Engineering Tripos Part IIB, 4A3: Turbomachinery, 2020-21

Module Leader

Dr A. Wheeler [1]

Lecturers

Dr A. Wheeler and Dr L. Xu [2]

Lab Leader

Dr L. Xu [3]

Timing and Structure

Michaelmas term. 75% exam / 25% coursework. 12 lectures (including examples classes) + coursework

Prerequisites

3A1 and 3A3 assumed

Aims

The aims of the course are to:

- provide a general understanding of the principles that govern the design of axial flow and radial flow turbomachines.

Objectives

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

- understand the principles underpinning the study of turbomachine aerodynamics.
- know the requirements for different type of turbomachines.
- know the factors which influence the overall design of turbomachine stages and which influence the matching of components.
- know the factors which influence overall design of turbomachines for propulsion and stationary power-plant applications.
- evaluate the performance of turbine and compressor bladerows and stages using mean-line analyses.
- select a design for a given duty.
- present and understand information on stage and machine design.
- describe and understand compressor off-design performance.
- analyse the performance of propulsion systems and stationary power plant.

Content

Applications and Characteristics of Turbomachines (12L, Prof. WN Dawes and Dr LP Xu)

- Stage design and choice of design parameters.
- Specific speed, dynamic scaling and measures of efficiency.
- Analysis of the mean-line flow in compressors and turbines.
- Radial flow turbomachines.
- Characteristics of compressors, pumps and turbines.
- Matching of components: compressors and turbines; nozzles, throttles and diffusers. Compressor off-design problems; stall and its consequences.
- Application of turbomachines: power plant and aircraft propulsion systems.

Coursework

Coursework	Format	Due date & marks
Cascade Experiment Testing of a turbine cascade in a small wind tunnel to measure the blade surface pressure distribution, loss coefficient and flow exit angle. Time required: About 3 hours in the lab plus 4 hours write up. Learning objectives: • Understand the measurement of profile loss in a turbine cascade. • Check the operation of experimental equipment. • Understand the assumptions and the likely uncertainties in a set of aerodynamic measurements.	Experimental work done in pairs. Individual report. Anonymously marked.	Reports are d the date of th [15/60]

Booklists

Please refer to the Booklist for Part IIB 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 [4].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [5] standard:

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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.

D1

Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.

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.

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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