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**

<table>
<thead>
<tr>
<th>Coursework</th>
<th>Format</th>
<th>Due date &amp; marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascade Experiment</td>
<td>Experimental work done in pairs.</td>
<td>Reports are due 2 weeks after the date of the experiment.</td>
</tr>
<tr>
<td>Testing of a turbine cascade in a small wind tunnel to measure the blade surface pressure distribution, loss coefficient and flow exit angle.</td>
<td>Individual report.</td>
<td>[15/60]</td>
</tr>
<tr>
<td>Time required: About 3 hours in the lab plus 4 hours write up.</td>
<td>Anonymously marked.</td>
<td></td>
</tr>
</tbody>
</table>

**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.

**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**

The UK Standard for Professional Engineering Competence (UK-SPEC) [5] 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 [6] which sets out the standard for degree accreditation.

The Output Standards Matrices [7] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.