

Engineering Tripos Part IB, 2P5: Electrical Power, 2018-19

Lecturer

[Dr T Flack](#) [1]

Timing and Structure

Weeks 1,3,5 & 7 Lent term, 2 lectures/week; weeks 2,4,6 & 8 Lent term, 1 lecture/week. 10 lectures + 2 examples classes

Aims

The aims of the course are to:

- Introduce the student to the principal types of electromechanical energy conversion device (induction motor, synchronous machine) as well as to the transmission and distribution of a three-phase power system.

Objectives

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

- Understand why three-phase systems are used universally for bulk power transfer.
- To analyse balanced three-phase circuits
- Understand the principles of per-unit calculation.
- Perform basic calculations on balanced three-phase loads, including symmetrical three-phase short-circuits.
- Understand the form and construction of synchronous generators, induction machines.
- Understand the synchronous generator phasor diagram and operating chart, and be able to carry out performance calculations using either.
- Understand the effects of torque control and excitation control on the behaviour of a synchronous generator.
- Carry out performance calculations on the induction motor, using the per-phase equivalent circuit.
- Understand the factors controlling the shape of the induction motor torque/speed curve.

Content

The functioning of modern industrial society depends heavily upon the ready availability of energy in a form that can be transported cheaply and converted easily into other forms. The advantages of electricity make it the overwhelming choice as the medium of transportation. The processes by which electricity is generated and the means by which it is reconverted into mechanical energy for industrial uses are therefore of fundamental importance.

Three-phase systems (2L)

- Star and delta-connected loads and sources.
- Star-delta transformation.
- Single phase representation.
- Solution of balanced three-phase circuits including mixed loads.
- Power factor correction.

Generation (2L)

- Prime energy sources.
- Constraints on power systems.
- Basic principles of a.c. generators.
- Comparative utility of single-phase and three-phase .
- Production of a rotating magnetic field by a three-phase winding.
- Development of synchronous machine equivalent circuit.

Synchronous Generators (2L)

- Phasor diagrams.
- Operation as a motor.
- Operation as a generator.
- Power and reactive power control.
- Operating chart.

Transmission and Distribution (2L)

- Per-unit system.
- Symmetrical three-phase faults.

Induction Motors (2L)

- Principles of operation
- Derivation of equivalent circuit.
- Construction.
- Performance predictions using equivalent circuit.
- Torque/speed characteristics and control of rotor resistance to vary them.

Booklists

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

Examination Guidelines

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

UK-SPEC

The [UK Standard for Professional Engineering Competence \(UK-SPEC\)](#) [4] describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers and engineering educators. Of particular relevance here is the '[Accreditation of Higher Education Programmes' \(AHEP\) document](#) [5] which sets out the standard for degree accreditation.

The [Output Standards Matrices](#) [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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Links

[1] <mailto:tjf1000@cam.ac.uk>

[2] <https://www.vle.cam.ac.uk/mod/book/view.php?id=364081&chapterid=43741>

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

[4] <http://www.engc.org.uk/ukspec.aspx>

[5] <http://www.engc.org.uk/standards-guidance/standards/accreditation-of-higher-education-programmes-ahcp/>

[6] <http://teaching.eng.cam.ac.uk/content/output-standards-matrices>