**	Understanding
2	(i) Explain the line current distribution and obtain the radiation resistance of a simple dipole antenna. (6) (ii) Discuss the relation between effective aperture and the directivity of an antenna. (7)	**BTL -2**	Understanding
3	(i) Derive expressions for near field and far field region of a small dipole antenna. (7) (ii) Sketch the regions around an antenna and explain reactive near field region in detail. (6)	**BTL -3**	Applying
4	(i) List out the numerical techniques and EM software used for the analysis of an antenna. (6) (ii) Outline the matching techniques used in broadband antennas. (7)	**BTL -1**	Remembering
5	(i) Categorize the electric and magnetic field radiated by loop antenna. (7) (ii) Examine the performance of Balanced to Unbalanced Transformer in wave propagation. (6)	**BTL -4**	Analyzing
6	(i) Define and explain the parameters of an antenna. Write about the Friis transmission equation. (7) (ii) Show that the impedance of a half wave dipole is 73 ohms and state how the impedance can be improved. (6)	**BTL -1**	Remembering
7	(i) Deduce the expression for electric and magnetic field components of a dipole with a length $l << \lambda$. (7) (ii) Assess the characteristics of an antenna using image theory. (6)	**BTL -5**	Evaluating

8	(i) Analyze the directivity of monopole antenna. (6) (ii) Derive expressions for the radiation intensity, input impedance of an antenna. (7)	**BTL -4**	Analyzing
9	(i) State and derive Lorentz reciprocity theorem for the receiving antennas. (6) (ii) Write technical notes on BAZOOKA Balun. (7)	**BTL -1**	Remembering
10	(i) Demonstrate the Thevenin equivalent circuit of transmitting and receiving antenna with neat diagrams. (7) (ii) A loss less λ/2 antenna with input impedance of 73Ω is to be connected to a line whose characteristic impedance is 50 Ω. Assuming that the pattern of antenna is given by U=Bo sin3θ. Find the overall maximum gain. (6)	**BTL -4**	Analyzing
11	(i) Using Vector Potential in magnetic field and electric field discuss the features of Helmholtz equation. (6) (ii) Estimate the expressions for the radiated field of a half wave dipole. (7)	**BTL -2**	Understanding
12	(i) Discuss about different Numerical techniques used in antenna parameter measurement. (6) (ii) Illustrate the Antenna temperature with a neat diagram. (7)	**BTL -1**	Remembering
13	Demonstrate the concept of Polarization .Explain its types and derive its loss factor and efficiency. (13)	**BTL -3**	Applying
14	(i) Formulate the wave equation using Maxwells equation for electromagnetic wave. (6) (ii) Design an antenna with omnidirectional amplitude pattern with a half-power beamwidth of 90◦. Express its radiation intensity by $U = \sin^n\theta$. Determine the value of n and attempt to identify elements that exhibit such a pattern. Determine the directivity of the antenna. (7)	**BTL -6**	Creating
	PART – C		
1	A circular loop, of loop radius λ/30 and wire radius λ/1000, is used as a transmitting/receiving antenna in a back-pack radio communication system at 10 MHz. The wire of the loop is made of copper with a conductivity of 5.7×10^7 S/m. Assuming the antenna is radiating in free space, figure out the (a) radiation resistance of the loop (3) (b) loss resistance of the loop (assume that its value is the same as if the wire were straight (3) (c) input resistance (3) (d) input impedance (3) (e) radiation efficiency (3)	**BTL -6**	Creating
2	Assess when does a loop antenna radiate perpendicular to the plane of the loop, and when does a loop antenna have a null perpendicular to the plane of the loop? (15)	**BTL -5**	Evaluating

3	(i) The electric field of an uniform plane electromagnetic wave in free space is $\overrightarrow{E} = 10(\overrightarrow{a_x} + j\,\overrightarrow{a_y})e^{-j25x}$. Interpret the direction of wave propagation , frequency of propagation and the nature of polarization of the wave propagated. (8) (ii) Perform the mathematical evaluation of the directivity of quarter wave monopole is twice that of half wave dipole. (7)		**BTL -5**	Evaluating
4	(i) Formulate the misconceptions related to the antenna balance and discuss about balun. (8) (ii) Construct a transmitter to deliver 100W into a 50 ohms load, mention the significance of selecting 50 resistance as load. (7)		**BTL -6**	Creating
UNIT II - RADIATION FROM APERTURES				
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture, distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, design considerations.				
Q.No.	**Question**		**Bloom's Taxonomy Level**	**Domain**
PART – A				
1	How the concept of aperture is applied in an antenna?		**BTL -1**	Remembering
2	At 2.7GHz, the increase in antenna temperature from Cygnus A with a 20m dish antenna is 51k. Compute the aperture efficiency of the antenna.		**BTL -2**	Understanding
3	Discuss the field equivalence principle.		**BTL -2**	Understanding
4	State Huygen's principle.		**BTL -1**	Remembering
5	Analyze the merits of offset feed reflector antenna.		**BTL -4**	Analyzing
6	Exhibit the concept of spill over in parabolic reflector.		**BTL -3**	Applying
7	Illustrate with an example, when does a dipole and slot antenna are said to be complementary to each other.		**BTL -3**	Applying
8	A parabolic antenna having a circular mouth is to have power gain of 1000 at λ= 10 cm. Estimate the diameter of mouth and HPBW of the antenna		**BTL -4**	Analyzing
9	Summarize the significance of F/D ratio in reflector antenna.		**BTL -2**	Understanding
10	State Fermat's Principle.		**BTL -1**	Remembering
11	Identify the limitations of reflector antenna? Name the methods to overcome them.		**BTL -4**	Analyzing
12	Review aperture blockage and mention how it can be prevented in reflector antenna.		**BTL -2**	Understanding

13	Find the diameter of aperture of a parabolic antenna to produce a null beam width of 10^o at 3GHz	**BTL -6**	Creating
14	List the design considerations and the applications of an aperture antenna.	**BTL -1**	Remembering
15	Asses the types of Feed widely used for reflector antenna and slot antenna.	**BTL -5**	Evaluating
16	Outline the principle of Babinet used in slot antenna.	**BTL -1**	Remembering
17	Classify the types of Horn antenna.	**BTL -3**	Applying
18	Interpret why the radiation pattern is symmetric in slot antenna?	**BTL -5**	Evaluating
19	Find the complementary slot impedance when the transmitting and receiving antennas are separated by 100km, while operating at a frequency of 10GHz.	**BTL -6**	Creating
20	Write the expression for far electric field for a circular aperture.	**BTL -1**	Remembering
	PART – B		
1	(i) Derive the radiation components of field from a rectangular aperture with an illustration of Field Equivalence Principle. (7) (ii) The aperture dimension of a pyramidal horn is 10 x 5 cm^2. It is operating at 6.6GHz. Find Beamwidth, Power gain and directivity. (6)	**BTL -6**	Creating
2	(i) Write short notes on Field equivalence principle, uniform aperture distribution on slot antenna and aperture blockage. (6) (ii) State & explain Huygens principle for aperture antennas. (7)	**BTL -1**	Remembering
3	(i) Express the far electric field component using Fourier transform technique, for an antenna, assuming aperture dimensions and aperture distributions are known. (7) (ii) Interpret the uniform aperture distribution on ground plane. (6)	**BTL -2**	Understanding
4	(i) Distinguish horn antenna from parabolic reflector. Bring out the design details of pyramidal horn antenna. (6) (ii) Categorize the Ridge Horns and explain in detail. (7)	**BTL -4**	Analyzing
5	(i) What is reflector antenna? Explain with design procedure. (8) (ii) Calculate the angular aperture for a paraboloid reflector antenna for which aperture number is (1) 0.25 (2) 0.50 (3) 0.60 . Given diameter of reflector mouth as 10m, calculate the position of the focal point with reference to the reflection mouth in each case. (5)	**BTL -1**	Remembering
6	Describe the working principle of Reflector antenna and its types. (13)	**BTL -5**	Evaluating

7	(i) Predict the rectangular aperture and derive the expressions for its uniform distribution on an infinite ground plane and space. (6) (ii) Demonstrate the far electric field for a circular aperture. (7)		**BTL -3**	Applying
8	(i) Analyze the working and design methodology of a Slot antenna. (6) (ii) Derive an expression for input impedance of a slot antenna. (7)		**BTL -4**	Analyzing
9	(i) Summarize the different types of horn antenna used for radiation. (6) (ii) Describe the working of pyramidal horn antenna and derive the expression for directivity. (7)		**BTL -2**	Understanding
10	(i) A rectangular aperture with a constant field distribution with a = 3 λ and b = 2 λ is mounted on infinite ground plane. Compute, in E-plane, HPBW,BWFN, FSLBW and FSLMM. (7) (ii) Compare the features of uniform and tapered apertures. (6)		**BTL -4**	Analyzing
11	(i) Obtain the expressions for effective aperture. (6) (ii) Two half wave dipoles are positioned along x-axis and are separated by distance "d". The lengths of dipole are parallel to z-axis. Find the total field of the array. Assume uniform amplitude excitation and a progressive phase difference of β. (7)		**BTL -2**	Understanding
12	(i) Describe the geometry of Cassegrain feed. (6) (ii) "A horn antenna may be regarded as a flared out waveguide", Justify. (7)		**BTL -1**	Remembering
13	(i) The earth subtends an angle of 17° when viewed from geo-stationary orbit, What are the dimensions and gain of a horn antenna that will provide global coverage at 4GHz (6) (ii) Enumerate the field components of a circular aperture on Infinite ground plane. (7)		**BTL -1**	Remembering
14	(i) Explore the design and construction principles of a parabolic reflector antenna. (6) (ii) Demonstrate the construction of the lens antenna and mention its merits and demerits. (7)		**BTL -3**	Applying
		PART – C		
1	Show that a feed pattern of (15) $G_f(\theta') = \begin{cases} G_o sec^4\left(\frac{\theta'}{2}\right) & 0 \le \theta' \le \theta_o \\ 0 & \theta' > \theta_o \end{cases}$		**BTL -5**	Evaluating

	In conjunction with a parabolic reflector, leads to an ideal aperture efficiency of $\varepsilon_{ap} = 1$. Determine the value of Go that will accomplish this.		
2	(i) Apply the principle of equality of path length to design a Pyramidal Horn Antenna , illustrate the design with appropriate diagram. (10) (10) (ii) Determine the length L,H –Plane aperture and flare angles in the E and H planes of a pyramidal horn for which the E-plane aperture $a_E = 10\lambda$ .The horn is fed by a rectangular waveguide with TE10 mode.Let $\delta=0.2\lambda$ in the E-Plane and 0.375λ in the H plane .Also find the beamwidth and directivity.(5) (5)	**BTL -6**	Creating
3	(i) Validate why an antenna using a paraboloid reflector is likely to be a highly directive receiving antenna? (8) (ii) Assess the different feeding methods of Parabolic reflector. Under what conditions this method of feed is unsatisfactory? (7)	**BTL -5**	Evaluating
4	(i) Show that for a slot in a conducting plane, the impedance Z_{slot} is given by Z_{dipole} $Z_{slot}=Z_0^2/4$ where Z_0 is the impedance of free space. (5) (ii) Design a rectangular aperture in an absorbing screen and derive the radiation components of field. (10)	**BTL -6**	Creating
UNIT III - <u>ARRAYS</u>			
Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beamforming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retrodirective and self-phased arrays.			
Q.No.	**Question**	**Bloom's Taxonomy Level**	**Domain**
PART – A			
1	Draw the field patterns of broad side and end fire antenna arrays. What is the difference?	**BTL -1**	Remembering
2	Analyze the blind angle phenomenon.	**BTL -4**	Analyzing
3	Outline the features of a grating lobe , how it can be eliminated in an array?	**BTL -1**	Remembering
4	Differentiate FNBW and HPBW?	**BTL -4**	Analyzing
5	Why is the phased array called as the scanning array?	**BTL -1**	Remembering
6	Assess the features of binomial array.	**BTL -5**	Evaluating
7	Classify antenna arrays.	**BTL -2**	Understanding

8	What is adaptive array? Where is it employed?	**BTL -1**	Remembering
9	Illustrate the effects of phase quantization?	**BTL -4**	Analyzing
10	Exhibit the behavior of the frequency scanned arrays	**BTL -3**	Applying
11	Interpret the features retro directive arrays.	**BTL -2**	Applying
12	Categorize the need for phase shifter in phased array antennas.	**BTL -1**	Remembering
13	A linear end fire, uniform array of 10 elements has a separation of λ/4 between elements. Find the directivity of array.	**BTL -6**	Creating
14	List the features and advantages of linear array.	**BTL -1**	Remembering
15	Formulate the feed network to be used in phased array antenna.	**BTL -6**	Creating
16	What is the principle of phased array antenna?	**BTL -2**	Understanding
17	Sketch the radiation pattern as a result of Pattern multiplication	**BTL -3**	Applying
18	Express Dolph-Chebyshev distribution for linear array.	**BTL -2**	Understanding
19	Generalize the array factor for odd illumination and sketch the pattern.	**BTL -2**	Understanding
20	Discriminate Binomial and Chebyshev distributions.	**BTL -5**	Evaluating
	PART – B		
1	(i) Outline the 2-Dimensional and 3-Dimensional arrays through an example. (5) (ii) Generalize the expression for antenna array factor and explain its significance (8)	**BTL -1**	Remembering
2	An array of dipoles of λ/2 length in end fire mode is to produce a power gain of 24.Find (i) Array length, number of elements when spaces λ/2 (ii) Null to Null beamwidth. (13)	**BTL -2**	Understanding
3	(i) Find the beamwidth between the nulls and half power points of the radiation pattern of a paraboloid operating at 10GHz, which has a mouth diameter of 0.15m. Also find power gain. (8) (ii) Determine the Half Power beam Width (in degree) and maximum directivity (in dB) of a 10 element binomial array with the spacing of λ/2 between the elements. (5)	**BTL -5**	Evaluating
4	(i) Analyze the radiation mechanisms of broad side antenna array and End fire antenna array with neat sketches. (8) (ii) List the properties of beam forming matrices (5)	**BTL -4**	Analyzing
5	(i) Inspect the expression for steering vector of phased array antenna. (5)	**BTL -4**	Analyzing

	(ii) Point out the significance. Give an account of beamforming networks for phased array antenna.	(8)		
6	(i) Discuss how analog and digital beam forming is achieved with an antenna array with a neat diagram. (ii) Interpret the advantages of MEMS technology in the implementation of phased array?	(8) (5)	**BTL -2**	Understanding
7	(i) Obtain the expression for the far field of a continuous array of point sources of uniform amplitude and phase. (ii) Describe and prove mathematically for finding directions of pattern nulls of the array.	(5) (8)	**BTL -2**	Understanding
8	(i) How does the directivity of an array represent the figure of merit on the operation of the system? Derive expressions for the directivity of broadside array and end fire array. (ii) Write short note on MEMS technology in phased arrays, Retro directive and self- phased arrays.	(8) (5)	**BTL -1**	Remembering
9	(i) What is meant by Dolph-Tschebyscheff distribution for linear array? (ii) Outline the different topologies of Retrodirective array.	(8) (5)	**BTL -1**	Remembering
10	Write short note on MEMS technology in phased arrays, Retro directive and self- phased arrays.	(13)	**BTL -3**	Applying
11	(i) Differentiate broad side antenna array from End fire antenna array. (ii) Model the principle of phased array antenna with a neat diagram.	(5) (8)	**BTL -4**	Analyzing
12	(i) In an array of identical elements list out the controls to shape the overall pattern of the antenna. (ii) Draw the far field geometry and phasor diagram of N-element array of isotropic sources positioned along z-axis.	(5) (8)	**BTL -1**	Remembering
13	Manipulate and tabulate the parameters of broadside array, end fire array and Hansen – Woodyard array.	(13)	**BTL -3**	Applying
14	Devise the design procedure for a broad side Dolph-Tschebyscheff array of 2M or 2M + 1 elements with spacing ‘d’ between the elements.	(13)	**BTL -6**	Creating
	PART – C			
1	Verify that the value and utility of an antenna array determine the received or transmitted power as a function of the arrival angle. Enumerate the performance of a phased array antenna.	(15)	**BTL -5**	Evaluating
2	Design a 10 x 8 (10 in the x direction and 8 in the y) element uniform planar array so that the main maximum is oriented along $\theta = 10^o$,$\varphi = 90^o$. For a spacing of dx=dy = λ /8 between the elements, find the progressive phase shift in both directions, directivity of the array.	(15)	**BTL -6**	Creating

3	(i) Formulate how the directivity can be improved by using a number of antennas in any broad side or end fire array. (8) (ii) Deduce and Sketch the Pascal's triangle upto m=7 for a Binomial array. (7)	**BTL -6**	Creating
4	Evaluate the performance of Analog and Digital beamforming in the construction of phased array with neat diagram. (15)	**BTL -5**	Evaluating

UNIT IV - MICROSTRIP ANTENNA

Radiation mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch and Circular patch– radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Applications of microstrip array antenna.

Q.No.	Question	Bloom's Taxonomy Level	Domain
	PART – A		
1	What is the radiation mechanism of microstrip dipole antenna?	**BTL -1**	Remembering
2	List the applications of microstrip array antenna.	**BTL -1**	Remembering
3	State Babinet's principle & its use in microstrip antenna design.	**BTL -1**	Remembering
4	Develop the radiation conductance of microstrip antennas.	**BTL -6**	Creating
5	Generalize the most commonly preferred substrate material for microstrip antenna. Mention their features.	**BTL -2**	Understanding
6	Compare transmission line model and cavity model in microstrip patch antenna.	**BTL -4**	Analyzing
7	An array of four λ/2 patches with spacing 'd' connected by microstrip lines to a 50Ω source has a total HPBW of 26o . Calculate its directivity.	**BTL -4**	Analyzing
8	What are the drawbacks of microstrip array	**BTL -1**	Remembering
9	Observe the .design procedure of rectangular patch antenna using cavity model.	**BTL -2**	Understanding
10	Analyze the excitation techniques used in patch antennas?	**BTL -4**	Analyzing
11	Sketch the equivalent circuit of microstrip line.	**BTL -3**	Applying
12	Enumerate the characteristics of different feeding techniques of microstrip patch antenna.	**BTL -1**	Remembering
13	Discuss about the substrate materials for microstrip antenna.	**BTL -2**	Understanding
14	Why microstrip antennas are preferred for space applications?	**BTL -1**	Remembering
15	Categorize the types of feeding mechanism.	**BTL -5**	Evaluating
16	Give the main idea of cavity model.	**BTL -2**	Understanding

17	Assess the advantages, limitation and applications of microstrip antenna.	**BTL -5**	Evaluating
18	Devise the mode of propagation in a rectangular patch antenna.	**BTL -6**	Creating
19	Demonstrate the transmission line model of rectangular patch antenna.	**BTL -3**	Applying
20	Interpret the various micro-strip antennas radiation pattern.	**BTL -3**	Applying
	PART – B		
1	Explain the following in relation with a patch antenna (a) Patch parameters (3) (b) Methods of bandwidth control (3) (c) Shape of antennas (3) (d) Characteristic impedance (4)	**BTL -2**	Understanding
2	(i) Describe the radiation principle of a rectangular patch antenna with a neat diagram. (6) (ii) Outline the working of circular patch antenna and derive the expression for resonant frequency. (7)	**BTL -1**	Remembering
3	Write the design procedure involved in the Microstrip array and feed network design. (13) (13)	**BTL -1**	11aRemembering
4	(i) Illustrate in detail the various feed techniques for microstrip antenna with neat diagrams. (5) (ii) Interpret the input impedance of a rectangular & circular patch antenna with appropriate expression. (8)	**BTL -3**	13aApplying
5	Design a rectangular microstrip antenna using a substrate (assume) with dielectric constant of 2.2, h=0.1588 cm (0.0625 inches) so as to resonate at 10GHz. (13)	**BTL -4**	Analyzing
6	Derive and explain the rectangular patch antenna in transmission line model. (13)	**BTL -3**	Applying
7	(i) With a neat diagram explain the radiation mechanism of a patch antenna. What are the excitation techniques available? (8) (ii) Express the feeding networks for the microstrip array with required diagram. (5)	**BTL -2**	Understanding
8	Describe the radiation of a circular patch antenna in cavity model. (13)	**BTL -1**	Remembering
9	(i) Recognize the various micro-strip antennas and draw its radiation pattern. (6) (ii) Recall the transmission line model of rectangular patch antenna. (7)	**BTL -1**	Remembering
10	Examine the radiation mechanism from microstrip antenna and also discuss about its excitation techniques. (13)	**BTL -4**	Analyzing
11	(i) Analyze the radiation parameters of the circular patch antenna. (8) (ii) Illustrate the excitation of circular patch and input impedance with appropriate diagram. (5)	**BTL -4**	Analyzing

12	Discuss the significance of input impedance of a rectangular patch and circular patch with appropriate equations. (13)	**BTL -2**	Understanding
13	Assess the vector and scalar potential of the microstrip dipole antenna (13)	**BTL -5**	Evaluating
14	Construct the circular patch antenna and obtain the mode field patterns. (13)	**BTL -6**	Creating
	PART – C		
1	Design a rectangular microstrip patch antenna for operation at 2GHz. The lossless substrate has a dielectric constant at 10 and a height of 0.127cm. (a) Determine the physical dimensions(width and length) of the patch (in cm.) . (5) (b) Approximate range of lengths (in cm) between the two radiating slots when input to be real. (5) (c) Find the location of a coaxial feed so that the total input impedance is 150 ohms. (5)	**BTL -6**	Creating
2	Determine the impedance of a single-section quarter-wavelength impedance transformer to match a 100-ohm patch element to a 50-ohm microstrip line. Determine the dimensions of the line assuming a substrate with a dielectric constant of 2.2 and a height of 0.1575 cm. (15)	**BTL -5**	Evaluating
3	Devise a microstrip patch antenna operating at the frequency of 2.4GHz for wireless application. (15)	**BTL -6**	Creating
4	Devise the parameters for circular patch and obtain the directivity of 8dB and plot the radiation pattern of the patch. (15)	**BTL -5**	Evaluating
	UNIT V - SPECIAL ANTENNAS AND MEASUREMENTS		
	Mobile phone antenna, base station, hand set antenna, UWB antenna, PIFA, Vivaldi antenna, Antenna for biomedical, Broadband antenna, antenna factor, Gain, impedance and radiation pattern measurements, Introduction to EMC, Test sites and anechoic chamber.		
Q.No.	**Question**	**Bloom's Taxonomy Level**	**Domain**
	PART- A		
1	Outline the methods to increase the bandwidth for PIFA.	**BTL -1**	Remembering
2	Why antenna measurements are necessary?	**BTL -2**	Understanding
3	Analyze the drawbacks in measurement of antenna parameters.	**BTL -4**	Analyzing
4	Interpret the measurement error.	**BTL -4**	Analyzing
5	List out few antenna configurations used in base station.	**BTL -1**	Remembering
6	Mention the advantages and disadvantages of Vivaldi antenna	**BTL -1**	Remembering
7	Summarize the characteristics of near field and far field.	**BTL -2**	Understanding

8	How the mobile radiation will affect the human? List the symptoms.	**BTL -3**	Applying
9	Categorize the different types of UWB antennas.	**BTL -6**	Creating
10	Formulate the Antenna factor and method to measure the antenna factor?	**BTL -6**	Creating
11	Define EMC.	**BTL -1**	Remembering
12	Demonstrate the instruments required to accomplish an antenna measurement task.	**BTL -3**	Applying
13	Characterize the two important goals especially for antennas of small portable phones. Which planar antenna is preferable for mobile stations?	**BTL -4**	Analyzing
14	Interpret the role of a folded dipole in yagi antenna.	**BTL -2**	Understanding
15	Assess the absolute gain and gain transfer in gain measurements.	**BTL -5**	Evaluating
16	What do you understand Broadband antennas	**BTL -3**	Applying
17	Evaluate the path loss in free space using absolute values.	**BTL -5**	Evaluating
18	Indicate the suitable antenna placement on a regular passenger car.	**BTL -2**	Understanding
19	Outline the features of an anechoic chamber and mention its uses.	**BTL -1**	Remembering
20	What is the range used for antenna testing?	**BTL -1**	Remembering
	PART – B		
1	(i) Analyze the Principles and requirements of UWB antenna and discuss its characterization parameters. (6) (ii) Interpret the features of Vivaldi antenna. (7)	**BTL -4**	Analyzing
2	Assess the nature of absorbing material and the anechoic chamber. Explain the design aspect of anechoic chamber. (13)	**BTL -5**	Evaluating
3	(i) Is current distribution measurement important in an antenna? Justify. How it is being measured? (6) (ii) Explain it through an experiment setup. Derive FRISS transmission formula and hence deduce an expression for gain of an antenna. (7)	**BTL -4**	Analyzing
4	Design log periodic antenna array to cover a frequency range of 84 to 200 MHz and to have a 7.5dB gain. Compute the required element lengths and spacing for optimal working. (13)	**BTL -6**	Creating
5	Interpret with a neat block diagram for antenna radiation pattern & gain measurement. Explain the procedure in detail. Describe the compact Antenna Test Ranges and near field ranges with neat diagrams. (13)	**BTL -3**	Applying

6	(i) Review the features of anechoic chambers and Absorbing materials used for Antenna measurements. (ii) With Schematic diagram explain both direct and indirect method of measuring gain of the antenna.	(7) (6)	**BTL -2**	Understanding
7	(i) Point out the construction and working of Log periodic dipole antenna with a neat diagram. Derive an expression for spacing factor. (ii) Describe about base station and hand set antenna.	(6) (7)	**BTL -3**	Applying
8	(i) With suitable diagrams prove that the input impedance is four times the transformed impedance for a folded dipole. (ii) Describe the frequency independent feature and operation of equiangular spiral antenna	(7) (6)	**BTL -1**	Remembering
9	(i) With neat diagrams, explain how transmitter and receiver antenna factors are measured. (ii) Discuss the issues related to EMC in detail	(7) (6)	**BTL -2**	Understanding
10	(i) Recall the three antenna method of gain measurement with mathematical substantiation. (ii) Describe all the non-adaptive and adaptive base station antennas of mobile communication with neat diagrams.	(7) (6)	**BTL -1**	Remembering
11	"Free space ranges are designed to suppress the contributions from the surrounding environment " Justify.	(13)	**BTL -4**	Analyzing
12	List the two types of antenna measurements and explain impedance measurement bridge method for low frequency and slotted line method for high frequency.	(13)	**BTL -1**	Remembering
13	Review a neat block diagram for antenna factor measurement and explain the procedure in detail.	(13)	**BTL -2**	Understanding
14	Draw and explain the anechoic chambers and Absorbing materials used for Antenna measurements.	(13)	**BTL -1**	Remembering
	PART – C			
1	Analyze the CATR reflector edge treatments to reduce the diffracted fields in the quiet zone.	(15)	**BTL -5**	Evaluating
2	. (i) For cellular (mobile) phone systems, the handset (phone) antennas are nearly omnidirectional, while by contrast base-station antennas are fairly directional (at least in the vertical direction).Analyze how this difference in directionality might be desirable, and/or inevitable . (ii) Assess the design constraints of mobile phone antenna.	(8) (7)	**BTL -6**	Creating
3	Examine the use of antenna in communication systems like biomedical and broadband devices. Plot the radiation pattern.	(15)	**BTL -6**	Creating
4	Explain the use of antenna in signal processing like tracking and weather forecasting. Plot its radiation pattern and spectrum.	(15)	**BTL -5**	Evaluating