INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**ANTENNAS AND PROPAGATION**				
Course Code	AEC011				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mrs. A.Usharani, Assistant Professor				
Course Faculty	Dr. V.Sivanagaraju, Professor Mrs. K.C.Koteswaramma, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:

I	Understand the radiation phenomena associated with various types of antennas along with emphasis on their applications.
II	Analyze the basic antennas theory and apply them for radiation of electromagnetic fields.
III	Explain the radiation mechanism to design different types of antennas.
IV	Demonstrate the concepts of radio wave propagation in the atmosphere.

COURSE OUTCOMES:

CO 1	Discuss about the radiation mechanism in wire antennas and Analyze the concept of antenna properties based on reciprocity theorem.
CO 2	Understanding the significance of loop antennas uniform linear arrays and helical antennas.
CO 3	Desribe the various types of microwave antennas and their applicatons.
CO 4	Analyze the reflector antennas with their applications, measure the different antenna parameters.
CO 5	Analyze the structure of atmosphere for the wave propagation.

COURSE LEARNING OUTCOMES:

AEC011.01	Discuss about the radiation mechanism in single wire, double wire antennas and the current distribution of thin wire antenna.
AEC011.02	Discuss the different parameters of an antenna like radiation patterns, radiation intensity, beam efficiency, directivity and gain etc,.

AEC011.03	Analyze the concept of antenna properties based on reciprocity theorem, evaluate the field components of quarter wave monopole and half wave dipole.
AEC011.04	Understand the significance of loop antennas in high frequency range and its types; derive their radiation resistances and directivities.
AEC011.05	Discuss the uniform linear arrays such as broadside array and end fire array, derive their characteristics.
AEC011.06	Analyze the practical design considerations for monofilar helical antenna in axial and normal modes.
AEC011.07	Discuss the various types of Microwave antennas and analyze the design consideration of pyramidal horn.
AEC011.08	Analyze the concept of complementary in slot antennas using Babinet's principle and understand the impedance of slot antennas.
AEC011.09	Understand the significance, features and characteristics of micro strip patch antennas, analyze the impact of different parameters on characteristics.
AEC011.10	Understand and analyze the reflectors are widely used to modify the radiation pattern as a radiating element, its types.
AEC011.11	Discuss various concepts related to antennas such as feed methods like front feed, rear feed, offset feed and aperture blockage.
AEC011.12	Discuss various methods and techniques for experimental measurements of antennas such as pattern measurement, directivity measurement, gain measurement etc.
AEC011.13	Understand the wave propagation through the complete study of the wave by the nature and characteristics of media during the wave travels.
AEC011.14	Understand the space wave propagation focusing on field strength variation with distance and height, effect of earth's curvature, absorption and super refraction.
AEC011.15	Analyze the structure of ionosphere and understand the sky wave propagation through refraction and reflection by ionosphere.
AEC011.16	Apply the concept of antennas and propagation to understand and analyze real time applications.
AEC011.17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

TUTORIAL QUESTION BANK

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
UNIT-I ANTENNA BASICS&THIN LINEAR WIRE ANTENNAS				
PART-A (SHORT ANSWER QUESTIONS)				
1	Describe the meant by radiation pattern?	Remember	CO 1	AEC011.02
2	Define Radiation intensity?	Understand	CO 1	AEC011.02
3	Define Beam efficiency?	Understand	CO 1	AEC011.02
4	Describe the different types of aperture?	Remember	CO 1	AEC011.02
5	Define Aperture efficiency?	Understand	CO 1	AEC011.02
6	Define an antenna?	Remember	CO 1	AEC011.02
7	Describe the meant by effective height?	Understand	CO 1	AEC011.02
8	Define Radiation intensity?	Remember	CO 1	AEC011.02
9	Define radian and steradian	Understand	CO 1	AEC011.02
10	Describe the meant by Beam Area?	Remember	CO 1	AEC011.02
11	Describe the FRIIS transmission formula and explain its significance?	Understand	CO 1	AEC011.01
12	Describe the meant by antenna beam width?	Remember	CO 1	AEC011.02
13	Describe the radiation resistance?	Understand	CO 1	AEC011.03
14	Describe the meant by isotropic radiator?	Remember	CO 1	AEC011.01
15	Describe the field zones?	Remember	CO 1	AEC011.01
16	Define Antenna bandwidth.	Understand	CO 1	AEC011.02
17	Define First-Null beamwidth	Remember	CO 1	AEC011.02
18	Define power pattern in dB.	Understand	CO 1	AEC011.02
19	Define Radiation intensity.	Remember	CO 1	AEC011.02
20	Define directional antenna.	Understand	CO 1	AEC011.02
PART-B (LONG ANSWER QUESTIONS)				
1	With the help of neat diagrams explain the principle of radiation mechanism in antennas.	Understand	CO 1	AEC011.01
2	Explain the following terms: (i) HPBW (ii) BWFN (iii) Directivity (iv) Aperture efficiency	Remember	CO 1	AEC011.02
3	Demonstrate the way in which an oscillating dipole throws out its radiation.	Understand	CO 1	AEC011.01
4	Show that the radiation resistance of a half wave dipole is 73Ohms?	Remember	CO 1	AEC011.01
5	Draw the equivalent circuit of an antenna? Explain the theorems which are used in antennas?	Understand	CO 1	AEC011.03
6	Derive FRIIS transmission formula and explain its significance?	Remember	CO 1	AEC011.01
7	Describe the current distribution on a thin wire antenna with neat diagrams	Remember	CO 1	AEC011.01
8	Derive the relation between directivity and beam solid angle?	Understand	CO 1	AEC011.02
9	Explain the following terms: (i)Gain and Resolution (ii)Antenna Apertures (iii)Antenna front to back ratio	Remember	CO 1	AEC011.02
10	Discuss the fields and patterns of Thin Linear Center-fed Antennas of different lengths with neat diagrams.	Understand	CO 1	AEC011.01
11	As related to antennas explain the following terms: (i) Radiation Pattern	Remember	CO 1	AEC011.02

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
	(ii) Beam efficiency (iii) Effective length			
12	Derive reciprocity theorem for antennas. Show that the transmitting and receiving patterns of an antenna are equal.	Understand	CO 1	AEC011.02
13	Briefly explain about effective length of an antenna	Remember	CO 1	AEC011.02
14	Derive the expression for the radiation pattern of a centre fed dipole antenna for variable wavelengths.	Remember	CO 1	AEC011.01
15	Derive the expression for E and H field components of a radiating element.	Remember	CO 1	AEC011.01
16	Determine the radiation resistance of elementary dipole with linear current distribution.	Remember	CO 1	AEC011.02
17	Describe the near field and far field region?why is the condition $2D^2/\lambda$ chosen for far field region.	Remember	CO 1	AEC011.01
18	Derive the relationship between effective aperture area and gain of antenna	Remember	CO 1	AEC011.02
19	Explain the following terms: (i) field pattern (ii) power pattern (iii) power pattern in dB (iv) major lobe,minor lobe.	Remember	CO 1	AEC011.02
20	Explain the following terms: a)Isotropic antenna b)Omnidirectional antenna c)Effective area d)polarisation	Remember	CO 1	AEC011.02
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	The radial component of the radiated power density of an infinitesimal linear dipole is given by Wav= $A_0 \sin^2\theta/ r^2$ ar W/m^2.Find its maximum directivity	Remember	CO 1	AEC011.01
2	Derive the expressions for field components of an alternating current element located at the origin?	Understand	CO 1	AEC011.01
3	Explain the concept of Retarded Potentials.	Remember	CO 1	AEC011.01
4	Derive an expression for the radiation resistance of a short electric dipole element.	Remember	CO 1	AEC011.01
5	Derive the field equations (E&M fields) of a $\lambda/4$ Mono pole antenna.	Understand	CO 1	AEC011.01
6	Derive the radiation resistance of a Short dipole of length $\lambda/15$, $\lambda/30$.	Understand	CO 1	AEC011.01
7	Prove the reciprocity theorem as applicable to antennas and hence show the equality of directional pattern for transmission and reception by same antenna.	Remember	CO 1	AEC011.03
8	A Transmitting Antenna Having An Effective Height of 100 meters has a current at the base 100A at the Frequency of 300KHz, Calculate the Field Strength at a distance of 100km,Rr,Pr.	Remember	CO 1	AEC011.02
9	Find the directivity, efficiency and effective area of an antenna if its R_r=80Ω, R_L=10Ω.The power gain is 10 dB and antenna operates at a frequency 100MHz.	Understand	CO 1	AEC011.02
10	An antenna has a radiation resistance of 72 Ω, a loss resistance of 8Ω and a power gain of 12 dB. Determine the antenna efficiency	Understand	CO 1	AEC011.02

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
UNIT-II LOOP ANTENNAS& ANTENNA ARRAYS				
PART-A(SHORT ANSWER QUESTIONS)				
1	Classify the different types of loop antennas	Remember	CO 2	AEC011.04
2	Write the value of 'θ' in accordance with the directivity of a small loop to achieve the maximum value of radiation intensity (U_{max})?	Understand	CO 2	AEC011.04
3	Write the far-field component of loop antenna.	Remember	CO 2	AEC011.04
4	List the applications of helical antenna?	Remember	CO 2	AEC011.06
5	Describe the a normal mode of helix antenna	Understand	CO 2	AEC011.06
6	Describe the a axial mode of helix antenna	Remember	CO 2	AEC011.06
7	Discriminate the axial mode with Normal Mode	Understand	CO 2	AEC011.06
8	Describe the parameters to be considered for the design of a helical antenna.	Understand	CO 2	AEC011.06
9	Describe the Advantages of folded dipole?	Remember	CO 2	AEC011.05
10	Describe the Application of folded dipole?	Understand	CO 2	AEC011.05
11	Describe the End fire array	Understand	CO 2	AEC011.05
12	Compare half wave dipole & folded dipole?	Remember	CO 2	AEC011.05
13	Describe the mean by basic yagi antenna	Remember	CO 2	AEC011.05
14	Describe the characteristics of Yagi uda antenna?	Understand	CO 2	AEC011.05
15	List out the types of array	Remember	CO 2	AEC011.05
16	What is a driven array?	Remember	CO 2	AEC011.05
17	What is a colinear array?	Understand	CO 2	AEC011.05
18	What is a phased array?	Understand	CO 2	AEC011.05
19	What is a conformal array?	Remember	CO 2	AEC011.05
20	What is an adaptive array?	Remember	CO 2	AEC011.05
PART-B (LONG ANSWER QUESTIONS)				
1	Draw the radiation pattern of 8 – isotropic elements fed in phase, spaced λ/2 apart with the principle of pattern multiplication.	Remember	CO 2	AEC011.05
2	Explain the working of helical antenna in axial mode?	Remember	CO 2	AEC011.06
3	With a neat sketch explain the operation of Yagi-Uda array.	Understand	CO 2	AEC011.05
4	Explain in detail about Broadside arrays.	Understand	CO 2	AEC011.05
5	Compare far fields of small loop antenna and short dipole antenna.	Remember	CO 2	AEC011.04
6	Describe in detail about End-fire arrays.	Understand	CO 2	AEC011.05
7	With the suitable diagram describe the construction and operation of helical antenna under normal mode.	Remember	CO 2	AEC011.06
8	Write a brief notes on Parasitic elements.	Understand	CO 2	AEC011.05
9	Derive the expression for far field components of a small loop antenna.	Remember	CO 2	AEC011.04
10	Explain the design considerations for monofilar helical antennas in different modes.	Remember	CO 2	AEC011.06
11	Comment on binomial arrays and describe how side levels are reduced by non-uniform amplitude distribution in broadside array.	Understand	CO 2	AEC011.05
12	With neat diagram explain how an array of 2 isotropic point sources can produce different radiation patterns by varying the phase excitation	Understand	CO 2	AEC011.05
13	Explain the characteristics and constructional details of Yagi-Uda antenna.	Understand	CO 2	AEC011.05

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
14	Explain about the linear array,compare broad side array and end fire array?	Understand	CO 2	AEC011.05
15	Derive the expression for radiation resistance of a loop antenna.	Remember	CO 2	AEC011.04
16	Describe the principle of pattern multiplication,explain with an example.	Understand	CO 2	AEC011.05
17	Briefly explain about various antenna arrays and its applications	Understand	CO 2	AEC011.05
18	Describe arrays of two point sources under the following condition with equal amplitude and phase	Understand	CO 2	AEC011.05
19	Describe arrays of two point sources under the following condition with equal amplitude and opposite phase	Understand	CO 2	AEC011.05
20	Describe arrays of two point sources under the following condition with unequal amplitude and any opposite phase	Understand	CO 2	AEC011.05
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Derive the expression for pitch angle to get circularly polarized radiation pattern for a helical antenna, operating in broadside mode and sketch its pattern.	Understand	CO 2	AEC011.06
2	Describe the broadside array and derive the expression for angles of nulls, maxima and half power points?	Remember	CO 2	AEC011.05
3	Deduce an expression for the radiation pattern of an end-fire array with N vertical dipoles	Understand	CO 2	AEC011.05
4	Find the directivity of 10 turn helix antenna having pitch angle 10^0, circumference C equal to λ and draw the helical antenna with geometry	Understand	CO 2	AEC011.06
5	Calculate the radiation resistance of a single-turn small circular loop having mean radius of λ/20 and radiating in free space.	Remember	CO 2	AEC011.04
6	A broadside array operating at 100 cm wavelength consists of four half wave dipoles spaced 50 cm. Each element carries radio frequency current in the same phase and magnitude 0.5 Amp. Calculate the radiated power.	Remember	CO 2	AEC011.05
7	Derive an expression for the radiation pattern of a Broadside uniform linear array of 4-elements with λ/2spacing and obtain its radiation pattern	Remember	CO 2	AEC011.05
8	For a 6-element Yagi array for operation of 500 MHz with a folded dipole, find the length of reflector element and driven element and Draw the 6-element Yagi array.	Understand	CO 2	AEC011.05
9	An end fire array consisting of several half wave length long isotropic radiators having directive gain of 30. Find the length of array for broad side antenna?	Understand	CO 2	AEC011.05
10	The mean radius of a small circular loop of constant current is λ/10. Find the physical area of the loop	Understand	CO 2	AEC011.04
UNIT-III VHF,UHF AND MICROWAVE ANTENNAS				
PART-A(SHORT ANSWER QUESTIONS)				
1	List out all the Microwave Antennas	Remember	CO 3	AEC011.07
2	Write the principle of Horn antenna.	Remember	CO 3	AEC011.07
3	Describe the mean by horn	Understand	CO 3	AEC011.07
4	Describe the mean by fermat's principle	Understand	CO 3	AEC011.07
5	Describe the different types of horn antennas used in practical applications	Remember	CO 3	AEC011.07
6	Describe the advantages horn antennas	Understand	CO 3	AEC011.07

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
7	Describe the drawbacks of lens antenna?	Remember	CO 3	AEC011.08
8	Relate thickness and frequency of Lens antenna.	Remember	CO 3	AEC011.08
9	Mention different types of Lens antennas	Understand	CO 3	AEC011.08
10	Reproduce the expression for flare angle of Horn antenna.	Remember	CO 3	AEC011.07
11	Discriminate Delay lens with Metal plate lens	Remember	CO 3	AEC011.08
12	List the applications of Lens antenna	Understand	CO 3	AEC011.08
13	List the applications of Horn antenna	Understand	CO 3	AEC011.07
14	Recall the expression for Axial length of Horn antenna.	Remember	CO 3	AEC011.07
15	State the advantages of Zoning?	Understand	CO 3	AEC011.08
16	Describe the features of slot antennas	Understand	CO 3	AEC011.08
17	Describe the limitations of strip antennas	Remember	CO 3	AEC011.09
18	Describe the advantages of slot antennas	Understand	CO 3	AEC011.08
19	List out the Feed Methods of Patch Antenna	Remember	CO 3	AEC011.09
20	List Out the advantages of strip antennas	Remember	CO 3	AEC011.09
21	Describe the features of Patch antennas	Understand	CO 3	AEC011.09
22	Write Design Considerations of Low profile Antennas	Remember	CO 3	AEC011.09
23	Describe the use of stocked MSA	Remember	CO 3	AEC011.09
24	Write the Performance Parameters of Micro Strip antennas?	Understand	CO 3	AEC011.09
25	Describe the mean by tuning in MSA	Understand	CO 3	AEC011.09
26	Discuss the effect of Substrate on the radiation of Patch antenna	Understand	CO 3	AEC011.09
27	Write the formula for centre frequency of patch antenna	Remember	CO 3	AEC011.09
28	Write Babinet's principle	Remember	CO 3	AEC011.08
29	Draw the Radiation pattern of slot antenna	Understand	CO 3	AEC011.08
30	Give examples of secondary antennas.	Remember	CO 3	AEC011.08
	PART-B(LONG ANSWER QUESTIONS)			
1	With necessary diagrams explain the principle of operation of Lens antennas	Remember	CO 3	AEC011.08
2	Discuss different types of horn antennas with neat sketches.	Understand	CO 3	AEC011.07
3	Describe the advantages, disadvantages and applications of lens antenna	Remember	CO 3	AEC011.08
4	Describe the radiation pattern and fields on the axis of an E-plane and H-plane sectoral horns	Remember	CO 3	AEC011.07
5	Describe the concepts of zoning and tolerances	Understand	CO 3	AEC011.08
6	Explain the features and radiation properties of rectangular patch antennas.	Understand	CO 3	AEC011.09
7	With necessary diagrams explain the principle of operation of Slot antennas	Understand	CO 3	AEC011.08
8	Mention the types of feeding structures used for a microstrip patch.	Understand	CO 3	AEC011.09
9	Explain the impact of different parameters on characteristics of micro strip antennas	Remember	CO 3	AEC011.09
10	State Babinet's principle and how does it give rise to the concept of complementary antenna.	Remember	CO 3	AEC011.08
11	Comment on fringing effect, describe the design considerations and how microstrip antenna radiates with neat diagram.	Understand	CO 3	AEC011.09
12	Discuss in detail about the pyramidal horn antenna and write down its merits and demerits?	Understand	CO 3	AEC011.07
13	Describe the electromagnetic horn antenna and describe their practical applications?	Understand	CO 3	AEC011.07

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
14	What are different types of antennas used at VHF. Discuss the advantages of a slot antenna.	Understand	CO 3	AEC011.08
15	What are different types of antennas used at UHF. Give the list of antennas used for broadband communication.	Remember	CO 3	AEC011.08
16	What are different types of antennas used at microwave frequencies. Give the list of antennas used for satellite communication.	Remember	CO 3	AEC011.08
17	Explain the working of a rectangular patch antenna and mention its applications.	Understand	CO 3	AEC011.09
18	Give the expressions for impedance, bandwidth and directivity of rectangular patch antenna.	Understand	CO 3	AEC011.09
19	Describe a horn antenna. How is this antenna fed and what are its applications?	Understand	CO 3	AEC011.07
20	Explain in detail about parasitic antenna ,broadband antenna And microstrip antenna	Understand	CO 3	AEC011.09
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	Find out the length , width & flare angles of θ_E & θ_H of pyramidal horn antenna for which the mouth height is 10 λ	Remember	CO 3	AEC011.07
2	A pyramidal horn antenna having aperture dimensions of a = 5.2 cm and b = 3.8 cm is used at a frequency of 10GHz. Calculate its gain and HPBW.	Understand	CO 3	AEC011.07
3	Design an optimum horn antenna with mouth height h=20 λ and path difference $\delta = 0.20\ \lambda$. Find L and θ.	Understand	CO 3	AEC011.07
4	The aperture dimensions of a pyramidal horn are 12 X 6 cm, operating at a frequency of 10GHz. Generate the beam width and directivity for the given specifications.	Remember	CO 3	AEC011.07
5	A pyramidal horn antenna has an aperture of 20 X 15 cm. Assuming the field distribution to be uniform over the aperture. Estimate the maximum directivity and the beam width of the antenna	Understand	CO 3	AEC011.07
6	Design a pyramidal horn with dimensions a=2.286 cm and b=1.016 cm, operating at frequency 11GHz and gain is 22.6dB	Remember	CO 3	AEC011.07
7	Find the required aperture area for an optimum rectangular horn antenna operating at 2GHz with 12 dBi gain.	Remember	CO 3	AEC011.07
8	Two identical horn antennas are separated by a distance of 100 m. both antennas have directive gains of 15 dB in the direction of transmission and their dimensions are 12cm X 6cm. the transmitting antenna sends out 5W at 3GHz , determine the received power.	Understand	CO 3	AEC011.07
9	Frequency is 12 GHz. A pyramidal horn with aperture dimensions a1= 20 cm, b1= 15 cm is attached to a rectangular waveguide (size: a = 19 mm, b = 9.5 mm). What is the gain of this horn antenna, if the length of the horn L is a) L = 25 cm b) L = 50 cm	Understand	CO 3	AEC011.07
10	Design a plano- convex dielectric lens for 5GHz with a diameter of 10λ. The lens material is to be paraffin and the F number is to be unity.	Remember	CO 3	AEC011.08
	UNIT-IV **REFLECTOR ANTENNAS& ANTENNA MEASUREMENTS**			
	PART-A (SHORT ANSWER QUESTIONS)			
1	Describe the different types of reflector antennas	Remember	CO 4	AEC011.10
2	Describe the mean by spill over?	Understand	CO 4	AEC011.11
3	Define F/D ratio?	Remember	CO 4	AEC011.11

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
4	Describe the advantages of parabolic reflector antenna	Understand	CO 4	AEC011.11
5	Describe the drawbacks of parabolic reflector antenna	Understand	CO 4	AEC011.11
6	Describe the drawbacks of corner and flat sheet reflector antennas	Remember	CO 4	AEC011.10
7	List the Applications of reflector antennas	Understand	CO 4	AEC011.10
9	Sketch the Paraboloidal Reflector antenna along with its radiation pattern.	Understand	CO 4	AEC011.11
10	Define capture area ?	Remember	CO 4	AEC011.11
11	List the various types of feed system for a parabolic reflector	Remember	CO 4	AEC011.11
12	Recall the applications of Parabolic dish antenna	Understand	CO 4	AEC011.11
13	Reproduce the figure of Cassegrain feed.	Remember	CO 4	AEC011.11
14	Describe the need for Antenna Measurement	Understand	CO 4	AEC011.12
15	Describe the Sources of Error in brief	Understand	CO 4	AEC011.12
16	What are feed systems of parabolid reflector	Understand	CO 4	AEC011.11
17	What are the applications of plane reflector?	Understand	CO 4	AEC011.11
18	What are the applications of corner reflector	Understand	CO 4	AEC011.11
19	What are the advantages of corner reflector	Remember	CO 4	AEC011.11
20	What are the applications of slot antennas	Understand	CO 4	AEC011.10
	PART-B (LONG ANSWER QUESTIONS)			
1	List out the differences between active and passive corner reflectors.	Understand	CO 4	AEC011.10
2	Briefly explain about Flat Sheet Reflectors.	Remember	CO 4	AEC011.10
3	Explain the important design parameters of parabolic reflector antenna	Understand	CO 4	AEC011.11
4	With a neat sketch explain the procedure of radiation pattern measurement.	Remember	CO 4	AEC011.12
5	Briefly explain about Corner Reflectors.	Understand	CO 4	AEC011.10
6	Explain different feed methods used for parabolic reflector antennas.	Understand	CO 4	AEC011.11
7	With a neat sketch explain the procedure of gain measurement using 3antennas.	Remember	CO 4	AEC011.12
8	Describe the Sources of Error while doing the Measurement.	Remember	CO 4	AEC011.12
9	Describe the Gain Measurement by Comparison Method with Neat Sketch.	Remember	CO 4	AEC011.12
10	Explain the geometry of paraboloidal reflector with neat diagram.	Understand	CO 4	AEC011.11
11	Describe the cassegrain method of feeding a parabolic reflector?	Understand	CO 4	AEC011.11
12	Describe the methods for measuring a)directivity b)power gain	Remember	CO 4	AEC011.12
13	Describe the absolute and three antenna methods for gain measurement.	Remember	CO 4	AEC011.12
14	Explain how a parabolodial antenna gives a highly directional pattern.what are the practical applications of such an antenna.	Understand	CO 4	AEC011.11
15	Describe the comparison method for gain measurement.	Remember	CO 4	AEC011.12
16	Describe the near field and far field region with respect to antenna measurements.	Remember	CO 4	AEC011.12
17	Describe the methods of feeding a paraboloid reflector in which the primary antenna is located at the focal point.	Understand	CO 4	AEC011.11
18.	Compare the flat sheet reflectors with corner reflectors.	Remember	CO 4	AEC011.10

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
19	Describe the corner reflector antennas with its practical applications.	Remember	CO 4	AEC011.10
20	Compare UHF,VHF and microwave antennas.	Remember	CO 4	AEC011.10
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	A paraboloid reflector of circular cross-sectional area 8000 sq.cm is uniformly excited at 5GHz. Calculate the HPBW and the gain.	Remember	CO 4	AEC011.11
2	A parabolic dish antenna provides a gain of 75dB at a frequency of 15GHz. Calculate the capture area, HPBW and FNBW	Remember	CO 4	AEC011.11
3	Analyze the different types of feed used in a reflector antenna. Also explain the principle of reflector antenna.	Understand	CO 4	AEC011.10
4	Find the diameter of the reflector antenna that has a 0.5 deg HPBW at a frequency of 8.2 GHz. Assume an efficiency constant = 0.6. Calculate the antenna gain and effective aperture.	Understand	CO 4	AEC011.10
5	The diameter of a parabolic reflector is 2m. For operation at 6 GHz, find the beam width between first nulls and the gain	Remember	CO 4	AEC011.11
6	A parabolic reflector antenna with diameter 20 m, is designed to operate at frequency of 6GHz and illumination efficiency of 0.54. Calculate antenna gain.	Understand	CO 4	AEC011.11
7	A parabolic antenna having circular mouth is to have a power gain of 1000 at λ=10 cm. Estimate the diameter of the mouth and half power beam width of the antenna.	Remember	CO 4	AEC011.11
8	Find the beam width between the first nulls of a 2.5m paraboloid reflector used at 6GHz .Calculate its gain.	Remember	CO 4	AEC011.11
9	A paraboloid reflector antenna is designed for operation at 3000MHz. Its largest aperture dimension is 20ft. For measurement of radiation pattern, what should be minimum distance between primary and secondary antenna.	Remember	CO 4	AEC011.11
10	A paraboloid reflector antenna is designed for operation at 5GHz at λ=10 cm.. Its largest aperture dimension is 30ft. For measurement of radiation pattern, what should be minimum distance between primary and secondary antenna.	Remember	CO 4	AEC011.12
	UNIT-V **RADIO WAVE PROPAGATION**			
	PART-A(SHORT ANSWER QUESTIONS)			
1	Define Ground wave?	Understand	CO 5	AEC011.13
2	Describe the types of Ground waves	Understand	CO 5	AEC011.13
3	Describe the Space Wave in detail	Understand	CO 5	AEC011.14
4	Describe Surface Wave in detail	Remember	CO 5	AEC011.14
5	Describe the Ray Path.	Remember	CO 5	AEC011.14
6	Explain Skip Distance?	Understand	CO 5	AEC011.14
7	Describe the Scattering Phenomena.	Remember	CO 5	AEC011.14
8	Define Lowest Usable Frequency	Understand	CO 5	AEC011.14
9	Describe maximum Usable Frequency	Understand	CO 5	AEC011.15
10	Describe The concept of Virtual Height.	Remember	CO 5	AEC011.15
11	Define Optimum frequency?	Remember	CO 5	AEC011.15
12	Explain the Structure of Atmosphere?	Understand	CO 5	AEC011.13
13	Describe the various layers of Ionosphere?	Understand	CO 5	AEC011.15
14	Describe the Absorption	Remember	CO 5	AEC011.15
15	Draw the Structure of Ionosphere	Understand	CO 5	AEC011.15

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
16	Define guided waves	Understand	CO 5	AEC011.13
17	Define unguided waves	Understand	CO 5	AEC011.15
18	Define ground wave or surface wave propagation	Remember	CO 5	AEC011.13
19	Define sky wave or ionospheric wave propagation	Understand	CO 5	AEC011.15
20	Define space wave propagation	Understand	CO 5	AEC011.14
	PART-B(LONG ANSWER QUESTIONS)			
1	Describe briefly the salient features of ground wave propagation.	Remember	CO 5	AEC011.13
2	Explain the term" wave tilt of surface waves"	Remember	CO 5	AEC011.14
3	Explain the following terms: (i) Critical frequency (ii) MUF (iii) Skip Distance (iv) Virtual height	Understand	CO 5	AEC011.14
4	Write short notes on i) Super refraction ii) Tropospheric scattering	Remember	CO 5	AEC011.14
5	Derive the Curved Earth Reflections in Ground Wave Propagation	Understand	CO 5	AEC011.13
6	Sketch and Explain the Field Strength Variation of Space wave with Antenna Height	Understand	CO 5	AEC011.14
7	Explain the Concept of Refraction and Reflection of Sky Waves by Ionosphere	Understand	CO 5	AEC011.15
8	Explain the phenomenon of ducting? What are the conditions required for manifestation of this phenomenon	Remember	CO 5	AEC011.15
9	Deduce an expression for the critical frequency of an ionized region in terms of its Maximum ionization density.	Understand	CO 5	AEC011.15
10	Write short notes on: a) Line of sight propagation b) Effect of earth's curvature	Remember	CO 5	AEC011.14
11	Describe the mechanism of space wave propagation over ideal flat earth with a neat sketch?	Understand	CO 5	AEC011.14
12	Review the effect of Earth's magnetic field on ground wave propagation	Understand	CO 5	AEC011.13
13	Summarize the structure of the atmosphere and explain each layer in detail.	Understand	CO 5	AEC011.13
14	The receiver and the transmitter are located at the LOS on the earth. For such a case, solve and find the distance between these two points on the earth.	Understand	CO 5	AEC011.14
15	Derive the expression for the MUF for flat earth and curved earth.	Understand	CO 5	AEC011.15
16	Evaluate the field strength of a space wave neglecting the curvature of the earth.	Understand	CO 5	AEC011.14
17	Explain the how the EM waves are propagated in troposphere layer.	Understand	CO 5	AEC011.13
18	Derive the expression for the MUF for flat earth and curved earth.	Understand	CO 5	AEC011.15
19	Briefly explain the mechanism of ionospheric propagation with neat diagram?	Understand	CO 5	AEC011.15
20	Point out Critical frequency and maximum usable frequency in wave propagation.	Understand	CO 5	AEC011.15
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1.	Derive the field strength equation at a distance in space wave propagation	Remember	CO 5	AEC011.14
2.	Derive the relation for dielectric constant of ionosphere layer in terms of plasma frequency.	Understand	CO 5	AEC011.15

S. No	Question	Blooms Taxonomy Level	Course Outcomes	Course learning Outcome
3.	Derive the relation between Maximum usable frequency (MUF) and skip distance.	Understand	CO 5	AEC011.15
4.	Discuss the effects of Earth's magnetic field on ionosphere radio wave propagation?	Understand	CO 5	AEC011.15
5.	With a neat sketch explain the mechanism of space wave propagation over ideal flat earth.	Understand	CO 5	AEC011.14
6.	Derive an expression for refractive index of an ionospheric layer	Understand	CO 5	AEC011.15
7.	Calculate the critical frequency for the F1, F2 and E layers for which the maximum ionic densities are $2.3x10^6$, $3.5x10^6$ and $1.7x10^6$ electrons per c.c respectively?	Understand	CO 5	AEC011.15
8.	Assume that reflection takes place at a height of 400km and that the maximum density in the ionosphere corresponds to 0.9 refractive index at10MHz. what will be the range (assume flat earth condition) for which the MUF is 10MHz?	Understand	CO 5	AEC011.15
9.	Prove that the refractive index of a layer of the ionosphere is given by $n = \sqrt{1 - \frac{81N}{f^2}}$	Understand	CO 5	AEC011.15
10.	Calculate the value of operating frequency of ionosphere layer specified by refractive index of 0.85 and electron density of5×10^5 electrons/m^3. Calculate the critical frequency and MUF with $ø_i = 30^0$	Remember	CO 5	AEC011.15

Prepared by

Mrs. A Usharani, Assistant Professor

HOD, ECE