**Module Descriptor**

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| **Title** | Advanced Aerodynamics | | |
| **Session** | 2025/26 | **Status** | Published |
| **Code** | ENGG10027 | **SCQF Level** | 10 |
| **Credit Points** | 20 | **ECTS (European Credit Transfer Scheme)** | 10 |
| **School** | **Computing, Engineering and Physical Sciences** | | |
| **Module Co-ordinator** | N Kamaruddin | | |

**Summary of Module**


This module is designed to build upon the student's understanding of aerodynamics beyond the principles, and into more specialised fields of aerodynamics.

Outcome 1 is intended to provide the student with an understanding of the physical principles that support the theory of rotary wing aircraft. Students will consider the flow behaviour and performance criteria for rotary wing systems.

Outcome 2 is intended to develop the student's understanding of key concepts in high-speed aerodynamics. Students will consider isentropic flow and analyse flow behaviour in the presence of shockwaves. Isentropic nozzle and diffuser design will be discussed.

Outcome 3 is intended to extend the student's understanding of mathematical modelling of fluid behaviour. Focus will be placed on modelling of the viscous boundary layer using Prandtl's Boundary Layer Equations.

Outcome 4 is intended to develop the student's understanding of concepts relating to aeroelastic phenomena, including analysis of linear translational, torsional, and combined (coupled) vibrations, with and without damping. The method of solution will be based on modelling of engineering systems and matrix methods allied to computerised solutions.

Outcome 5 is intended to provide the student with an understanding of aerodynamic technologies. Key technologies including laminar flow control and drag reduction systems will be considered. The students will then have an opportunity to explore emerging aerodynamic technologies.

During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current- students/your-graduate-attributes/) in the following areas-

Universal: Academic - Critical thinking, analytical & inquiring mind; Personal- Ethical; Professional- Research Minded

Work-Ready: Academic - Knowledgeable, Digitally Literate, Problem Solver; Personal - Effective Communicator; Professional - Ambitious

Successful : Academic - Autonomous; Personal - Resilient; Professional- Driven

This module has been reviewed and updated, taking cognisance of the University's Curriculum Framework principles. Examples of this are found within the module such as active and engaging laboratory and tutorial activity, module assessment which reflects real-life (industry) problems/activities, development of problem-solving skills, recorded lecture content supporting students to organise their own study time and the use of integrated group activities supporting learning communities.

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| **Module Delivery Method** | **On-Campus[1]** ☒ | | **Hybrid[2]** ☐ | **Online[3]** ☐ | **Work -Based Learning[4]** ☐ | |
| **Campuses for Module Delivery** | ☐ Ayr<br>☐ Dumfries | | ☐ Lanarkshire<br>☐ London<br>☒ Paisley | | ☐ Online / Distance Learning<br>☐ Other (specify) | |
| **Terms for Module Delivery** | Term 1 | ☒ | Term 2 | ☐ | Term 3 | ☐ |
| **Long-thin Delivery over more than one Term** | Term 1 – Term 2 | ☐ | Term 2 – Term 3 | ☐ | Term 3 – Term 1 | ☐ |

| **Learning Outcomes** | |
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| **L1** | Examine rotary wing performance and analyse flow behaviour around rotary wings. |
| **L2** | Apply knowledge of compressible flow behaviour to perform calculations in high-speed aerodynamics. |
| **L3** | Apply mathematical models of viscous fluid behaviour to analyse the boundary layer. |
| **L4** | Solve complex problems of multi degree of freedom vibrational engineering systems relevant to aeroelasticity. |
| **L5** | Examine and assess key technologies in aerodynamics, including new emerging technologies. |

| **Employability Skills and Personal Development Planning (PDP) Skills** | |
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| **SCQF Headings** | **During completion of this module, there will be an opportunity to achieve core skills in:** |
| **Knowledge and Understanding (K and U)** | **SCQF 10**<br>A broad knowledge and understanding of high-speed aerodynamics, boundary layer flow behaviour, and rotary aerodynamics. |

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

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| | Specific and detailed knowledge and understanding of the application, techniques and practices associated with high speed aerodynamics, boundary layer flow behaviour, and key aerodynamic technologies. |
| **Practice: Applied Knowledge and Understanding** | **SCQF 10**<br>Applying knowledge and understanding to analyse and solve complex aerodynamic problems.<br>Select and critically evaluate technical literature and other sources of information to solve complex problems<br>Evaluate the environmental and societal impact of solutions to complex problems (to include the entire life-cycle of a product or process) and minimise adverse impacts. |
| **Generic Cognitive skills** | **SCQF 10**<br>Bringing information together from a variety of sources during problem solving and being able to explain potential problems with methods and strategies.<br>Be able to compare suggested solutions with expected values. |
| **Communication, ICT and Numeracy Skills** | **SCQF 10**<br>Ability to perform, interpret and evaluate complex numerical, geometrical and graphical data and using it to solve problems associated with aerodynamic concepts.<br>Ability to derive and solve complex equations.<br>Using communications skills to prepare and deliver technical reports, including text and illustration. |
| **Autonomy, Accountability and Working with Others** | **SCQF 10**<br>Identifying and addressing their own learning needs both during and out with class time.<br>Identifying solution routes and strategies using their own initiative and informed judgements. |

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| **Prerequisites** | **Module Code** ENGG09027 | **Module Title** Aircraft Design and Performance |
| | **Other** | |
| **Co-requisites** | **Module Code** | **Module Title** |

| **Learning and Teaching** |
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| In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.<br>The learning and teaching activity for this module include lectures, laboratories, tutorials and problem based learning. |

| **Learning Activities**<br>During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below: | **Student Learning Hours**<br>(Note: Learning hours include both contact hours and hours spent on other learning activities) |
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| Lecture / Core Content Delivery | 18 |
| Tutorial / Synchronous Support Activity | 18 |
| Independent Study | 164 |
| n/a | 0 |
| n/a | 0 |
| n/a | 0 |
| **TOTAL** | 200 |

**Indicative Resources**

**The following materials form essential underpinning for the module content and ultimately for the learning outcomes:**


Anderson, J.D. (2006) Fundamentals of Aerodynamics. 4th edn. New York: McGraw-Hill.

Anderson, J.D. (2021) Introduction to Flight. 9th edn. New York: McGraw-Hill.

Barnard, R.H. and Philpott, D.R. (2009) Aircraft Flight: A Description of the Physical Principles of Aircraft Flight. 4th edn. Harlow: Prentice-Hall.

Bramwell, A.R.S., Deakin, S. and Hall, M.J.R. (2001) Bramwell's Helicopter Dynamics. 2nd edn. Oxford: Butterworth-Heinemann.

Filippone, A. (2006) Flight Performance of Fixed and Rotary Wing Aircraft. Amsterdam: Elsevier.

Houghton, E.L. (2003) Aerodynamics for Engineering Students. 5th edn. Oxford: Butterworth-Heinemann.

Leishman, J.G. (2016) Principles of Helicopter Aerodynamics. Cambridge Aerospace Series. Cambridge: Cambridge University Press.

Padfield, G.D. (2007) Helicopter Flight Dynamics: The Theory and Application of Flying Qualities and Simulation Modelling. Oxford: Blackwell Publishing.

Sadraey, M.H. (2017) Aircraft Performance: Theory and Practice. Boca Raton, FL: CRC Press.

Stepniewski, W.Z. and Keys, C.N. (1984) Rotary Wing Aerodynamics. Mineola, NY: Dover Publications.


**(N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)**

**Attendance and Engagement Requirements**

**In line with the Student Attendance and Engagement Procedure, Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.**

**For the purposes of this module, academic engagement equates to the following:**

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| The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. Students will scan their attendance, via the attendance scanners, each time they are on-campus, they will have their attendance recorded in class and they will be expected to login to the VLE several times per week. Students who are unable to attend a timetabled session, due to illness or other circumstance, should notify their Programme Leader. Across the School an 80% attendance threshold is set. Students who fall below this, will be referred to the Student Success Team to see how they can be best supported in their studies. |

| **Equality and Diversity** |
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| **The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.**<br><br>Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. This module has laboratory-based teaching and as such you are advised to speak to the Module Co-ordinator to ensure that specialist assistive equipment, support provision and adjustment to assessment practice can be put in place, in accordance with the University's policies and regulations. |
| **(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)** |

**Supplemental Information**

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| **Divisional Programme Board** | **Engineering Physical Sciences** |
| **Overall Assessment Results** | ☐ **Pass / Fail** ☒ **Graded** |
| **Module Eligible for Compensation** | ☐ **Yes** ☒ **No**<br>**If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.** |
| **School Assessment Board** | Engineering |
| **Moderator** | B Rakhshani |
| **External Examiner** | E Tingas |
| **Accreditation Details** | This module is part of the IMechE accredited programmes BEng/MEng (Hons) Mechanical Engineering |
| **Module Appears in CPD catalogue** | ☐ **Yes** ☒ **No** |
| **Changes / Version Number** | 2.16<br>Module Descriptor copied to 2025/26 template and resources list updated to reflect ILR feedback, Attendance, Engagement and EDI statements updated. Examination replaced with Unseen Closed Book Class Test. |

| **Assessment (also refer to Assessment Outcomes Grids below)** |
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| **Assessment 1** |

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| Assessment Category 1: Class Test (Unseen, Closed Book), Weight – 65% |
| **Assessment 2** |
| Assessment Category 2: Case Study, Weight – 35% |
| **Assessment 3** |
| N/A |
| (N.B. (i) Assessment Outcomes Grids for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed.<br>(ii) An indicative schedule listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.) |

| **Component 1** | | | | | | | |
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| **Assessment Type** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **Weighting of Assessment Element (%)** | **Timetabled Contact Hours** |
| Unseen Closed Book (Class Test) | ☒ | ☒ | ☒ | ☒ | ☐ | 65 | 2 |

| **Component 2** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Type** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **Weighting of Assessment Element (%)** | **Timetabled Contact Hours** |
| Case study | ☐ | ☐ | ☐ | ☐ | ☒ | 35 | 0 |

| **Component 3** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Type** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **Weighting of Assessment Element (%)** | **Timetabled Contact Hours** |
| N/A | ☐ | ☐ | ☐ | ☐ | ☐ | | |
| **Combined total for all components** | | | | | | 100% | 2 hours |

**Change Control**

| **What** | **When** | **Who** |
|---|---|---|
| Module Descriptor copied to 2025/26 template and and resources list updated to reflect ILR feedback, Attendance, Engagement and EDI statements updated. Examination replaced with Unseen Closed Book Class Test. | March 2025 | N Kamaruddin |
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