

Engineering Tripos Part IIB, 4C3: Electrical and Nano Materials, 2017-18

Module Leader

[Dr J H Durrell](#) [1]

Lecturers

Dr J Durrell, Prof J Robertson and Dr S Hofmann

Timing and Structure

Michaelmas term. 16 lectures. Assessment: 100% exam.

Aims

The aims of the course are to:

- introduce undergraduates to a range of modern electrical materials and devices emphasising their processing, properties and limitations. The course will concentrate on materials technology of specific relevance to the electronics industry.

Objectives

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

- appreciate the range and diversity of modern electronic materials.
- understand a variety of bulk and thin film process requirements of these materials.
- identify specific materials for specific electrical/electronic/magnet applications.
- appreciate the key properties of electrical materials.
- recognise the limitations of modern electrical materials for specific applications.
- apply a range of materials in circuit applications.
- understand how to control materials properties and microstructure at the nanoscale.

Content

Bulk Materials, Properties and Applications (6L, Dr J Durrell)

- Magnetic fields in materials (2L);
- Bulk superconductors (1.5L);
- Pyroelectrics and their application as i.r. sensors (1.5L);
- Piezoelectrics (1L);

Thin Film Technology (4L, Dr S Hofmann)

- Vacuum Science and Technology (1L); (kinetic theory of gases, vacuum requirements/systems)
- Deposition Techniques (1.5L) (evaporation, MBE, sputtering, CVD, ALD)
- Thin Film and nano-metrology (1.5L); (scanning/transmission EM, XRD, scanning probe techniques, XPS, RBS, SIMS).

Microcircuits (6L, Professor J Robertson)

- Materials issues in devices (2L); (transistors, contacts, interconnects);
- Circuit limitations (1.5L); (electromigration and device miniaturisation);
- Advanced materials (2.5L); (semiconducting and display devices).

Booklists

Please see the [Booklist for Group C Courses](#) [2] for references for this module.

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.

IA2

Demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs.

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.

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.

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:jhd25@cam.ac.uk>

[2] <https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=51671>

[3] <https://teaching.eng.cam.ac.uk/content/form-conduct-examinations>

[4] <https://teaching.eng.cam.ac.uk/content/uk-spec>