Engineering Tripos Part IB, 2P6: Communications, 2021-22

Course Leader

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Lecturer

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Timing and Structure

7 lectures: 1 in week 5, 2 per week in weeks 6-8

Aims

The aims of the course are to:

- Introduce the basic elements of typical communication systems.
- Provide an understanding of bandwidth, as it applies to signals and transmission channels.
- Discuss digitisation of signals and how it affects their properties.
- Understand the basic elements of analogue and digital modulation schemes.

Objectives

As specific objectives, by the end of the course students should be able to:

- Describe the key elements of a communication system.
- Understand analogue modulation, and discuss the merits of amplitude and frequency modulation, and their power and bandwidth requirements.
- Understand how digitisation affects the characteristics of a signal; in particular, the separate effects of sampling (in time) and quantisation (in amplitude).
- Analyse the trade-off between quantisation rate and the quality of digital representation.
- Understand the basic principles of digital modulation, be familiar with the design choices involved, and analyse the performance of modulation schemes in terms of error probability and data rates.
- Understand the need for coding, and encode and decode bits using simple error-correcting codes such as repetition and Hamming codes

Content

Signals and Channels

- Key signal properties (Energy, Power, Bandwidth)
- Communication channels and some simple channel models

Analogue Modulation

- Amplitude modulation
- Frequency modulation

Digitisation of Analogue Signals

- Digitisation of signals (sampling, quantisation)

Digital Communication

- Basics of Baseband modulation, Passband modulation
- Data rate, probability of detection error
- Introduction to coding: Repetition codes and Hamming codes

Multiple Access

- Frequency-division, Time-division, and Code-division multiple access

Booklists

Please refer to the Booklist for Part IB Courses for references to this module, this can be found on the associated Moodle course.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [4] standard:

Toggle display of UK-SPEC areas.

GT1

Develop transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

IA1

Apply appropriate quantitative science and engineering tools to the analysis of problems.

IA3

Comprehend the broad picture and thus work with an appropriate level of detail.

KU1

Demonstrate knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics.

KU2

Have an appreciation of the wider multidisciplinary engineering context and its underlying principles.

E1

Ability to use fundamental knowledge to investigate new and emerging technologies.

E2

Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate.

E3

Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.

E4

Understanding of and ability to apply a systems approach to engineering problems.

P1

A thorough understanding of current practice and its limitations and some appreciation of likely new developments.

P3

Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc).

US1

A comprehensive understanding of the scientific principles of own specialisation and related disciplines.

US2

A comprehensive knowledge and understanding of mathematical and computer models relevant to the engineering discipline, and an appreciation of their limitations.

US3

An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

US4

An awareness of developing technologies related to own specialisation.

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Links
[1] mailto:sjg@eng.cam.ac.uk
[2] mailto:ag495@cam.ac.uk
[3] https://teaching.eng.cam.ac.uk/content/form-conduct-examinations
[4] https://teaching.eng.cam.ac.uk/content/uk-spec