Course ID
RMEQUIP
Course Duration
2-3 days

Course Title
Radio Measurements Equipment: Principles and Operation

Related Courses

- Spectrum Management: Planning, Monitoring, Licensing, and Economics (SPECMGT, 2-3 days)
- Spectrum Monitoring Workshop: Principles and Practice (SPECMON, 3-5 days)
- Spectrum Monitoring: Principles of Vector Network Analysis, Procedures, and Key Results (VECTOR, 3-5 days)
- Wireless All-in-One: RF Propagation, Cellular Principles, Personal Radio Services, WiFi, WiMAX, CDMA, and GSM (ALL-IN-ONE, 5 days)
- LTE: A Comprehensive Three Day Course (LTE-C3DC, 3 days)
- WIMAX: A Comprehensive Three Day Course (WIMAX-C3DC, 3 days)
- 3G Systems: WCDMA/UMTS and CDMA2000 (3G5D, 5 days)
- 3G Systems: WCDMA/UMTS and CDMA2000 Overview (3G3D, 3 days)
- GSM, GPRS, and EDGE: An Intensive Tutorial (GSMPLUS, 3 days)

Aimed At

Those with RF/wireless background who wish to study the principles and operation of radio measurement process and equipment as employed in spectrum monitoring and management.

Group Size

5-15

Prerequisites

- RF Propagation Models, Fading Characteristics, and Link Budget Analysis (RFPROP, 3 days)
- RF Systems: Principles, Design, and Deployment (RFSYS, 3 days)
- Wireless Network Structure, Operation, and Technologies (3 days, WIRELESSNET)

Course In a Nutshell

This course is part of a special curriculum that brings together in one place a series of courses dealing with spectrum monitoring, vector analysis, and spectrum management as well as spectrum monitoring system organization and measurement equipment characteristics. The present course is aimed at those who wish to study the radio measurements equipment and measurements procedures in some depth. The course duration, indicated as 2-3 days, depends on the desired depth of coverage.

Customize It!

Customize this course to your own requirements at little-to-no additional cost. We can teach distinct versions of this course tailored for audiences such as new hires, experienced personnel, managers/executives, and non-technical staff. The specific issues discussed in the course, as well as the depth of treatment for each, can also be tailored to your need.

Course Outline

- Introduction and Course Overview
- Applications of Radio and Baseband Measurements
  - National Regulatory Agency Perspective
  - Operator Perspective
  - End User Benefits
  - Future and Challenges
  - Applications of Measurements: Session Review and Discussion
- Measurement Instruments
  - Analog Instruments
  - Digital Instruments
    - Sampling Theorem
    - A/D Conversion
    - Quantization Error
  - Instrument Specifications
  - Important Figures in Measurements
  - Statistical Analysis of Measurement Results
  - Standard Deviation of Populations and Samples
  - Various Probability Distribution Functions
  - Measurement Instruments: Session Review and Discussion
- Measurements: Presenting Results
  - Physical Meaning of Measurement Ambiguity and Uncertainty
  - Combined Measurements Ambiguity and Uncertainty
  - ISO 1993 Precision of Measurements
  - Type B Measurement Ambiguity for Analog and Digital Measurement Instruments
  - Type A Measurement Ambiguity Estimation
  - Examples of Measurements Instruments in Electronics and Telecommunications
  - Presentation of Measurements Results: Session Review and Discussion
- Modulations and Signal Types Overview
  - Modulations in Communication and Broadcasting Systems
  - Types of Analog Modulations and Signal Reception
    - Amplitude Modulation
    - Angle Modulations (FM/PM)

- Types of Digital Modulations and Signal Reception
  - Amplitude Shift Keying
  - Phase Shift Keying
  - Frequency Shift Keying
- Multiplex and Multiple Access
  - TDM/TDMA
  - FDM/FDMA
  - CDM/CDMA
  - OFDM
- Modulations and Signal Types: Session Review and Discussion

- Radio Monitoring Equipment
  - Problems, Classification and Structure of Radio Monitoring Equipment
  - Design Philosophy and Constraints
  - Requirements for Equipment Technical Parameters
    - Quality Criterion Selection
    - Main Technical Parameters
  - Characteristics of Equipment Families
    - Radio Monitoring and Location Detection System
    - Stationary and Mobile Stations
    - Portable Equipment
    - Manpack Equipment

- Radio Receiver Applications for Radio Monitoring System
  - Tuned Radio Receiver
  - Main Radio Receiver Parameters
    - Operating Frequency Range
    - Amplitude-Frequency Response of the Linear Receive Path
    - Voltage Standing Wave Ratio
    - Main Channel and Spurious Channels
    - Noise and Receiver Sensitivity
    - Pre-Amplifier Gain Factor Selection
    - Receiver Multi-Signal Selectivity
    - Intermodulation Noise and Products
    - Blockage Effect
    - Crosstalk Distortion
  - Digital Radio Receivers
    - General Principles of Digital Radio Receiver Implementation
    - Types of Digital Radio Receivers
  - Radio Receiver: Session Review and Discussion

- Single-Channel and Multi-Channel Radio Signal Detection
  - Single-Channel Signal Detection
  - Characteristics of Single-Channel Detection of Narrow-Band Signals
  - Probabilistic Features of the Frequency Observation Time

- Probability of Separate Frequency Registration
- Estimate of the Total Number of Registered Frequencies
- Double-Channel Detection of Narrow-Band Signals
- Comparison of Single-Channel and Double-Channel Processing
- Panoramic Multi-Channel Receivers
- Radio Signal Detection: Session Review and Discussion

- Oscilloscope: Principles and Operation
  - Oscilloscope Principles of Operations
  - Cathode Tube
  - Oscilloscope Block Diagram
  - Input Signals Amplifiers
  - System for Horizontal Signal Control
  - Synchronization System
  - Oscilloscope Probes
  - Digital Oscilloscope Principles of Operation
  - Digital Oscilloscope and Data Acquisition
  - Modules for Signal analysis
    - FFT
  - Examples of Oscilloscopes
  - Oscilloscope: Session Review and Discussion

- Oscilloscope Measurements
  - Screen Graduation
  - Voltage Measurements
  - Amplitude Measurements
  - Measurement of DC Component in AC Signals
  - Measurements of Time Intervals
  - Period and Frequency Measurements
  - Measurements of Rising and Falling Signal Edges
  - Phase Difference Measurements
  - Phase Measurements Using Lisague Figures
  - Grounding Problem
  - Examples of Measurements in Laboratory
  - Oscilloscope Measurements: Session Review and Discussion

- Spectrum Analyzer: Principles and Operation
  - Basic Principles of Spectrum Analyzer Operations
  - Electromagnetic Field Strength Measurements
  - Main Mathematical Relations
  - Environment Influences
  - Spectrum Analyzer: Session Review and Discussion

- Direction Finding Techniques
  - Basic Direction Finding Techniques Overview
  - Purpose of Direction Finding Measurements and Measurement Organization
  - Errors in Direction Finding Measurements
  - Direction Finding Measurements: Session Review and Discussion
- Course Recap and Conclusion

How You Will Learn

- You will learn from an instructor who's well versed in spectrum monitoring and management processes and equipment as well a wide range of RF/wireless technologies.
- Along with the lecture, we will use exercises and interesting group activities to enrich the instruction and drive home the important points.
- If you already know something about the topics dealt with in this course, we will build on that knowledge base. We will compare and contrast what's familiar with what's new, making the new ideas easier to learn as well as more relevant.
- If your background is less technical, we will use meaningful examples and analogies to simplify the complex subject matter.
- The Participant Handbook will provide you with a framework to which you can add the information and insight provided in real-time, turning it into a valuable reference resource you can take back to your job.

Revised *Nov 1, 2010vf*