ME410 AERODYNAMIC PERFORMANCE

Module Registrar: Dr M T Stickland  
matt.stickland@strath.ac.uk

Taught To (Course): Cohorts for whom class is compulsory

Other Lecturers Involved: Dr I J Taylor  
Dr T Scanlon

Credit Weighting: 10  
(ECTS 5)

Semester: 1

Compulsory class  
Academic Level: 5

Assumed Prerequisites: 16231 Flight and Spaceflight1; ME201 Aero Design and Flight Test or 16259 Aero Design1; 16351 Flight and Spaceflight2.

Educational Aim

This module aims to introduce students to the principles of experimental aerodynamics and computational aerodynamics performance assessment. The course also provides an introduction to the importance of aeroelastic phenomena on aerodynamic design. Various aeroelastic phenomena will be introduced, with both static and dynamic problems investigated for a range of applications. The aim is to provide students with an understanding of the importance of understanding the aerodynamic flow field and its importance in the design process, and the interaction of the aerodynamic loading with the structure. A range of analysis techniques will be used to develop an understanding of the aerodynamic performance of aircraft and industrial aerodynamic problems.

Learning Outcomes

On completion of the module the student is expected to be able to

LO1 Understand experimental methods relating to aerodynamics and the calculation of the error in measurements and Learn how to program in National Instrument's Labview

LO2 Carry out simple simulations using the open source CFD code OpenFOAM (submerged jet flow)

LO3 Determine whether or not a structure is susceptible to adverse aeroelastic effects and to distinguish between different types of aeroelastic phenomena and their importance with respect to the structural integrity of the engineering system.

Syllabus

The module will teach the following:

Experimental aerodynamics and their use in the verification of simulation data.
Simulation using open source CFD codes
Programming in NI labview.
Aeroelasticity fundamentals – static and dynamic aeroelastic phenomena; resonant and self-excited oscillations.
Wing divergence and control reversal.
Flutter – Classical coupled flutter; stall flutter.
Bluff body aeroelasticity – Vortex induced vibration; galloping.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 experimental methods
C1 The student should be able to write a technical report
C2 Carry out a simple aerodynamic experiment using a wind tunnel
C3 Use a hot wire anemometer and program in NI labview
C4 carry out an error analysis of the experiment

LO2 Carry out simple simulations using the open source CFD code OpenFOAM
C1 The student should be able to create a domain
C2 Create a suitable mesh
C3 solve a flow problem and analyse the results

LO3 Aeroelasticity
C1 The student should be able to determine whether or not a structure is susceptible to aeroelastic effects and to calculate the critical conditions at which these effects will occur.
C2 Students should be able to identify and understand the differences between the various aeroelastic phenomena and determine the conditions at which each instability may occur.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

12 Principles of Assessment and Feedback
(on Learning & Teaching web pages: www.strath.ac.uk/learnteach/informationforstaff/staff/assessfeedback/12principles/)

Assessment will be by 1 coursework, one on-line class tests and submission of a report containing the results of the CFD simulation and experimental work.

Regular feedback and discussion will be available in tutorial sessions. Feedback from the coursework will enable students to reflect on their understanding of the subject material. Individual feedback will be available by appointment with the course lecturers.

Coursework submissions will be returned with marks and detailed written feedback to allow students to reflect on their performance.

Discussion of the course material between teacher-student and also amongst peers will be encouraged in tutorial sessions. Students will also be encouraged to discuss coursework with their peers to improve learning.

Summative feedback: The summative feedback will be provided by the assessment results of the coursework and the laboratory report.

Formative feedback: Tutorial sessions will provide opportunities for students to discuss their work and course material with members of staff. Students are expected to prepare accordingly for the tutorial sessions. The marked coursework and laboratory report will be returned to students with written feedback. Formative feedback may also be given during personal appointments with the course lecturers.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
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<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Month(s)</td>
<td>Duration</td>
</tr>
<tr>
<td>LO1 and LO2</td>
<td>1</td>
<td>15 mins</td>
<td>5%</td>
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Indicate which learning outcomes (LO1, LO2 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines: To be confirmed

Resit Assessment Procedures: submission of new coursework and/or laboratory report prior to the commencement of the August examination diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined by the August diet. This re-examination will consist entirely of coursework/report.
### Recommended Reading

<table>
<thead>
<tr>
<th><strong>Purchase essential</strong></th>
<th><strong>Purchase recommended</strong></th>
<th><strong>Highly recommended reading</strong></th>
<th><em>Simply for reference (do NOT purchase)</em></th>
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</thead>
<tbody>
<tr>
<td>&quot;An Introduction to the Theory of Aeroelasticity&quot; by Fung, Dover, ISBN 0-486-67871-7 (Highly recommended reading)</td>
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<tr>
<td>&quot;Wind Effects on Structures&quot; by Simiu and Scanlan, Wiley, ISBN 0-471-12157-6 (Highly recommended reading)</td>
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### Additional Student Feedback

(Please specify details of when additional feedback will be provided)

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<th>Time</th>
<th>Room No</th>
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Session: 2014/15

### Approved:

Course Director Signature: [Signature]

Date of Last Modifications: 24 September 2014
## MODULE TIMETABLE

<table>
<thead>
<tr>
<th>Module Code:</th>
<th>ME410</th>
<th>Module Title:</th>
<th>Aerodynamic Performance</th>
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**Brief Description of Assessment:**

2 lab reports / courseworks

**Assessment Timing**:

Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment(s).

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<thead>
<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
<th>WK5</th>
<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
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<td>Class test</td>
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<td>Course work 1 released</td>
<td>CFD report submission</td>
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<td>Course work 1 hand in</td>
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<th>Semester Two</th>
<th>WK1</th>
<th>WK2</th>
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