Engineering Tripos Part IIB, 4A15: Aeroacoustics, 2017-18

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

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.

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.

US2

A comprehensive knowledge and understanding of mathematical and computer models relevant to the engineering discipline, and an appreciation of their limitations.

US4

An awareness of developing technologies related to own specialisation.

Last modified: 01/06/2018 12:07

Links
[1] mailto:aa406@cam.ac.uk
[2] http://to.eng.cam.ac.uk/teaching/courses/y4/Booklist-IIB-GrpA.pdf
[3] https://teaching24-25.eng.cam.ac.uk/content/form-conduct-examinations
[4] https://teaching24-25.eng.cam.ac.uk/content/uk-spec