TeTech

M.H. Trompstraat 6
3601 HT Maarssen
The Netherlands
Tel: + 31 (0) 346 284004
Fax: + 31 (0) 346 283691
Email: *ANTDESNL*
Web: *www.tetech.nl*
CoC: 30169033
VAT: NL001961734B19

Practical RF Antenna Design Short Course.

Introduction.

Wireless communication has penetrated into the live of many people. The demand for wireless communication is still growing. As a result, more and more Electronic Engineers become involved with antennas. The antenna is the interface between your Electronics (electrical signals) and the Air (EM-field). Many (RF) Engineers consider Antennas as magic. This course will take out the magic.

TeTech already has a course on Antenna Properties and Antenna Measurement. This course is especially developed for people who want to (or have to) develop their own antennas. It provides you the information to make sure that you can handle Antennas in the same way as other electronic building blocks within the Wireless System.

This course uses the "Course & Go" concept. This concept combines Consultancy, Design and Education. For you it means that you just get what you need to know for your Antenna Challenge. You will not loose time listening to topics, which are far away from your application. The relevant knowledge is transferred in an interactive and intensive way. The interactivity also reduces foreign language related problems.

Who should attend?

This Course is for people involved with Antenna Design. The focus is on mobile and portable communication (LPD ISM equipment with Internal or External Antennas, RF & UHF RFID, Wireless add-ons for PC/laptop, wireless networking, Antennas for Covert Operations and Intelligence, Cellular Systems, etc). The concepts are easily applicable to other fields of Antenna Design (for example Fixed Service HF or Microwave).

If you are a Technical User of Antennas, the "Antenna Properties and Antenna Measurement" course may be a better choice. If you are in magnetic field generating or receiving antennas (Inductive EAS, MF & RF RFID, power transfer, magnetic field sensing); please contact TeTech.

The focus is on concepts (with Computer Aided Antenna Design in mind). If you want to study antennas on a theoretical basis (differential vector calculus), this course is not suited for you.

What you will learn?

After course completion, attendees will:

- know the physical limitations of Antenna Systems.
- have good understanding of the relationship between: Radiation Pattern, Gain, Geometry, Wavelength and Radiation Resistance.
- be able to design electrically large en small Antennas with a limited number of practical and/or simulation (iterative) steps.
- be able to tailor the Geometry to ease matching.

Prerequisite.

Attendees should have a Secondary Vocational or Polytechnic level in Telecommunications, Physics or Electronics. Attendees should be familiar with:

- arithmetic & goniometric functions
- complex calculus (a+jb)
- the concept of Fields (E- and H-Field)
- RLC Lumped Component & Transmission Line Circuits
- 3D imagination
- definitions used within the antenna community.
- Average knowledge of English Language

Advanced Mathematics (differential calculus) will not be used during this course (though some knowledge of the concept of differential calculus is helpful).

If you are not familiar with definitions involved with antennas and basic EM field properties, you may complete the *"Antenna Properties and Antenna Measurement"* course shortly before attending this course.

This course is conducted in Dutch or English.

Course Outline.

This course uses "Course & Go". The course focuses on your actual Antenna Design Challenge. In most cases, only the topics with direct relation to your Challenge will be covered. This means that if your application requires a Patch Antenna, topics on electrically large Antennas may not be covered.

TeTech uses NEC2D with 4NEC2 pre- and postprocessor and IE3D for antenna simulation. If you are using other software, at least one of the attendees should be able to use the software.

Course content:

A Quick tour through relevant definitions, concepts and relations.

Basic function of an Antenna, seen as a "black box", Gain, Directive Gain, Radiation Efficiency, Radiation Pattern, Effective Area (Ae), Power Flux Density, E- and H-field, Poynting Vector (Poynting's Theorem), Polarization, Line Of Site transmission (LOS), Gain versus Frequency, Wavelength, physical size and trade-offs, Transmitter versus Receiver perspective, etc.

If you are not familiar with these basics, please complete the *"Antenna Properties and Antenna Measurement"* course first.

Radiation basics and Radiation Resistance.

Field from single wire element (focus on far field Radiation Pattern), Radiated power, concept of Radiation Resistance, principles of superposition of radiated E- or H- field, Field Pattern from multiple wire elements (for example a Loop, effect of Ground Plane, capacitive loads), Radiation from Dielectrics (PCB substrate material).

Radiation from basic geometries and Input Impedance.

Current Distribution, Radiation Pattern and Input Impedance of: Short Dipoles, Short Monopoles, Loaded Dipoles and Monopoles, Large and Small Loops, Slots, influence of nearby conductors (e.g. Ground Plane), Re-radiation and Scattering from Large Structures.

Lumped Component Circuits and Transmission Lines equivalents are used to make a "connection" between RF Engineering and Antennas. Reference to EM-field simulation is made.

Matching, Baluns and Common Mode Aspects.

Matching by means of geometry modification (Inverted F, Half Wave micro-strip, Asymmetrical Dipole, End Fed Dipole, etc), Matching with Circuit Components, Monopole versus Dipole structures (incl. Common Mode Aspects), Baluns.

Bandwidth and Losses.

Principles of Dielectric and Copper Resistance Loss, Mismatch Loss (Reflection Coefficient, VSWR), How to modify the Geometry to reduce Losses, Bandwidth of Antennas and how to modify Geometry to optimize Bandwidth (incl. Dual Resonator Antennas).

Multi Element Antennas (Array's) and Large Reflector Antennas.

Theory of Group Pattern and Element Pattern, Broadside & End Fire Array's, mutual impedance, power splitting. Theory of Illuminated Apertures.

Fourier Transform and/or Z-Transform can be used for a more in-depth treatment of Beam Forming.

Antenna Gallery.

Several Antennas can be treated, like: Wide Band, Patch, Traveling Wave, Large Reflector, Multiple Reflector, Slot, Covert, micro-strip, special receiving, Dielectric, Antennas with unusual Radiation Pattern, etc.

What will be covered and to what extend, depends on your specific requirements. This incomplete list just shows, what can be done.

Antenna Simulation.

Simulation is used throughout this course. In this section, attention will be given to practical issues (meshing, feeding the structure, problems with dielectrics, etc). Most issues have already been discussed during the previous sections, but here commonly made errors are treated in a very practical way.

A (short) introduction to NEC2D can be added on request (NEC2D and 4NEC2 are available free).

Radiation Safety.

This is a quick tour through the ICNIRP document inclusive some examples. If you are going to develop antennas for High Power Applications and/or body worn devices, this section is necessary.

All course material is presented in a mixture of theory, sound examples and exercises that are specially prepared for your application. During the practical part of the course, 13 cm equipment is used (or the clients equipment and sources).

Every course attendee receives a specially prepared, easy to read handout that consists of 100 pages (70% text and 30% illustrations), covering the general part of the course. The material for the custom part depends on your design challenge.

This course can be completed with an examination (English or Dutch language).

Location, Schedule and Number of Attendees.

This course is given on-site and can be conducted within and outside office hours. The course concept is intensive with much feed back. Therefore, the number of attendees is limited to 3 (three) per session.

The time required for this course depends on: Entry level of attendees, Number of Attendees, Agreed Program, etc. You have to think of 3 to 5 days.

Price.

As mentioned above, the course duration depends on many factors, so a fixed price cannot be given here. For budgetary purposes, you may use the indication mentioned below.

The total price is built up of a fixed sum of E 400.-- plus E 110.-- per hour (a discount applies for longer course duration). Costs for transportation, accommodation, visa, tax, etc, will be added. .

When your interest is in antennas smaller then say one lambda, you may consider the *"Practical design of small RF Antennas"* course.

Interested?

If you are interested, please contact TeTech, free of any obligation. This Course can easily be adapted to your special needs. TeTech will be happy to discuss your requirements and convert them into a course that will help you meet your goals.

This course covers just a part of TeTech's Expertise. There are several other courses with a strong relation to this course. In addition, TeTech can fulfill your educational needs in the field of Electronic Design (System & Component level) and Signal Processing.

Version: December 2019.

Tel: +31 (0) 346 284004, Fax: +31 (0) 346 283691, info@tetech.nl, www.tetech.nl