

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05) ANTENNA ENGINEERING DESIGN SUBJECT CODE:2720503 M.E. SEM-II

Type of course: Major Elective -II

Prerequisite: Higher Engineering Mathematics, Basic fundamentals of Fourier transform. Electromagnetic fundamentals, Coordinate system theory. Wave Propagation theory, Transmission line fundamentals, Waveguide theory. Able to operate measurement instruments for antennas.

Rationale:

PG Students of EC Engineering need to possess good understanding of the fundamentals and applications electromagnetic modelling. They are expected to be able to design various application based cost effective antennas such that it can be used according to application. They will be practiced in design software like HFSS, CST etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Syllabus:

Sr. No.	Content	Total Hrs	% Weightage
1	Review of Antenna Theory: Fundamental theory of antennas: Reciprocity theorem, Antenna equivalent circuit, Classification of antennas, Special types of Antennas for different frequency bands.	6	13%
2	Antenna Parameters: Radiation Impedance, Radiation Pattern, Antenna Impedance, Bandwidth, Directivity, Gain, Antenna efficiency, Radiation Efficiency, Antenna Polarization, Antenna Apertures, Antenna temperature, near-field and far-field concepts, and radiation mechanism.	7	16%
3	Arrays: Linear, Planar, and Circular Two-Element Array N-Element Linear Array: Uniform Amplitude and Spacing N Element Linear Array: Directivity Design Procedure ,N Element Linear Array: Three-Dimensional Characteristics Rectangular-to-Polar Graphical Solution , N-Element Linear Array: Uniform Spacing, Nonuniform, Binomial Array Amplitude , Planar and Circular Arrays.	6	17%
4	Antenna synthesis: Introduction to various methods of antenna synthesis such as Schelkunoff Polynomial, Fourier transform, Woodward Lawson. Dolph-Chebyshev , Triangular, Cosine, and Cosine-Squared Amplitude Distributions	3	6%
5	Microstrip Antennas Rectangular and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarization, Arrays and Feed Networks, Multi Band, Recent advances in fractal antenna and patch array. Applications	6	20%

	in Wireless and Satellite communication.		
6	Horn and Reflector antenna Horn Antennas - Rectangular Horn (Pyramidal), Circular Aperture Horn, Circular (Conical) Corrugated Horn Reflector Antennas - Paraboloidal Reflector Geometry, Dual Reflector Antennas and feeds, Spherical Reflector, Shaped Reflectors	3	6%
7	Phased arrays Fixed Phase Shifters or Phasers, Non-uniform and Random Element Existence Arrays, Feed Networks, Adaptive Antenna & Digital beam forming, smart antenna for wireless communication	3	6%
8	Antenna Analysis: Introduction to antenna analysis methods: Integral equation method, Moment method, Finite Difference Time Domain methods; Applications of these methods to the practical antennas such as dipole, loop, helical, microstrip patch, and PIFA.	4	10%
9	Antenna Optimization Techniques: Various optimization techniques (OT) such as Genetic algorithm, Artificial Intelligence, Fuzzy logic. Comparative analysis of the OT's for particular application and antenna type.	2	6%
	Total	40	100%

Reference Books:

1. Balanis C A, Antenna Theory: Analysis and design, Wiley
2. J.D.Krauss, Antennas McGraw Hill.
3. Hohnson R C and H Jasik, Antenna Engineering Handbooks, McGraw Hill
4. Ramo, Whinnery, Fields and waves in communication electronics John Wiley
5. Robert Stratman Elliott, 'Antenna Theory and Design', Prentice-Hall, 1981
6. A. David Olver, 'Microwave Horns and Feeds', IEEE Press
7. Allan Walter Love, 'Reflector antennas', IEEE Antennas and Propagation Society
8. A.W. Love, 'Electromagnetic Horn Antennas', IEEE press
9. Robert J. Mailloux, 'Phased Array Antenna Handbook' ARTECH HOUSE

Course Outcome:

By the end of this course, the student should be able to do the followings

1. To Design the antenna and simulate it by using software and analyses various parameters.
2. To compare the various parameters of antennas by using the mathematical expression derived by various electromagnetic modelling techniques.
3. To measure the radiation pattern, return loss and other parameters by using measurement instruments like Vector network analyzer, spectrum analyzer, anechoic chambers etc.

List of Experiments:

Based on above contents

Design based Problems (DP)/Open Ended Problem:

1. To design patch antenna array by using the CST software and analyze return loss, radiation pattern, polarization, directivity etc.

2. To design fractal antenna by using CST software and analyze the various parameters.
3. To analyze the charge distribution by using the method of moment and finite element method by MATLAB.
4. To design the corrugated horn antenna by using HFSS software and analyze the radiation pattern.

Major Equipments:

Antenna Trainer, Vector Network analyzer, Spectrum analyzer.

C. List of Software:

Matlab, CST, HFSS.

Journals

1. IEEE Antennas and Propagation Magazine
Published by – IEEE Antenna and Propagation Society
ISSN No. – 1045 – 9243
Link: <http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=74>
2. IEEE Antennas and Wireless Propagation Letters
Published by – IEEE Antenna and Propagation Society
ISSN No. – 1536 - 1225
Link: <http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7727>

Learning website:

www.nptel.ac.in

www.amanogawa.com/archive/antennaA.html

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.