Engineering Tripos Part IIB, 4A15: Aeroacoustics, 2018-19

Module Leader

Dr A Agarwal [1]

Lecturers

Dr Agarwal, Professor Ann Dowling and Professor Nigel Peake

Timing and Structure

16 lectures + 2 examples classes; Assessment: 100% exam

Prerequisites

3A1 assumed

Aims

The aims of the course are to:

- analyse and solve a range of practical engineering problems associated with acoustics.

Objectives

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

- understand how sound is generated.
- understand how sound propagates in free space and within ducts.
- understand shielding and scattering of sound.
- model sound sources for various aeroacoustic problems and design for low noise.

Content

The students are expected to analyse and solve a range of practical engineering problems associated with acoustics. Examples include modelling of noise sources from jets, fans, wind turbines, vacuum cleaners, etc. and exploring ways to reduce noise either at the source or through acoustic damping. Upon completion of this module, the students would be well placed to pursue research in the area of acoustics and related fields. Students would also be more employable (the topics covered in the course is of interest to GE, Rolls-Royce, Dyson, Mitsubishi Heavy Industries, automobile companies and acoustic consultancies)

Classical Acoustics (5L) (Dr A Agarwal)

- The wave equation and simple solutions
- Impedance
- Energy
- Generalised functions and Green’s function
- Sound from simple sources (monopoles, dipole, compact sources)

Jet noise (3L) (Dr A Agarwal)

- Compact quadrupole
- Sound from a single eddy
- Sound from a random distribution of eddies
- Lighthill's eighth-power law
- Convection and refraction effects

Sound propagation (2L) (Prof. N. Peake)

- Ray theory
- Snell's law
- Refraction by temperature gradients

Trailing edge noise (2L) (Prof. N. Peake)

- Scattering and shielding
- Scattering from a source near a sharp edge
- Example: Wind turbine noise and the aeroacoustics of the owl

Duct acoustics (2L) (Prof. A P Dowling)

- Normal modes
- Concept of cut-off modes
- Damping/liner
- Helmholtz resonator
- Example: Thermoacoustic instability

Rotor/Fan Noise (2L) (Prof. A P Dowling)

- Rotor alone noise
- Rotor/Stator interaction noise
- Examples: Aircraft noise, fan and turbine noise

Booklists

Please see the Booklist for Group A 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:aa406@cam.ac.uk
[2] http://to.eng.cam.ac.uk/teaching/courses/y4/Booklist-IIB-GrpA.pdf
[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-ahep/
[6] http://teaching.eng.cam.ac.uk/content/output-standards-matrices