ANTENNAS AND WAVE PROPAGATION

Subject Code:(EC601 PC)

Regulations : R16 JNTUH

Class:III Year B.Tech ECE II Semester

Department of Electronics and communication Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

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ANTENNAS AND WAVE PROPAGATION(EC601 PC)

COURSE PLANNER

(MOOC-NPTEL)

https://onlinecourses.nptel.ac.in/noc19_ee19/

COURSE OVERVIEW:

The course covers the basics of the antenna parameters, retarded potential, radiated power, radiation resistance, gain and directivity of thin linear wire antennas, VHF, UHF and microwave antennas like Yagi - Uda, Helical antenna, reflector antenna, micro strip antenna, and lens antenna, antenna arrays broadside and end fire, antenna measurements to measure the antenna parameters, wireless communication maintained through ground, space and sky.

II.PREREQUISITE:

1.Basic knowledge of Electromagnetic Waves.

III:COURSE OBJECTIVES:

1.	To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2.	To distinguish between UHF, VHF and Microwave Antennas, their requirements, specifications, characteristics and design relations.
3.	To analyze the characteristics of yagi-uda antennas, helical antennas, pyramidal horns, microstrip patch antennas and parabolic reflectors and identify the requirements to facilitate their design.
4.	To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
5.	To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements
6.	To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

IV:Course Outcomes:

S.No.	Description	Bloom's Taxonomy Level
1.	Explain the mechanism of radiation, distinguish between different antenna characteristic parameters, establish their mathematical relations,Distinguish between short dipoles, half-wave dipoles, quarter-wave mono poles and small loops, configure their current distributions,	**L2:Understand & L4:Analyze**
2.	Characterize the antennas based on frequency, configure the geometry and establish the radiation patterns of folded dipole, Yagi-Uda Antenna, Helical Antennas, Horn Antennas, and to acquire the knowledge of their analysis, design and development.	**L2:Understand & L5:Evaluate**
3.	Analyze a microstrip rectangular patch antenna and a parabolic reflector antenna, identify the requirements and relevant feed structure, carry out the design and establish their patterns.	**L2:Understand & L4:Analyze**
4.	Carry out the Linear Array Analysis, estimate the array factor and characteristics and sketch the pattern for 2-element array, N-element BSA, EFA, modified EFA, Binomial Arrays	**L3: Apply & L4:Analyze**
5.	Classify the different wave propagation mechanisms, identify their frequency ranges, determine the characteristic	**L2:Understand &**

	features of ground wave, ionospheric wave, space wave, duct and tropospheric propagations, and estimate the parameters involved.	**L3: Apply**

V: HOW PROGRAM OUTCOMES ARE ASSESSED:

PO's	Program Outcomes (PO)	Level	Proficiency assessed by
PO 1	**Engineering knowledge**: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Hands on Practice Sessions
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Lab Sessions
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Assignments & Exercises
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Seminars, Discussions
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	Projects
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Projects
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	--	----
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Projects
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Seminars /Presentations
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	Projects
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	Competitive Examinations

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) - : None

VI: HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PSO's	Program Specific Outcomes (PSO)	Level	Proficiency assessed by
PSO 1	**Professional Skills**: An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	1	Lectures, Assignments
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	2	Projects
PSO 3	**Successful Career and Entrepreneurship**: An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	2	Experiments / Projects

VII:MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3	2	2	-	2	2	--	2	2	1	1	3	1	2
CO2	1	2	3	3	3	2	2	--	1	1	2	1	1	3	1
CO3	2	3	1	3	1	-	2	--	2	2	2	2	2	1	1
CO4	2	2	1	-	2	2	2	--	2	1	1	1	1	2	1
CO5	2	1	2	2	2	1	2	--	1	2	1	2	1	3	1
Average:	1.6	2.2	1.8	2.0	1.6	1.4	2.0		1.6	1.6	1.4	1.4	1.6	2.0	1.2
Rounded	2	2	2	2	2	1	2	--	2	2	1	1	2	2	1

VIII: JNTUH SYLLABUS:

UNIT - I Antenna Basics: Introduction, Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height, Illustrative Problems. Fields from Oscillating Dipole,

Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem

Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small Loops (Qualitative Treatment).

UNIT - II VHF, UHF and Microwave Antennas - I : Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Mono filar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

UNIT - III VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flar Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, Illustrative Problems.

UNIT - IV Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods)

UNIT - V Wave Propagation – I: Introduction, Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment) – Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation – Introduction, Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

Wave Propagation – II: Sky Wave Propagation – Introduction, Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation

TEXT BOOKS:

Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, MC GRAW HILL EDUCATION, New Delhi, 4th ed., (Special Indian Edition),

2010. 2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed., 2000.

REFERENCE BOOKS:

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.

MOOC-NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc19_ee19/

IX:LESSON PLAN-COURSE SCHEDULE:

Session	Week	Unit	Topics	Course Learning outcomes	Reference	Teaching Methodlogy
1.	I	I	Basic Antenna Parameters - Patterns	To Know and understand the shapes of the radiation patterns.	T1	Chalk-Talk
2.			Beam Area, Radiation Intensity	To understand and analyze the elemental field characteristics of antenna	T1	Chalk-Talk
3.			Beam Efficiency, Directivty-Gain-Resolution	To understand Beam Efficiency, Directivty.	T1	Chalk-Talk
4.			Antenna Apertures,Effective Height and Related Problems.	To analyze the Antenna Apertures,Effective Height	T1	Chalk-Talk
5.			Fields from Oscillating Dipole	To understand Fields from Oscillating Dipole	T1	Chalk-Talk
6.	II	I	Field zones,Front-to-back ratio	To understand and analyze the elemental field characteristics of antenna	T1	Chalk-Talk
7.			Antenna Theorems	To understand the Antenna Theorems and laws	T1	PPT
8.			Radiation potentials	To understand & Evaluate Radiation potentials	T1	Chalk-Talk
9.			Retarded potentials	To understand & Evaluate Retarded potentials	T1	Chalk-Talk
10.			Helmholtz Theorm & Problems	To understand the Antenna Theorems and laws	T1	Chalk-Talk
11.	III	I	Thin Linear Wire Antennas: Radiation from Small Electric Dipole	To understand and analyze the elemental field characteristics of antenna	T1	Chalk-Talk
12.			Quarterwave Monopole-Current Distributions	To evaluate the Current Distributions in Quarterwave Monopole	T1	Chalk-Talk
13.			Halfwave Dipole- Current Distributions	To evaluate the Current Distributions in Halfwave	T1	Chalk-Talk

				Dipole		
14.			Field Components	To understand and analyze the elemental field characteristics of antenna	T1	PPT
15.			Radiated Power	To understand and analyze the elemental field characteristics of antenna	T1	Chalk-Talk
16.	IV	I	Radiation Resistance	To evaluate the Radiation Resistance of an antenna	T1	Chalk-Talk
17.			Beamwidths, Directivity	To evaluate theBeamwidths, Directivity	T1	Chalk-Talk
18.			Effective Area, Effective Height and Natural current distributions	To evaluate the Effective Area, Effective Height and Natural current distributions	T1	Chalk-Talk
19.			Fields and patterns of Thin Linear Center- fed Antennas of Different Lengths	To evaluate the Fields and patterns of Thin Linear Center-fed Antennas of Different Lengths	T1	PPT
20.			Loop Antennas - Introduction	To know the characteristics of loop antenna.	T1	PPT
21.	V	I	Small Loop Antenna	To know the characteristics of small loop antenna.	T1	PPT
22.			Comparison of Far Fields of Small Loop and Short Dipole	To understand the Comparison of Far Fields of Small Loop and Short Dipole	T1	PPT
23.			Radiation Resistances of Small and Large Loops	To Analyze the Radiation Resistances of Small and Large Loops	T1	Chalk-Talk
24.			Directivities of Small and Large Loops	To Analyze the Directivities of Small and Large Loops	T1	Chalk-Talk
25.			Illustrative Problems	To Analyze and apply the characteristics of loop antenna.	T1	Chalk-Talk
26.	VI	II	VHF, UHF AND Microwave Antennas - I: Arrays with Parasitic Elements	To Understand the characteristics of multi elemental antennas.	T1	Chalk-Talk
27.			Arrays with Parasitic Elements, Yagi - Uda Arrays,	To Understand the characteristics of multi elemental antennas.	T1	PPT
28.			Folded Dipoles their characteristics.	To know the characteristics of Helical antenna.	T1	Chalk-Talk
29.			Helical Antennas – Significance, Geometry, basic properties	To know design characteristics of helical antenna	T1	Chalk-Talk
30.			Design considerations for mono filar helical antennas in Axial Mode and Normal Modes.	To know the design characteristics of helical antennas in Axial Mode and Normal Modes.	T1	Chalk-Talk
31.	VII	II	Horn Antennas - Types	To know the design characteristics of Horn antenna.	T1	Chalk-Talk
32.			Fermat s Principle	To Understand Fermat s Principle	T1	Chalk-Talk
33.			Optimum Horns	To Understand the Optimum Horns	T1	PPT
34.			Design Considerations of Pyramidal Horns	To Analyze the Design Considerations of Pyramidal Horns	T1	Chalk-Talk

35.			**MOCK TEST - I**			
36.	VIII	III	Microstrip Antennas - Introduction	To know the basics of Microstrip Antennas	T1	Chalk-Talk
37.			Features, Advantages and Limitations	To Understand the Features, Advantages and Limitations	T1	PPT
38.			Rectangular Patch Antennas - Geometry and Parameters	To Analyze Rectangular Patch Antennas - Geometry and Parameters	T1	PPT
39.			Characteristics of Microstrip Antennas	To Understand the Characteristics of Microstrip Antennas	T1	Chalk-Talk
40.			**BRIDGE CLASS-1**			
41.	IX	III	Impact of Different Parameters on Characteristics	To Understand the Impact of Different Parameters on Characteristics	T1	Chalk-Talk
42.			Reflector Antennas - Introdcution, Flar Sheet and Corner Reflectors	To understand the reflector type of antennas	T1	Chalk-Talk
43.			Paraboloidal Reflectors - Geometry, Pattern Characteristics	To understand the Paraboloidal Reflectors of antennas	T1	Chalk-Talk
44.			Feed Methods, Reflector Types - Related Features	To understand the Characteristics of reflector antennas	T1	Chalk-Talk
45.			**BRIDGE CLAS-2**			
46.	X	III	Lens Antennas - Introduction,	To understand the lens antenna	T1	Chalk-Talk
47.			Geometry of Non-metallic Dielectric Lenses	To understand the operation lens antenna	T1	Chalk-Talk
48.			Geometry of Non-metallic Dielectric Lenses	To understand the operation lens antenna	T1	Chalk-Talk
49.			Zoning, Tolerances, Applications.	To understand the characteristics lens antenna	T1	Chalk-Talk
50.			**BRIDGE CLAS-3**			
51.	XI	IV	**Antenna Arrays:** Point Sources - Definition, Pattern	To understand the point Sources - Definition, Pattern	T1	Chalk-Talk
52.			Arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication	To understand the Arrays of 2 Isotropic Sources - Different Cases	T1	Chalk-Talk
53.			Uniform Linear Arrays - Broadside Arrays, Endfire Arrays	To Analyze the Uniform Linear Arrays - Broadside Arrays, Endfire Arrays	T1	PPT
54.			EFA with Increased Directivity, Derivation of their Characteristics and Comparision	To Analyze the EFA with Increased Directivity, Derivation of their Characteristics and Comparision	T1	PPT
55.			**BRIDGE CLAS-4**			
56.	XII	IV	BSAs with Non-unitform Amplitude Distributions - General Considerations and Binomial Arrays,	To understand the BSAs with Non-unitform Amplitude Distributions	T1	Chalk-Talk
57.			**Antenna Measurements:** Introduction, Concepts - Reciprocity, Near and Far Fields	To know the Antenna Measurements	T1	Chalk-Talk

58.			Coordinate System, Sources of Errors. Patterns to be Measured	To understand theoordinate System, Sources of Errors. Patterns to be Measured	T1	Chalk-Talk
59.			Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements	To Analyze the Pattern Measurement Arrangement, Directivity Measurement	T1	Chalk-Talk
60.			**Mock Test-2**			
61.	XIII	V	Wave Propagation - I: Introduction, Definitions, Categorizations and General Classifications	To Understand the Wave Propagation	T1 & T2	PPT
62.			Different Modes of Wave Propagation, Ray/Mode Concepts, Ground Wave Propagation	To Understand the Different Modes of Wave Propagation	T1 & T2	Chalk-Talk
63.			Plane Earth Reflections, Space and Surface Waves, Wave Tilt	To analyze the Plane Earth Reflections, Space and Surface Waves, Wave Tilt	T1 & T2	Chalk-Talk
64.			Curved Earth Reflections, Space Wave Propagation - Introduction	To analyze the urved Earth Reflections, Space Wave Propagation - Introduction	T1 & T2	PPT
65.			**BRIDGE CLAS-5**			
66.	XIV	V	Field Strength Variation with Distance and Height, Effect of Earth's Curvature	To Understand the Field Strength Variation with Distance and Height, Effect of Earth's Curvature	T1 & T2	Chalk-Talk
67.			Absorption, Super retraction, M-Curves and Duct ropagation,Scattering Phenomena, Tropospheric Propagation.	To Understand the Absorption, Super retraction, M-Curves and Duct ropagation	T1 & T2	Chalk-Talk
68.			Sky Wave Propagation - Introduction-Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere	To Understand the Sky Wave Propagation - Introduction	T1 & T2	PPT
69.			Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere	To know the Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere	T1 & T2	PPT
70.			**BRIDGE CLAS-6**			
71.	XV	V	Ray Path, Critical Frequency,MUF, LUF	To Understand the Ray Path, Critical Frequency,MUF, LUF	T1 & T2	PPT
72.			OF, Virtual Height and Skip Distance	To Understand the OF, Virtual Height and Skip Distance	T1 & T2	Chalk-Talk
73.			Relation between MUF and skip Distance	To Establish the Relation between MUF and skip Distance	T1 & T2	Chalk-Talk
74.			Multi-hop Propagation.	To Understand the Multi-hop Propagation.	T1 & T2	Chalk-Talk
75.			**BRIDGE CLAS-7**			

X:QUESTION BANK: (JNTUH)
DESCRIPTIVE QUESTIONS:

UNIT-I

ANTENNA FUNDAMENTALS

SHORT ANSWER QUESTIONS

S.No	QUESTION	Blooms taxonomy level	Course Outcome
1	Define an antenna?	Remember	1
2	Describe the meant by radiation pattern?	Remember	1
3	Define Radiation intensity?	Analyze	1
4	Define Beam efficiency?	Remember	1
5	Define Directivity?	Analyze	1
6	Describe the different types of aperture?	Remember	1
9	Define different types of aperture?	Understand	1
10	Define Aperture efficiency?	Remember	1
11	Describe the meant by effective height?	Analyze	1
12	Describe the field zones?	Understand	1
13	Define antenna efficiency?	Understand	1

LONG ANSWER QUESTIONS

1	Explain the retarded vector potential in detail?	Understand	1
2	Derive an expression for the power radiated by the current element and calculate the radiation resistance?	Analyze	1
3	Derive an expression for the far field component of a half wave dipole of an antenna?	Analyze	1
4	Derive the total power radiated by half wave dipole?	Remember	1 1
5	Show that the radiation resistance of a half wave dipole is 73Ohms?	Understand	1
6	Derive an expression for the electric field and magnetic field due to a current element at a distance point in free space?	Remember	1 1
7	Derive an expression for the gain of half wave dipole?	Understand	1
8	Derive FRIIS transmission formula and explain its significance?	Understand	1 1
9	Derive an expression for power radiated by an isotropic antenna?	Understand	1
10	Derive the relation between directivity and beam solid angle?	Remember	1

UNIT -2

VHF, UHF AND MICROWAVE ANTENNAS - I

SHORT ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Describe the the Special feature of folded dipole antennas?	Remember	2
2	Describe the Advantages of folded dipole?	Understand	2
3	Describe the Application of folded dipole?	Remember	2
4	Describe the a axial mode of helix antenna	Remember	2

5	Discriminate the axial mode with Normal Mode	Understand	2
6	Describe the parameters to be considered for the design of a helical antenna	Apply	2
7.	Describe the characteristics of Yagi uda antenna?	Understand	2
8	Describe the different types of horn antennas used in practicalapplications	Understand	2
9	Describe the mean by fermat's principle	Remember	2
10	Describe the advantages horn antennas	Remember	2

LONG ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the special features of various types of Horn antennas	Evaluate	2
2	With a suitable diagram, discuss the construction and operation of aYagi-Uda antenna?	Analyze	2
3	Explain in detail the working principle of Helical antenna in Normal mode	Evaluate	2
4	Explain the principle of operation and applications of folded dipoles?	Evaluate	2
5	Draw The Helical Antenna With Neat Geometry.	Evaluate	2
6	Explain in detail the working principle of Helical antenna in Axial mode	Evaluate	2
7	Explain About the Design Considerations Of Pyramidal Horn Antenna.	Analyze	2
8	Explain the Working Principle of Horn Antenna.	Analyze	2
9	Derive the Voltage and Current Relations in Parasitic Elements.	Analyze	2
10	Classify the Types of Horn Antennas with neat Geometry	Analyze	2

UNIT-3:

VHF, UHF AND MICROWAVE ANTENNAS - II

SHORT ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Describe the features of Patch antennas	Remember	3
2	Describe the different types of reflector antennas	Remember	3
3	Define F/D ratio?	Understand	3
4	List Out the advantages of strip antennas	Understand	3
5	Describe the drawbacks of parabolic reflector antenna	Remember	3
6	Write the formula for centre frequency of patch antenna	Understand	3
7	List out all the Microwave Antennas	Understand	3
8	List the Applications of reflector antennas	Apply	3
9	Describe the features of micro strip antennas	Understand	3
10	Discuss the effect of Substrate on the radiation of Patch antenna	Understand	3

LONG ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Describe the features of micro strip antennas?	Evaluate	3
2	Describe the advantages and limitations of strip antennas?	Understand	3
3	Explain the characteristics of micro strip antennas?	Understand	3
4	Explain advantages and disadvantages of corner and flat sheet reflectors?	Understand	3
5	Explain feed methods of parabolic reflector in detail?	Analyze	3
6	Describe types lens antennas? Explain?	Analyze	3
7	A parabolic reflector antenna with diameter 20 m, is designed to operate at frequency of 6GHz and illumination efficiency of 0.54. Calculate antenna	Apply	3
8	Estimate the diameter of a parabolic reflector required to produce a beam of5 width at 1.2GHz. How would you make this reflector?	Appl	3
9	Describe the feed methods of rectangular strip antennas?	Remember	3

10	Calculate the directivity and power gain of an optimum horn antenna with asquare of 10 λ on a side.	Apply	3

UNIT-IV

ANTENNA ARRAYS& MEASUREMENTS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Describe the point source.	Remember	4
2	Describe the meant by array.	Understand	4
3	Describe the meant by uniform linear array.	Remember	4
4	List out the types of array	Understand	4
5	Describe the Broad side array	Understand	4
6	Describe the End fire array	Understand	4
7	Describe the collinear array	Understand	4
8	Describe the parasitic array	Remember	4
9	Describe the Sources of Error in brief	Remember	4
10	Differentiate broad side and End fire array	Understand	4

SHORT ANSWER QUESTIONS

LONG ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Write short notes on various forms of arrays i. Broad side array ii. End fire array ii. Collinear array iv. Parasitic array?	Apply	4
2	Explain the Radiation Pattern Measurement with Neat Sketch.	Analyze	4
3	Explain the Gain Measurement by 3-Antenna Method with Neat Sketch.	Remember	4
4	Explain the Sources of Error while doing the Measurement.	Remember	4
5	Explain the Directivity Measurement with Neat Sketch.	Evaluate	4
6	Write detail notes on Binomial arrays	Evaluate	4
7	Explain the principle of Pattern multiplication?	Apply	4
8	Derive the expression for the far field pattern of an array of 2 – isotropic point sources i) Equal amplitude and phase ii) Equal amplitude.	Apply	4
9	Explain the Gain Measurement by Comparison Method with Neat Sketch.	Remember	4
10	Generalize the Concept of Dolph Tchebyscheffs Array.	Remember	4

UNIT-V

Wave propagation

SHORT ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Define Ground wave?	Understand	5
2	Describe the types of Ground waves	Understand	5
3	Describe the Space Wave in detail	Understand	5
4	Describe Surface Wave in detail	Remember	5
5	Describe the Ray Path.	Understand	5
6	Explain Skip Distance?	Remember	5
7	Describe the Scattering Phenomena.	Understand	5
8	Define LUF?	Understand	5
9	Describe maximum Usable Frequency?	Remember	5
10	Describe The concept of Virtual Height.	Understand	5

LONG ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Describe and Distinguish between the terms – (i) Critical Frequency &MUF (ii) Virtual Height and Skip Distance.	Understand	5
2	Derive the Relation Between Skip Distance and MUF	Analyze	5
3	Explain the Effect of Earth's Curvature and Absorption	Analyze	5
4	Explain the Concept of Refraction and Reflection of Sky Waves by Ionosphere	Understand	5
5	Sketch and Explain the Field Strength Variation of Space wave with Distance and Antenna Height	Apply	5
6	Explain the duct propagation and M-Curves in detail?	Apply	5
7	Explain the Significance of E And F Layers of Ionosphere,And Account for the Multi Hop Propagation	Analyze	5
8	Derive the Curved Earth Reflections in Ground Wave Propagation	Remember	5
9	Derive the Plane Earth Reflections in Ground Wave Propagation	Understand	5
10	Describe the Following Terms in Detail (i)Critical Frequency(ii)Super Refraction	Remember	5

XI :I-ASSIGNEMNT QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Derive an expression for power radiated by an isotropic antenna?	Understand	1
2	Explain the retarded vector potential in detail?	Understand	1
3	With a suitable diagram, discuss the construction and operation of aYagi-Uda antenna?	Analyze	2
4	Explain About the Design Considerations Of Pyramidal Horn Antenna.	Analyze	2
5	Describe the features of micro strip antennas?	Evaluate	3

II- ASSIGNEMNT QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Explain feed methods of parabolic reflector in detail?	Analyze	3
2	Derive the expression for the far field pattern of an array of 2 – isotropic point sources i) Equal amplitude and phase ii) Equal amplitude.	Apply	4
3	Write short notes on various forms of arrays i. Broad side array ii. End fire array ii. Collinear array iv. Parasitic array?	Apply	4
4	Describe and Distinguish between the terms – (i) Critical Frequency &MUF (ii) Virtual Height and Skip Distance.	Understand	5
5	Describe the Following Terms in Detail (i)Critical Frequency(ii)Super Refraction	Remember	5

UNIT – 1

MULTIPLE CHOICE QUESTIONS

Antennas convert ----------to----------

a) Photons to electrons b) Electrons to photons c) Both a and b d) None

2. Antennas are of ---------- types

a) Two b) Four c) Infinite

d) None

3. Which of the following is true

a) Time changing current radiates b) Accelerated charges radiates c) Both a and b d) None

4. Radiation pattern is ---------- dimensional quantity

Two b) Three c) Single d) None

5. ---------- is also called as 3-dB bandwidth

a) FNBW b) HPBW c) Both a and b d) None

6. One steradian is equal to ---------- square degrees

a) 360 b) 180 c) 3283 d) 41,253

7. ----------is independent of distance

a) Pointing vector b) Radiation intensity c) Both a and b d) None

8. The minimum value of the directivity of an antenna is.....

a) Unity b) Zero c) Infinite d) None

9. Directivity is inversely proportional to.....

a) HPBW b) FNBW c) Beam area d) Beam width

10. Gain is always ----------than directivity

a) Greater b) Lesser c) Equal to d) None

FILL IN THE BLANKS QUESTIONS

The Eθ Component of current element is given by----------

The Er Component of current element is given by----------

The HΦ Component of current element is given by----------

The main application of Loop Antenna is----------

The Directivity of Loop Antenna is_----------

UNIT – 2

MULTIPLE CHOICE QUESTIONS

Alternating current element is given by

a) I dl b) I dl cosωt c) I dl sinωt d) I

2. ---------potential is used to find the field components of current element

a) Scalar Potential, V b) Vector Potential, A c) Both a and b d) None

3. -------- is basic building block for any practical antenna

a) Current element b) Monopole c) Dipole d) Loop

4. The H Φ Component will consists of----------field.

a) Radiation b) Induction c) Both a and b d) All

5. The E θ Component will consists of----------

a) Radiation b) Induction c) Electro static d) All

6. The E r Component will consists of----------

a) Induction b) Electro static c) Both a and b d) All

7. The induction and radiation fields of current element are equal at distance of ------

a) λ/2 b) λ/4 c) λ/6
d) λ/10

8. The radiation resistance of current element is given by
a) R r = 80Π 2 (dl/λ) 2 b) R r = 20Π 2 (dl/λ) 2 c) R r = 10Π (dl/λ)
d) None

9. The radiation resistance of short dipole is given by
a) R r = 80Π 2 (dl/λ) 2 b) R r = 20Π 2 (dl/λ) 2 c) R r = 10Π (dl/λ)
d) None

10. The radiation resistance of short monopole is given by
a) R r = 80Π 2 (dl/λ) 2 b) R r = 20Π 2 (dl/λ) 2 c) R r = 10Π (dl/λ)
d) None

FILL IN THE BLANKS QUESTIONS

Hansen-Wood yard Array is a ----------array
The currents in Non linear are ----------
Binomial array was invented by-
The amplitudes will be ---------- in the resultant pattern using principle of multiplication of Patterns
The phases will be ---------- in the resultant pattern using principle of multiplication of Patterns.

UNIT – 3

MULTIPLE CHOICE QUESTIONS

1. If the individual antennas of the array are spaced equally along a straight line.
Then It is ----------array.
a) Linear. b) Non-Linear. c) Both a and b. d) None.

2. Linear array is a system of ------spaced elements.
a) Un equally. b) equally. c) Both a and b.
d) None.

3. In a Uniform Linear array all elements are fed with current of ----------amplitude
a) Equal. b) Unequal. c) Both a and b. d) None.

4. In a Broad side array the radiation is along----------
a) X-direction. b) Y-direction. c) Both a and b. d) None.

5. In a end- fire array the radiation is along ----------
a) X-direction. b) Y-direction. c) Both a and b. d) None.

6. In increased end- fire array the radiation is along----------
a) X-direction. b) Y-direction. c) Both a and b. d) None.

7. Which array is also called as Hansen-Woodyard array.
a) Broad side. b) End-fire. c) Increased End-Fired) None

8. Which array is also called as Stone's array.
a) Broad side. b) End-fire. c) Increased End-Fire. d) Binomial.

9. Hansen-Wood yard array is a --------array
a) Linear. b) Non-Linear. c) Both a and b. d) None.

10. Stone's array is a --------array
a) Linear. b) Non-Linear. c) Both a and b. d) None.

FILL IN THE BLANKS QUESTIONS

Radiation pattern of Yagi-Uda array is--------directional
Helical antenna was invented by----------
The path difference in horn antennas must be--
The horn antennas are used in the frequency range of
The impedance of wave guides will be ----------than Transmission lines.

UNIT – 4

MULTIPLE CHOICE QUESTIONS

Microwave frequency range is-------
a) Above 30MHZ b) Above 300MHZ C) Above 00MHZ
d)2000MHZ.
2. Yagi-Uda antenna consists of-----
a) Folded Dipole b) Reflector C) Director
d) All above
3. The radiation resistance of folded dipole of equal radii is----------
a) 657Ohms b) 292 Ohms C) 300 Ohms
d) 277 Ohms
4. The radiation resistance of folded dipole of unequal radii (r 2 =2r 1) is----------
a) 657Ohms b) 292 Ohms C) 300 Ohms
d) 277 Ohms
5. The helix is having the geometry of ----------
a) Straight wire b) Circle C) Cylinder
d) All above.
6. The radiation pattern of helix in Axial mode is----------
a) Bi directional b) Uni directional C) 4 lobed
d)Omni directional
7. The radiation pattern of helix in Normal mode is----------
a) Bi directional b) Uni directional C) 4 lobed
d) Omni directional
8. In Normal mode of operation the length of the helix is----------
a) >λ b) <λ
C) =λ d) None
9. In Axial mode of operation the length of the helix is----------
a) >λ b) <λ
C) =λ d) None
10. Horn antennas used in the frequency range of----------
a) VHF b) UHF C) SHF
d) MW

FILL IN THE BLANKS QUESTIONS

1.Frii's transmission formula is_____
Comparision method for measurement of antenna gain is also called as ___
The formula for gain of an antenna using comparision method is___
In two antenna method the assumption is ____
In the case of circular or elliptical polarization's the total antenna gain is given by_____

Unit – 5

MULTIPLE CHOICE QUESTIONS

1. Micro strip antenna was first introduced by .....
A). Marconi B). Hertz C).

Munson D). Cassegrain

2. The widely used shape for patch antennas is .....

A). Rectangular B). Circular C). Elliptical D).Parabolic

3. The efficiency of Micro strip antenna is .....

A). High B). Very high C). infinite D). Low

4. For square corner reflector the flaring angle is.....

A). 30 degrees B). 60 degrees C). 90 degrees D). 180 degrees

5. The no. of images formed for a square corner reflector, using method of images are...

A). 3 B). 5 C). 7 D). 6

6. The no. of images formed for a 30 degrees corner reflector, using method of Images are.....

A). 3 B). 5 C). 7 D). 6

7. The no. of images formed for a 60 degrees corner reflector, using method of Images is.....

A). 3 B). 5 C). 7 D). 6

8. A single narrow beam of radiation results in square corner reflector for Spacing of s=.....

A). 2λ B). λ C). 3λ/2 D). λ/2

9. Two narrow beams of radiation results in square corner reflector for spacing of s=.....

A). 2λ B). λ C). 3λ/2 D). λ/2

10. Three narrow beams of radiation results in square corner reflector for Spacing of s=.....

A). 2λ B). λ C). 3λ/2 D). λ/2

FILL IN THE BLANKS QUESTIONS

The horizon of the earth, d0 is given by-----

In ground or surface wave propagation the electric field at the receiving point is given by is given by…….

In free space the power received is given by Pr=…

The basic path loss for general communication is given by

The relation between Critical Frequency and MUF is…

XII. WEBSITES:

1.https://www.hindawi.com/journals/ijap/

2.https://india.oup.com/product/antennas-and-wave-propagation

3.https://ieeexplore.ieee.org

4. https://www.radio-electronics.com/info/antennas/

XIII: EXPERT DETAILS:

1. Prof.Girish Kumar-IIT-Bombay

2.Prof. M. Gopal, Department of Electrical Engineering, IIT Delhi

3.Prof. S.D. Agashe, Department of Electrical Engineering, IIT Bombay

4.Prof. S. Majhi, Department of Electrical Engineering, IIT Guwahati
5.Dr. Indrani Kar, Department of Electrical Engineering, IIT Guwahati

XIV:JOURNALS:

Open Journal of Antennas and Propagation
International Journal on Communications Antenna and Propagation (IRECAP)
Journal of Modeling and Simulation of Antennas and propagation
International Journal of Antennas and Propagation
Journal of Electromagnetic Waves and Applications

XV: LIST OF TOPICS FOR STUDENT SEMINARS:

Different types of antennas and their application
Basic antenna parameters
Natural current distributions and far field patterns of thin center fed antennas of different lengths
Arrays of two isotropic sources-different cases—Principles of pattern multiplication
BSAs with non-uniform amplitude distribution-Binomial arrays
Yagi-Uda array-Its characteristics and design equations
Helical antennas—Its characteristics, uses, and design equations
Horn antennas—types, Fermat's principle, equations for optimum horns
Micro strip antenna –characteristics-impact of different parameters on its characteristics
Paraboloidal reflector antennas-Its geometry ,design considerations and its uses

XVI:CASE STUDIES/Mini PROJECTS:

Designing of Helical Antenna.
Designing of Horn Antenna.
Designing of Dipole Antenna.
Designing of Micro strip Antenna.
Design a lens structure