RF Engineering Training

RF Engineering Training Boot Camp, RF Engineering Bootcamp is the unique answer to your RF planning, design and engineering in any wireless networks needs.

RF Engineering Training, also known as Radio Frequency Engineering, is a subset of electrical engineering that deals with devices which are designed to operate in the Radio Frequency spectrum: range of about 3 kHz up to 300 GHz.

RF Engineering Training covers all aspects of Radio Frequency Engineering, a subset of electrical engineering. RF Engineering training will incorporate theory and practices to illustrate the role of RF into almost everything that transmits or receives a radio wave which includes : cellular networks such as GSM, CDMA, UMTS.HSPA+, LTE, LTE-Advanced, Wi-Fi, Bluetooth, Zigbee, WiMAX, Satellite Communications, VSAT, two-way radio, and Public Safety Solutions.

RF Engineers are a part of a highly specialized field and are an integral part of wireless solutions. Their expertise is needed to design effective and reliable solutions to produce quality results, an in-depth knowledge of math, physics and general electronics theory is required.

RF Engineers are specialists in their respective field and assist in both the planning, design, implementation, and maintenance of different RF solutions.

To produce quality results in RF Engineering Training bootcamp, the program covers an in-depth knowledge of math, physics, general electronics theory as well as specialized modules in propagation and microstrip design may be required.

Topics Covered in RF Engineering Training Bootcamp – Crash Course:

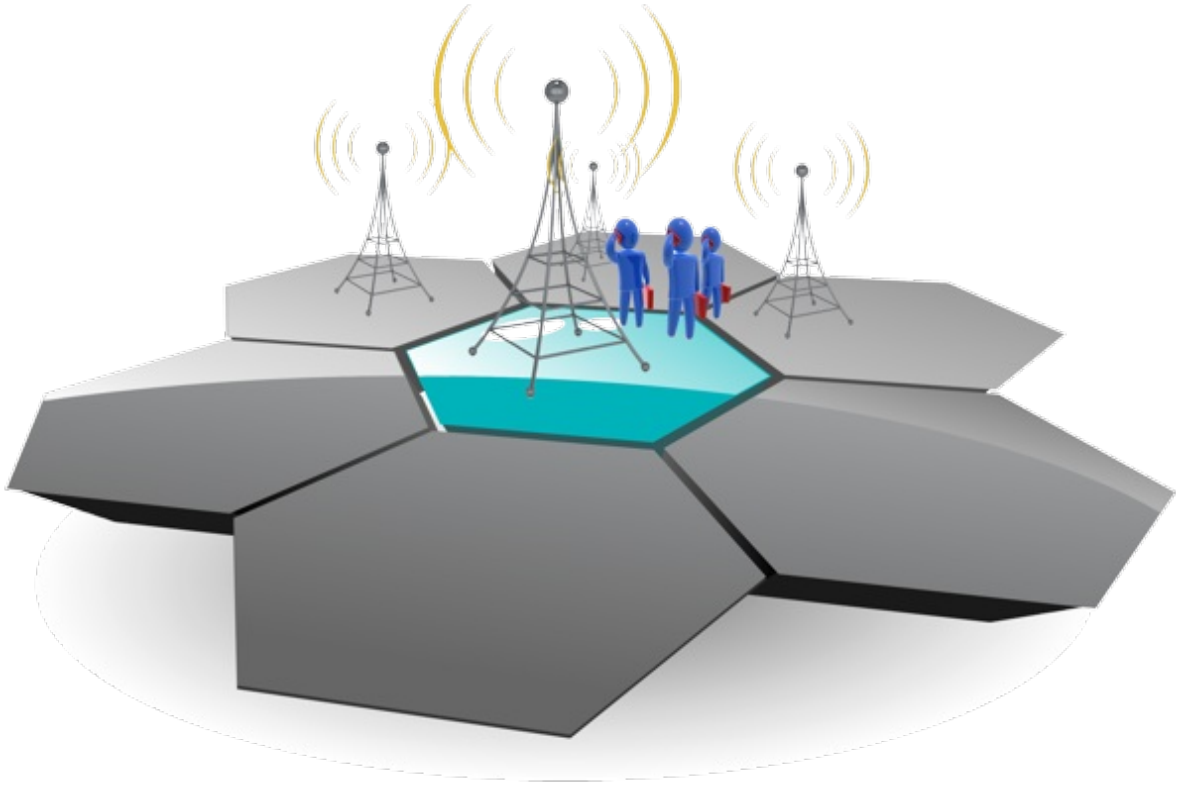
- RF Theory
- RF Engineering Principles
- Modulation
- Antenna Theory
- Interference Analysis
- Link Design
- Principles of Noise and Interference
- Principles of Jamming
- Communications Control and Jamming Theory of Operation
- RF System Specifications

- RF Surveys and Planning
- Radio Wave Propagation and Modeling
- Frequency Planning
- Traffic Dimensioning
- Cell Planning Principals
- Coverage Analysis
- RF Optimization
- RF Benchmarking
- RF Performance
- RF Safety
- RF Simulation
- RF Testing
- RF System Integration and Measurements
- Planning of Radio Networks
- Advanced Topics in Cell Planning
- Advanced Topics in RF Planning and Architecture
- Voice and Data Traffic Engineering
- RAN Optimization

Special RF Training Courses

Basic and Advanced RF Training Courses

Course Name	Length
Antenna Engineering Training Boot Camp	4 days
Antenna Training – Engineering, Theory, Analysis and Design	3 days
Cellular Networks Performance Workshop Training	3 days
DAS Training – Distributed Antenna System	3 days
RF Engineering Training Boot Camp	4 days
RF Fundamentals – RF Training	2 days
RF Optimization Training	2 days
RF Safety – Radio Frequency Safety Training	2 days
RF Theory & Technical Training	2 days
RF Training – Advanced	2 days



Objectives

RF Engineering Boot Camp provides participants with a solid understanding of RF surveys and planning, electromagnetic modeling and simulation, interference analysis and resolution, coverage analysis, propagation models, RF engineering, system specifications and performance, modulation, antenna theory, link design, traffic engineering, optimization, benchmarking, safety, RF testing and system integration and measurements. Design and production engineers and technicians interested in improving RF engineering skills through a practical approach will benefit from this course.

Outline

RF Engineering Principles

- Fundamentals of RF Systems
- RF 101
- History of RF
- Basic Building Blocks in Radio and Microwave Planning and Design
- RF Principles, Design, and Deployment
- RF Propagation, Fading, and Link Budget Analysis
- Intro to Radio Planning for Mobile and Fixed Networks
- RF Planning and Design for GSM, CDMA, UMTS/HSPA/HSPA+, LTE, LTE-Advanced and other Networks
- RF Planning and Design for Satellite Communications and VSAT

- RF Planning and Design for 2-way Radio Communications
- RF Planning and Design for Radar and Jammers Path Survey
- RF Impairments
- Noise and Distortion
- Antennas and Propagation for Wireless Systems
- Filters
- Amplifiers
- Mixers
- Transistor Oscillators and Frequency Synthesizers
- Modulation Techniques
- Receiver Design
- Eb/No vs. SNR, BER vs. noise, Bandwidth Limitations
- Modulation Schemes and Bandwidth
- RF Technology Fundamentals
- Types of Modulation: AM, FM, FSK, QAM, PSK & QPSK
- RF Engineering Principals applied
- Cellular and Mobile RF
- Fixed Wireless RF (802.11, 802.16, HF, UHF, Microwave, Satellite, VSAT, Radar and GPS)

RF System Design Considerations

- RF System Design
- Multiple Access Methods and Comparative Capacities
- Modulation, Bandwidth, Interference, Performance
- BER vs. Noise
- Bandwidth Limitations
- Noise Figure
- Eb/No vs. SNR
- Receiver Sensitivity
- Desensitization and Blocking
- Dynamic Range
- Intermodulation Distortion
- Power Output
- Spectral Efficiency and System Limitations
- Sample Link Budget Calculations
- Link Structure
- Design Engineering
- Performance Engineering

- Traffic Engineering
- System Noise Management
- Propagation Modes
- Scattering Parameter Analysis
- RF Regulatory Considerations

RF Propagation Principles

- Estimating Path Loss
- VHF/UHF/Microwave Radio Propagation
- Physics and Propagation Mechanisms
- Propagation Models and Link Budgets
- Practical System Design Considerations
- The Physics of Propagation: Free Space, Reflection, Diffraction
- Local Variability: Rayleigh fading and multipath cancellation
- Free Space Path Loss
- Area Propagation Models: Okumura, HATA, Cost 231 and others
- Point-to-Point Models: techniques and commercial software
- Analyzing measured data to produce models
- Reliability of Service
- Macro-cell Indoor Penetration
- Micro-cellular systems and techniques
- Propagation Prediction Tools and Measurement Tools
- Propagation Losses
- Refraction and Fresnel Zones
- Reflection and Scattering Loss
- Multipath
- Rayleigh Fading Models
- Noise and interference
- Polarization distortion
- Diversity implementation
- Link Budgets and High-Level System Design
- Link Budget Basics and Application Principles
- Traffic Considerations

Details Of Propagation Models And Their Uses

- Free space, Okamura/HATA, Okamura with Knife Edge Diffraction, Longley-Rice, and the proprietary BIBY-C
- Simple Analytical models
- General Area models

- Point-to-Point models
- Local Variability models
- The Okumura Model
- The Hata Model
- The EURO COST-231 Model
- Walfisch-Betroni/Walfisch-Ikegami Models
- Morphological Zones
- Commercial Propagation Prediction Software

RF Modulation

- Fundamentals of analog transmission
- Quantization
- Pulse-code modulation
- Geometrical representations of waveforms
- Modulation techniques (QAM, PSK, QPSK, DPSK, FSK)
- The additive Gaussian noise channel
- Optimal detectors
- Performance analysis of digital receivers.

Antenna Theory & Design Principles

- Principle of Antennas and Wave Propagation
- Antenna properties
- Impedance, directivity, radiation patterns, polarization
- Types of Antennas, Radiation Mechanism (Single Wire, Two-Wires, Dipole)
- Current Distribution on Thin Wire Antenna
- Radiation Pattern
- Gain Antenna types, composition and operational principles
- ERP and EIRP
- Antenna gains, patterns, and selection principles
- Antenna system testing
- Fundamental Parameters of Antennas
- Radiation Pattern and types
- Radiation Intensity and Power Density
- Directivity, Gain, Half Power Beamwidth
- Beam Efficiency, Antenna Efficiency
- Bandwidth, Polarization (Linear, Circular and Elliptical)
- Polarization Loss Factor
- Input Impedance

- Antenna Radiation Efficiency
- Effective Length, Friis Transmission Equation
- Antenna Temperature
- Infinitesimal Dipole
- Small Dipole
- Region Separation
- Finite Length Dipole
- Half Wavelength Dipole
- Ground Effects
- Loop Antennas
- Small Circular Loop
- Circular Loop of Constant Current
- Circular Loop with Non-uniform Current
- Ground and Earth Curvature Effects
- Mobile Communication Systems Application
- Types of Antennas
    - Resonant antennas
    - Traveling wave antennas
    - Frequency Independent antennas
    - Aperture antennas
    - Phased arrays
    - Electrically small antennas
    - Circularly polarized antennas
    - Elementary Antenna Elements
    - Omnidirectional Antennas
    - Microstrip Antennas
    - Achieving circular polarization
    - The helix antenna
    - Electrically Small Antennas
    - Fractal Antennas
    - Ultra Wideband (UWB) Antennas
    - Low Profile Antennas
    - Linear Wire Antennas
- Monopole configurations
- Feed considerations
- Dipole configurations

- Ground plane considerations
- Bandwidth improvement techniques
- Antenna Arrays

VHF/UHF/Microwave Radio Propagation

- Estimating Path Loss
- Free Space Propagation
- Path Loss on Line of Sight Links
- Diffraction and Fresnel Zones
- Ground Reflections
- Effects of Rain, Snow and Fog
- Path Loss on Non-Line of Sight Paths
- Diffraction Losses
- Attenuation from Trees and Forests
- General Non-LOS Propagation Models

RF Optimization Principles

- Site Acquisition
- Design, analysis and optimization of wireless networks
- Verification of network deployments for wireless networks
- RF engineering principals
- Good quality network and services
- Network planning resources
- Link budgets, scheduling and resource allocation
- Preparation and Report generation
- Real-time coverage maps
- True-up RF modeling software

RF System Optimization

- RF coverage and service performance measurements
- System Setting
- Initial optimization testing of installed networks
- Antenna and Transmission Line Considerations
- System field-testing and parameter optimization
- Functional testing and optimization for implemented sites
- Test plan development
- System drive test and data analysis
- System parameter settings and interference control

Key RF Performance Indicators

- FER, Mobile Receive Power, Ec/Io, Mobile Transmit Power
- System accessibility analysis
- Available radio resources and network trunking issues
- System parameter optimization
- Regression analysis to measure benefits
- Frequency/PN offset planning
- Self-generated system interference
- Cell site integration
- Construction coordination
- Equipment installation/antenna system verification
- RF parameter datafills
- Radio testing
- Initial drive testing
- Performance monitoring
- Site migration planning and testing
- ERP changes
- Orientation changes

RF Troubleshooting

- Safety
- Basic troubleshooting steps
- Signal tracing
- Signal injection
- Lead dress
- Heat sinks

Labs and Calculations

- Wireless Network Link Analysis
- System Operating Margin (SOM)
- Free Space Loss
- Freznel Clearance Zone
- Latitude/Longitude Bearing
- Microwave Radio Path Analysis
- Line-of-Sight Path Analysis
- Longley-Rice Path Loss Analysis
- United States Elevation Analysis

- Parabolic Reflector Gain and Focal Point Calculator
- Urban Area Path Loss
- Antenna Up/Down Tilt Calculator
- Distance & Bearing Calculator
- Omnidirectional Antenna Beamwidth Analysis
- Return Loss Calculator
- Knife Edge Diffraction Loss Calculator
- Scattering: gamma in/out from s-parameters
- Lumped Component Wilkinson Splitter / Combiner Designer
- Pi & Tee Network Resistive Attenuation Calculator
- RF Safety Compliance Calculation
- Microstripline Analysis & Design
- Calculating Phase Line Length
- 3-Pole Butterworth Characteristic Bandpass Filter Calculation
- RF Pi Network Design
- PLL 3rd Order Passive Loop Filter Calculation
- Antenna Isolation Calculator