The University Of Sheffield.

Electronic & Electrical Engineering.

EEE224 COMMUNICATION ELECTRONICS

Credits: 20

Course Description including Aims

This module introduces the basic structure of a communication system and examines the various circuits and signal engineering strategies that are necessary to make a system work. The idea of spectrum as a limited resource and some of the regulatory framework that allows multiple use of spectrum without conflict between users is introduced. The unit, which aims to form a bridge between communication systems and electronics, will include a number of case studies in order to place ideas in a sensible context.

The specific aims of the unit are . . .

1. To provide the necessary mathematical background for signal and systems analysis, signal processing and its applicability in communication electronics.
2. To provide an introduction to the field of communication systems, including nomenclature, methodology and applications.
3. To introduce the concept of modulation and examine its influence on system performance.
4. To examine typical circuits for implementing both analogue and digital modulation and demodulation.
5. To introduce the idea of synthesising circuits to achieve specified transfer functions in the context of active filters.
6. To introduce the concepts of oscillators and the circuits that may be employed.

Outline Syllabus

Signals and systems, analogue modulation, circuits for modulation. Fourier analysis. Digital modulation, multiplexing. Introduction to transmission lines, reflection coefficients. Receivers, demodulation, circuits for demodulation. 1st and 2nd order systems. Linear oscillators.

Time Allocation

48 hours of lectures 24 hours problem classes, 125 hours of guided independent study.

Recommended Previous Courses

Knowledge equivalent to first year EEE117 and EEE118.

Assessment

Three hour examination: answer 4 questions from 6 in three hours.

Recommended Books

Pearson J	Basic Communication Theory	Prentice Hall
Frenzel L E	Principles of Electronic Communications Systems	McGraw Hill
Peterson D	Audio, Video and Data Telecommunications	McGraw Hill
Sedra A S & Smith K C	Microelectronic Circuits	Oxford

Objectives

By the end of the unit, a candidate will be able to,

1. manipulate discrete and continuous signals using common techniques such as time shifting, time scaling, amplitude scaling and modulation
2. explain the basic principles underlying a communication system.
3. choose which type of modulation to use for a specific application.
4. display knowledge of representative types of circuitry to implement various modulation and demodulation schemes
5. derive and interpret transfer functions for first and second order systems
6. use normalised filter polynomials, in conjunction with first and second order circuits to realise basic low pass active filters
7. design linear oscillators for use in communication electronics.

Detailed Syllabus

Lecture	Topic
1	Outline of course, objectives and textbooks. Brief history of communications. The basic communication system and the need for modulation. Basic time/frequency relationship. Spectrum regulation.
2-5	Signal and systems analysis. Types of signals. Signal manipulation. Types of systems, memory, causality, linearity.
6-8	Amplitude modulation, DSB, SSB, suppressed carrier. Circuits for modulation. Power in signals. Envelope and square law demodulation. Bandwidth required for AM.
9-11	Introduction to angular modulation, phase modulation, frequency modulation, spectrum and dependence on frequency deviation and modulation index. FM modulators, demodulators, limiters. Bandwidth.
12-13	Receivers, superhet, signal and image frequency, image frequency rejection, automatic gain control, stereo broadcasting.
14-17	Fourier analysis and its importance for estimating bandwidths of signals. Positive and negative frequency. Simple rules and manipulation. Convolution and importance with Fourier analysis.
18-22	Introduction to pulse and binary modulation schemes, PAM, PWM, PPM, PCM, ASK, FSK, PSK, bandwidth and noise consideration. Sampling and Nyquist. Circuits for modulation and demodulation with pulse and binary signals. Bit error rates. Mulitplexing, FDM, TDM. Hartley Shannon law
23-24	Outline of course, objectives, and textbooks. Introduction to transmission lines (no wave eqns). Stripline, coaxial cable, waveguide and antennas.
25-28	Concepts of characteristic impedance and reflection from impedance mismatch. Characteristic impedance in terms of LC per unit length. VSWR and reflection coefficient. Calculation of voltages and currents in transmission line examples for simple step and pulse waveforms.

29-31	Laplace transform, system functions, transfer function in the context of filters, transform impedance for circuit analysis, step response - frequency response transformations.
32-34	Introduction to electronic filters, standard forms of first-order filter transfer functions, first-order filter frequency responses, first-order step response, first-order filter circuit analysis.
35-38	Operational amplifier (op-amp), gain-bandwidth product (GBP), op-amp systems, second-order circuits and frequency responses, second-order active filter circuits, cascades.
39-41	Introduction to electronic oscillators, basic principles for oscillation, linear oscillators (RC, LC and crystal).

UK-SPEC/IET Learning Outcomes

Outcome Code	Supporting Statement
SM1p/SM1m	The methods of signal manipulation, modulation are presented together with simple communication theory, and electronics. Outcome tested by examination.
SM2p/SM2p	The mathematics of modulation generation and detection, communication theory and superhet receivers are fundamental to communication systems. There is necessarily mathematical input to the development of the models describing second and higher order systems and noise and the ability to perform analysis based on these models. Outcome tested by examination.
EA1p/EA1m	The module is based on understanding engineering principles with respect to communication systems and allowing their performance to be evaluated. Outcome tested by examination.
EA2p/EA2m	Students are taught about different modulation systems and their performance relative to each other allowing them to make an informed choice.
EA3p/EA3m	Problem sheets, exam questions and worked examples are based on engineering practice and scenarios where possible.
EA4p/EA4m	The basics of a complete communication system are taught allowing students to appreciate the engineering problems, for example a superhet receiver. Outcome tested by examination
D5p, D5m	Design is presented as the reason for modelling. Throughout the course, students are presented with problems that ask them to design to achieve given specifications; tested by examination.
EP6p, **EP6m**	The concept of frequency allocation and licensing by regulating bodies (OFCOM) are introduced.