Engineering Tripos Part IA, Dimensional Analysis, 2023-24

Lecturer

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Lab Leader (Dimensional Analysis - Fluids)

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Lab Leader (Dimensional Analsysis - Structures)

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Timing and Structure

4 lectures: 1 lecture per week, weeks 1-4, Michaelmas term

Aims

The aims of the course are to:

- Introduce and illustrate the use of Dimensional Analysis.
- Develop an understanding of dimensional consistency and how it can be applied: to convert from one system of units to another; to check the units of an equation; to check algebra; and to aid memory.
- Develop the techniques required to form dimensionless groups and relationships.
- Explain how Dimensional Analysis can be used: to simplify problems by reducing the number of parameters; to correlate experimental data; to assist in the design and use of scale models for testing.

Objectives

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

- Convert between different measuring systems.
- Produce dimensionless groups from a given set of physical quantities.
- Understand the importance of dimensionless presentation of physical relationships.
- Use dimensional analysis to simplify problems and to aid in planning experiments.

Content

1. Introduction
2. Basic and derived units of measurement
3. Scales of units and conversion between different systems of units
4. Dimensions and dimensional consistency of equations
5. Dimensionless quantities, equations and relationships
6. Buckingham's Pi Theorem
7. Forming dimensionless relationships
8. Writing governing equations in terms of dimensionless variables
9. Forms of dimensionless relationships

10. Similarity and model testing
11. Use of Dimensional Analysis to design experiments and present experimental data.

LABORATORY EXPERIMENTS

Use of Dimensional Analysis in model testing to obtain general expressions for a number of problems.

1. Dimensional Analysis 1: The deflection of an elastic beam under load.
2. Dimensional Analysis 2: (a) Temperature variation in two blocks initially at different temperatures; (b) The flow over a "V" notch weir.

Booklists

Please refer to the Booklist for Part IA 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].

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Links
[1] mailto:sdm63@cam.ac.uk
[2] mailto:rg471@cam.ac.uk
[3] mailto:sas229@cam.ac.uk
[4] https://teaching.eng.cam.ac.uk/content/form-conduct-examinations