

MRes Fluid Dynamics Across Scales

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information

Programme Title	Fluid Dynamics Across Scales			
Award(s)	MRes			
Programme Code	H405B (1 year stand-alone course)	H405 (1 + 3 year CDT programme)		
Associateship	None			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Engineering			
Department	Department of Aeronautics			
Mode and Period of Study	1 academic year, full-time			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Degrees in Engineering			
Total Credits	ECTS:	90	CATS:	180
FHEQ Level	Level 7			
EHEA Level	2 nd cycle			
External Accreditor(s)	None			
Specification Details				
Student cohorts covered by specification	2016/17 entry			
Person responsible for the specification	Professor J.C. Vassilicos, Director, CDT in Fluid Dynamics across Scales			
Date of introduction of programme	October 2014			
Date of programme specification/revision	September 2016			

Description of Programme Contents

Fluid Dynamics is important to numerous industrial, biological, biomedical and geophysical applications, and this course will provide students with formal training that broadens and deepens their understanding of the discipline, as well as provide a wide range of theoretical and practical tools, and transferable skills that are relevant in a variety of settings including in industry and academia.

This degree programme is offered as a full-time course lasting 1 academic year, and leads to the MRes degree. The MRes forms the first year of the 4-year Fluids CDT programme, but is also offered as a standalone course. Students taking only the MRes partake in the same activities organised for the students on the 4-year programme.

All students will take 5 core modules as part of their formal requirements to master the fundamentals; these will be formative courses. They will also take 4 courses/workshops in research techniques, transferable and professional skills, and personal development. The other main component of the MRes will be an Independent Research Project (May-September). The taught courses will be timetabled in the Autumn and Spring Terms 1 and 2. Term 3 is given over to the independent research project.

Learning Outcomes

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

1. Knowledge and Understanding

Knowledge and Understanding of:

1. The fundamentals of fluid dynamics across length- and time-scales, and across three different themes: aerodynamics, multiphase flows and microflows, and fluid-structure interactions. The development of the application of Mathematics and Statistics in a wide range of situations relevant to research and industry.
2. The importance of precision of argument.
3. Problem-solving strategies and methods.
4. Experimental skills.
5. Computational skills.
6. A selection of subjects which students study in greater depth, according to their interests leading to current developments at the frontiers of the subject.

2. Skills and other Attributes

Intellectual Skills:

1. Ability to assimilate and understand a large body of complex concepts and their inter-relationships.
2. Ability to deconstruct fluid flow problems, analyse them into their constituent components, and then synthesise them to develop an integrated solution.

3. Ability to recognise the commonalities underlying disparate phenomena and to exploit these in research on emerging and novel technologies.
4. Ability to recognise and analyse the multi-scale nature of fluid dynamics.
5. Ability to use structured mathematical analytical approach to solving problems in fluid dynamics, including the importance of assumptions made and consequences of their violation.
6. Ability to use mathematics to describe and model in fluid dynamics applications, including appropriate solution method, and interpretation of results; the methods developed should include 'back-of-the-envelope' calculations, scaling arguments, and numerical computations of reduced systems.
7. Ability to use appropriate numerical methods for the solution of problems in fluid dynamics, while keeping in mind issues of stability, accuracy, and convergence, and the need to validate the numerical predictions against experimental data.
8. Ability to select appropriate experimental techniques to provide reliable data.
9. Ability to carry out extended investigative work in fluid dynamics as an individual through an extended research project.

Practical Skills:

1. Carry out investigative project work as an individual and as part of a small group.
2. Use symbolic and numerical software as part of practical computation.
3. Use experimental techniques to carry out measurements of fluid flows as appropriate.

Professional Skills Development:

1. Solve open-ended problems and problems with well-defined solutions by formulating problems in precise terms, identifying key issues and trying different approaches in order to make progress.
2. Carry out an independent investigation using textbooks and other available literature, searching databases and interacting with colleagues and staff to extract important information.
3. Communicate effectively by listening carefully and presenting complex information in a clear and concise manner orally, in paper and using IT.
4. Use analytical skills, paying attention to detail and using technical language correctly, to manipulate precise and intricate ideas, to construct logical arguments.
5. Use IT skills for communication and analysis.
6. Work independently, use their initiative, organize themselves to meet deadlines, plan and execute an extended project
7. Work in groups, interacting constructively with others.

Entry Requirements

Academic Requirement	A first class (1st Honours) degree in an engineering, physical sciences, applied mathematics, or related subject.
Non-academic Requirements	N/A
English Language Requirement	IELTS 6.5 with a minimum of 6.0 in each element or equivalent.

The programme's competency standards document can be found at:

<http://www.imperial.ac.uk/fluids-cdt/training-programme/>

Learning & Teaching Strategy

Scheduled Learning & Teaching Methods

- Lectures
- Tutorials
- Workshops
- Lab practicals
- Group project work
- Group and individual presentations
- Individual research project

E-learning & Blended Learning Methods

- Virtual Learning Environment: BlackBoard
- Selected lecture recordings via Panopto

Project and Placement Learning Methods

- Group and individual project work

Assessment Strategy

Assessment Methods

- Written examinations
- Oral examination
- Coursework (problem sheets , group project reports and individual practical lab reports)
- Group and individual oral presentations
- Group and individual written reports

Academic Feedback Policy

Students will obtain feedback via the following routes:

- Marked coursework
- Meetings with research project supervisors
- Meetings with Core Course Tutor
- If the Core Course Tutor and/or any of the research project supervisors should report any problems with the student's progress, either on the project work or on the other parts of the course, the Director of Teaching will discuss these with them and the student.
- Since the MRes is part of a Centre for Doctoral Training, it is possible that students may receive feedback from the CDT Director if necessary

Re-sit Policy

The College's Policy on Re-sits is available at: www.imperial.ac.uk/registry/exams/resit

Mitigating Circumstances Policy

The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/registry/exams

Assessment Structure

Marking Scheme

A student must:

- Achieve a mark of at least 50% in each individual core course examination
- Achieve an aggregate examination mark of at least 50%
- Achieve an aggregate mark of at least 50% in the combined coursework assessments
- Achieve a mark of at least 50% in the individual research project

Final Degree Classifications

Pass – a student must achieve an aggregate mark of at least 50% in each element.

Merit – a student must achieve an aggregate mark of at least 60% in each element.

Distinction - a student must achieve an aggregate mark of at least 70% in each element.

As a prerequisite for continuing to the PhD research programme, students will be required to pass the MRes with a minimum mark of 60%.

Module Weightings

Element (% Weighting)	Module	% Module Weighting
Taught (50%)	Fluid Dynamics Part 1	20%
	Fluid Dynamics Part 2	20%
	Computational Fluid Dynamics	20%
	Experimental Fluid Mechanics	20%
	Applications of Fluid Dynamics Across Themes	20%
Research (50%)	Independent Research Project	100%

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	% Written Exam	% Course- work	% Practical	FHEQ Level	ECTS
	Fluid Dynamics Part 1	CORE	40	160	0	200	0%	0%	100%	7	8
	Fluid Dynamics Part 2	CORE	40	160	0	200	100%	0%	0%	7	8
	Computational Fluid Dynamics	CORE	40	160	0	200	60%	40%	0%	7	8
	Experimental Fluid Mechanics	CORE	40	160	0	200	40%	60%	0%	7	8
	Applications of Fluid Dynamics Across Themes	CORE	40	160	0	200	0%	100%	0%	7	8
	Independent Research Project	CORE	0	1250	0	1250	0%	100%	0%	7	50

Supporting Information

The Programme Handbook is available at: <http://www.imperial.ac.uk/fluids-cdt/training-programme/>

The Module Handbook is available at: <http://www.imperial.ac.uk/fluids-cdt/training-programme/>

The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements

The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance

The College's Academic and Examination Regulations can be found at: <http://www3.imperial.ac.uk/registry/proceduresandregulations/regulations>

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<http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters-statutes-ordinances-and-regulations/>

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