The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6223 ANTENNAS, PROPAGATION & SATELLITE SYSTEMS

Credits: 15

Course Description including Aims

1. To bridge the gap between fundamental electromagnetic theory and its practical implementation in basic antenna analysis.
2. To analyse the performance of canonical wire, array, aperture and printed antennas with regard to input impedance, directivity and radiation pattern.
3. To provide an introduction to macroscopic HF and VHF propagation phenomena.
4. To understand the fundamental principles underlying the design of satellite communication systems.

Outline Syllabus

Review of electromagnetic theory for antenna analysis. Metrics used for quantifying antenna performance: radiation pattern, gain, input impedance. Half wave, full wave dipole antennas, monopole antennas. Image theory. Antenna arrays: isotropic source, two-element array, uniform linear array. Polarization: linear, elliptical, axial ratio. Aperture theory: Fourier transformation between aperture field and radiation pattern, rectangular and circular aperture, effective aperture. Microstrip antennas. Antenna radiation hazards: SAR and body interactions with antenna near fields. Propagation in a plasma: critical frequency, refractive index. Ionospheric propagation of HF radio waves: ionospheric layers, ionospheric refraction, multi-hop skip distances, MUF, ionosonde. Tropospheric propagation of VHF/UHF waves: refraction and ducting. Outline of numerical antenna analysis techniques: moment and finite difference methods.

Noise in communication systems. Basic satellite principles. Satellite orbits. Satellite communications systems. Earth stations – types and performance. Satellite transponders – amplifiers, redundancy, tramsmitters, frequency translation. Multiple access systems.

Time Allocation

36 lectures plus 12 hours of additional support material.

Recommended Previous Courses

Background knowledge equivalent to EEE345 “Engineering Electromagnetics” and MAS243 “Mathematics IV”

Assessment

Examination 4/6 questions.

Recommended Books

Balanis, C.A.	*Antenna Theory*	Harper and Row
Collin, R.E.	*Antennas and Radio Wave Propagation*	McGraw-Hill/ISE
Jull, E.V.	*Aperture Antennas and Diffraction Theory*	IEE Peter Perigrinus

Silver, S.	*Microwave Antenna Theory and Design*	McGraw-Hill
Ramo, S., Whinnery, J.R., Van Duzer, T.	*Fields and Waves in Communication Electronics*	John Wiley & Sons
Benoit, H.	*Satellite Television*	Arnold
Gomez, J.M.	*Satellite Broadcast Systems Engineering*	Artech House

Objectives

By the end of the unit a successful student will be able to

1. Demonstrate understanding of the basic principles behind the operation of the various types of antenna employed in practice.
2. Analyse the performance of antennas in well-defined situations.
3. Display awareness of propagation phenomena and their impact on communication systems.
4. Assess the suitability of antennas for specific deployment scenarios such as in terrestrial cellular networks or satellite communications.