

Antenna and Wave Propagation

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SCIENTIFIC
PUBLISHERS (INDIA)
www.scientificpub.com

Published by:
Scientific Publishers (India)
5-A, New Pali Road, P.O. Box 91,
Jodhpur – 342 001 (India)

E-mail: info@scientificpub.com
www.scientificpub.com

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ISBN: 978-81-7233-692-9

Lasertype set : Rajesh Ojha

Printed in India

Dedicated
to
"MAA SARASWATI"



*Bramhanandam Paramsukhadam Kevalam Gyaanmurtim,
Dwandateetam Gagansadrasam Tatvamasyaadilakshyam,
Ekam Nityam Vimalamachalam Sarvdhisakshibhutam,
bhavateetam trigunrahitam Sadgurum tam namami.*

*to all
our GURU'S,
our parents and to
Dhruv and Pradnya*

PREFACE

Today, in the day to day life, when communication systems have become the basic part of one's life, for increasing the business, for security, for multimedia or more than that say for the purpose of mere entertainment; the need of antenna has increased in the communicé market. Thus, as antennas are the basic parts of these systems therefore no one can ever imagine any data transfer via wireless, mobile, optical or satellite communications without them or even chatting with our friends sitting at the other part of the earth. These antennas work along the transmitter and receiver systems to instantaneously transfer the important information across the globe in few seconds.

Generally, on an outing everyone have seen many kinds of antenna mounted on the roof of a building, on the towers, on back of vehicles, on Wi-Fi sets on military tankers or even on the cordless mobile phone sets carried by all. The antennas are designed according to the frequency and the application for which it has to be used. For last many years the antennas are developed according to one's personal need. Therefore, these antennas are of many types, Yagi-Uda antennas used for T.V. Reception, Dish (Lens) antennas for Digital T.V. reception purpose, Parabolic reflectors along with the helical antennas for satellite communication, whip antenna for FM reception on the mobile vehicles, Horn antenna are mounted on the surface of the aircraft for receiving and transmitting various frequencies, last but not the most commonly used antennas are the microstrip antennas which are made up of only a patch of a conductive material on the mobile phone sets. Recently this technology is advancing towards the development of "SMART ANTENNAS".

The motivation of writing this text came when one our author during her regular classroom teaching felt the absence of a suitable text for this topic. This book is to fill the void and is designed for the final year undergraduate or to assists the first year post graduate students of electronics and communication engineering and allied subjects. It may be difficult to cover the entire text in one semester. Depending on other courses offered and the emphasis given in a programme, a teacher may omit one or two topics.

Book is a perfect blend of theoretical and practical aspects of the topic. Concepts and analytical mathematical treatment are given only

to the extent required. Worked out examples are given where considered necessary. To cover the practical topics and by keeping in mind the need of dissertation project for the post graduate students a brief description of an antenna designing software IE3D is introduced as a unit of this book.

UNIT 1: Antenna Fundamentals

This unit is the introductory preface for understanding the working of an antenna system. It includes all the basic parameters which play an important role in understanding how an antenna works or the parameters to be kept in mind during the designing of an antenna.

UNIT 2: Types of antenna

This part of the book covers all the types of antenna used today for different types of communication techniques. Here all the emphasis is on how a particular antenna works, where these designed antennas can be used, what are the suitable frequency range for the same and much more.

UNIT 3: Antenna Arrays

Here in this unit the emphasis is on the theory of using more than one antenna of the same type as an array; so as to increase the gain of the system. Further, we have discussed various techniques like the old method and the Binomial array technique for the designing of an array.

UNIT 4: Radio wave propagation-I

The text given under this unit is providing the information related to all the three modes of propagation, i.e. the ground wave, sky wave and the space wave propagation. Along with this it gives the relevant structures of the ionosphere which changes according to day and night. It is also covered that how this change effects the transmission during both these different timings.

UNIT 5: Radio wave propagation-II

This unit is a continuous sequence of the 4 unit. Here we discuss the basic parameters included during different modes of propagations, according to which the height of antenna, distance between two stations are been decided and much more.

UNIT 6: Advance antenna Topics

This part of the book is written by keeping in mind the need of our post graduate students where they are briefed about the advance applications of antenna such as- Smart Antenna, antennas for biomedical applications, antennas for monitoring RF radiation, IR antennas, phased array.

UNIT 7: IE3D Antenna designing software

This unit full fills the entire basic requirement for a basic learner of this software used for the purpose of designing of own antenna.

We set out to write this book with an aim of giving a broad, yet fairly in depth, and up-to-date coverage of Antenna and Wave Propagation. How far we have succeeded in this aim is for the readers to judge. We would be grateful for comments from the readers, especially students, teachers and practising professionals.

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ACKNOWLEDGEMENT

Many have contributed to the successful preparation of this text. We would like to place on record our grateful thanks to all of them.

We started writing this book after we were inspired and motivated to do so by our honourable Director Er. Navneet Agarwal Sir (JIET Group of Institution, Jodhpur).

We are also thankful to Mr. Sunil Trivedi for his kind help as and when required regarding surfing and browsing. We give our especial thanks to Er. Ankit Bhandari to design the layout for our book.

All our administrator staff and few other colleagues at the institute have in some way contributed to this process.

We thank, Mr. Pawan Kumar and Tanay Sharma, Directors, Scientific Publisher (India), Jodhpur, meticulously processed the manuscript with remarkable speed, both during the editorial and production stages, and made valuable improvements.

Mr. Rajesh Ojha, for his skilful services, in word processing the handwritten manuscript. He did his job so efficiently and delightfully that we had no hesitation in revising, modifying and correcting the computerized manuscript many times.

A number of persons in our family especially our parents and children have been well wishers of this activity. Those were the unspoken words by many of them then "Look at us", which were then been ignored by us. We feel sorry for that time and say thanks to them to understand our condition.

We are overwhelmed, when we think of the fact that there are so many who have worked to make this effort a success although there is only our name printed in the column of authors but we are indebted to each of them.

It is our experience that both science and religion have their roles to play in one's life. While science has helped me to think and reason rationally, religion has carried us beyond the realm of thought and reasoning. A great seer of India has

blessed this effort. Immense pleasure is felt by us to write this last page on the land of Tannot Check post near Jaisalmer, with the blessing of Goddess Tanot Rai Mata ji. It is with this great humility that we offer this text at the feet of the Supreme Being.

Ashish Mathur
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