

# Fundamentals of Antennas

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**Prerequisite:** Knowledge of electrical engineering, electromagnetics, and mathematics will be useful.

**Overview:** This course has several main parts. Firstly, the course begins with fundamental background for antenna systems. Next, antenna types and details will be presented. Lastly a wide variety of aspects that effect antenna performance with respect to specification, implementation, test, and evaluation will be addressed.

## **Course Content:**

### **Fundamentals of Antennas:**

- Introduction to Antennas
- Radiation mechanism
- Antenna field components (i.e, near-field, far-field)
- Radiation patterns
- Theory of antenna reciprocity
- Radiation resistance
- Antenna impedance
- Antenna matching
- Radiation intensity
- Radiation directivity
- Antenna efficiency
- Radiation gain
- Beamwidth
- Bandwidth
- Polarization
  - Linear, Elliptical, Circular, etc.
- Antenna aperture
- Input impedance
- Noise Temperature, Noise Factor, Noise Figure

### **Antennas Types:**

- Linear wire antennas
- Dipoles, monopoles, bowtie, batwing, etc.,
- Loop antennas
- Helix, quadrafilar helix
- Aperture antennas (e.g., horns)
- Patches
- Reflector antennas

- Broadband antennas
- Arrays
  - Linear, Planar, and Circular

Antenna Specifications:

- Existing manufactory spec
- New development spec

Antenna Siting Issues:

- Mask and Coverage Considerations
- Influence of ground plane and craft structure effects on antenna patterns

Test and Evaluation:

- Component Level
  - Vector Network Analyzer Basics
  - The Smith Chart
- Simulation
  - NEC based code, FDTD, and others
- Antenna Test Range Options
  - Outdoor ground test ranges
  - Indoor Anechoic Chamber
    - Direct far field ranges
    - Near-field ranges
    - Compact ranges
- System Level Performance Assessments

**Handout Notes:** A Handout Package of PowerPoint slides will be provided for material presented. This information will be copyrighted by the author and cannot be reproduced without the written permission of the authors. One Handout package will be provided per student. The Handout Package will be spiral bound with protective vinyl on the front and back cover (clear on front, navy blue on back).

Included Texts:

1. **Antenna Theory: Analysis and Design, 3rd Edition**  
Constantine A. Balanis, ISBN: 0-471-66782-X, Hardcover  
117 pages, March 2005, (Retail value US \$118.95)

The textbooks is included for use in the course and will be provided to each attendee. Four textbooks are currently in stock at CNS Seminars & Consultants. These will be provided on the first day of the course. An additional 8 will be ordered, but due to the late confirmation date of this course, they can not be guaranteed to be on hand for the course. In all likelihood they will be. Once a PO is received, the books will be ordered within 24 hours.

**Location:** Spectral Systems Incorporated, Dayton, OH.

**Host Responsibilities:**

- Facilities: Room, Restrooms, seats, chairs, etc,
- Refreshments access or provided (coffee, soda, snacks, etc.)
- Scheduling of students and fund coordination

LCD projector and white/chalkboard (or equivalent).

**Format:** The course is offered in a two-day format on site at the contractors facility. The maximum class size is 12 students.

**Scheduling:** At the time of scheduling the course, a payment scheduling deposit equal to one half the amount of the course, or a purchase order shall be received.

**Rescheduling or Cancellation:** Once the course has been ordered, the course can be rescheduled or cancel but additional fees will likely occur. The amount of these fees will be negotiated at the time of course rescheduling or cancellation. Generally, non-recoverable expenses (e.g., travel costs) will be forfeited and a 20% cancellation fee will occur.

**Final Payment:** If ordered by Purchase Order, an invoice will be submitted within 10 work days after completion of the course. Final Payment will be due 45 days after the completion of the course.

**Affiliation Disclaimer:** The instructor for this course, Dr. Chris Bartone, is a full time faculty member with Ohio University. This course is not offered by Ohio University. This course is offered by Dr. Bartone, through his company CNS Seminars & Consultants, Ltd. Dr. Bartone has offered this and/or similar courses to other customers to include the Florida Air National Guard, and the National Aeronautics Space Administration (NASA) through CNS Seminars & Consultants, and the United States Coast Guard, via NAVTECH Seminars. The offering of this course in no way is affiliated or affected by Ohio University.

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