The University Of Sheffield.

Electronic & Electrical Engineering.

EEE334 ANTENNAS, RADAR AND NAVIGATION

Credits: 10

Course Description including Aims

This course is about understanding the fundamentals of antennas and radar systems, it will also provide a basic introduction to airborne navigation and landing systems.

The basic properties and characteristics of some of the most commonly used antenna systems will be examined. The emphasis will be on practical design and the applications of antennas. The radar part of the course will introduce the basic concepts of radar and examine various types of commercial and military radar systems in common use. Throughout the course emphasis will be placed on 'first-order' analysis techniques in order to reduce the use of advanced mathematics.

An engineer completing this course should feel at least acquainted with most types of antennas and radar system and will be able to do rough and ready performance calculations.

Outline Syllabus

Basic properties of antennas, dipole antennas, basic loop antennas, aperture antennas, array antennas, introduction to radar systems, radar range equation, designing a radar system, radar surveillance, tracking radar, Doppler radar, radar detection theory, radar cross section, stealth, counter measures, bistatic radar, introduction to navigation systems.

Time Allocation

24 lectures

Recommended Previous Courses

EEE223 "Electrical Energy Management and Conversion" EEE224 "Communication Electronics"

Assessment

2 hour examination, answer 3 questions out of 4

Recommended Books

Kingsley S & Quegan S	*Understanding Radar Systems*	Scitech
Balanis C.A.	*Antenna Theory : Analysis and Design, 2nd ed*	Wiley

Objectives

By the end of the module successful students will be able to

1. Demonstrate an awareness of various types of antenna and their application
2. Calculate basic antenna parameters such as gain and radiation pattern for simple antenna topologies
3. Use the radar equation to calculate system parameters such as range resolution and unambiguous range for various radar systems
4. Demonstrate an awareness of various types of radar including continuous wave and pulsed Doppler systems
5. Demonstrate an awareness of the principles of stealth and basic forms of electronic counter measures

Detailed Syllabus

- Introduction and outline of course
- Basic properties of antennas
    - What is an antenna? Why use an antenna, Radiation mechanism
    - Outline of basic antenna types
    - Radiation patterns 2-D and 3-D
    - Far-field parameters
    - Beamwidth and sidelobes, Directivity and gain, antenna equivalent area
    - Polarisation – linear, circular
    - Input impedance, antenna equivalent circuits, radiation efficiency, matching and bandwidth
- Dipole antennas
    - Concept of electric and magnetic fields
    - E and H fields from short dipole (minimum maths)
    - Radiated power, radiation resistance, directivity
    - Half-wave dipole, monopole, feed structures
- Basic loop antennas
    - Small loop, large loop, helix
- Introduction to aperture antennas
    - Concept, far-field of a line source and a rectangular aperture
- Introduction to antenna arrays
    - Concept of element pattern and array factor
- Introduction to radar systems
    - Types of radar systems and applications
- Radar range equation
- Introduction to radar systems
- Designing a radar system
- Radar surveillance
- Tracking radar

- Doppler radar systems
- Radar cross-section (RCS)
- Introduction to Stealth
    - Designing for stealth
    - Stealth materials and coatings
- Radar detection counter measures
- Bistatic radar

UK-SPEC/IET Learning Outcomes

Outcome Code	Supporting Statement
SM1p/SM1m	The basic principles of antennas radar are introduced. Antenna theory is examined by applying Maxwell's equations to a dipole. Radar systems are analysed including pulsed and Doppler systems. Assessed in exam
SM2p / SM2m	Mathematics is used to describe and analyse antennas starting with Maxwell's equations. Vector calculus, line, surface and volume integration. Statistical methods are covered in radar detection. Assessed in exam.
SM3p/SM3m	When considering the design of a stealth air vehicle, an appreciation of aeronautical engineering is required. Assessed in exam.
EA1p	Various aspects of radar system performance are analysed using the radar equation. Assessed in exam.
EA2p/EA2m	Mathematical methods such as volume and surface integration are used to analyse and quantify the performance of various types of antenna. Assessed in exam
EP2p/EP2m	Materials and products used in electronic warfare such as stealth coatings and chaff are discussed. Assessed in exam.
EA1m	Electromagnetic theory is used to analyse and design antenna components (elements) and more complex array antenna systems. Assessed in exam