MEng Aeronautical Engineering (H401)

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	Aeronautical Engineering				
Award(s)	MEng				
Programme Code(s)	H401				
Awarding Institution	Imperial College London				
Teaching Institution	Imperial College London				
Faculty	Faculty of Engineering				
Department	Department of Aeronautics				
Associateship	City and Guilds of London Institute (ACGI)				
Main Location of Study	South Kensington Campus				
Mode and Period of Study	4 academic years full-time				
Cohort Entry Points	Annually in October				
Relevant QAA Benchmark Statement(s) and/or other external reference points	Honours Degrees in Engineering and Master's Degrees in Engineering				
Total Credits	MEng	ECTS:	240	CATS:	480
FHEQ Level	Level 7				
EHEA Level	2nd cycle				
External Accreditor(s)	Royal Aeronautical Society (RAeS) Accreditation received: 2015 Accreditation renewal: 2020 Institute of Mechanical Engineers (IMechE) Accreditation received: 2015 Accreditation renewal: 2020				

Specification Details	
Student cohorts covered by specification	2016-17 entry to 2018-19 entry
Person responsible for the specification	Dr Errikos Levis, Director of Undergraduate Studies
Date of introduction of programme	N/A
Date of programme specification/revision	Oct 2019

Programme Overview

The Department of Aeronautics aims to provide a course that trains and prepares the future leaders in aeronautics and related engineering disciplines, in a program that ranks as the top aeronautics course in the UK and one of the best World-wide. This is done through an integrated programme of study wherein the specific engineering disciplines are learnt from the first week of the first year; we strongly believe that this is the most appropriate approach to train highly-competitive engineers in the 21st century, and as such the degree programme does not include a *general* engineering foundation.

We also aim to graduate students of the highest quality, who will not only demonstrate technical and professional leadership in their fields, but who are adaptable and therefore well-suited to careers in both the industrial and service sectors. Our students must demonstrate both knowledge and skills and apply them to problems relevant to modern engineering practice in both *general* terms and in *discipline-specific* terms.

The programme aims/objectives are to:

- To provide students with a solid technical basis in all the key areas of the modern discipline-specific Engineering profession through delivery of a coherent, coordinated and balanced degree course, integrating core engineering science with practical application.
- To enable students to acquire a mature appreciation of the context in which engineering projects are developed.
- To develop in our students excellence in oral, written and graphical communication.
- To invest graduates with a fitness to enter professional practice and the capacity to have a beneficial impact upon it, whether in the industrial or service sectors generally or in the specific engineering discipline in particular.
- To develop an understanding of the physical world and of the use of mathematical abstraction to represent it.
- To develop the ability to make rational decisions.
- To develop clarity and style in professional communication.
- To develop skills of management, planning, organisation and teamwork.
- To appreciate the conceptual and creative aspects of design; to develop the ability to incorporate concepts into the design of new products or processes.
- To develop an awareness of the place of the individual in business, society and the environment.
- To develop a commitment to the public interest.
- To inculcate an understanding of professional behaviour.
- To develop the intellectual capacity and breadth of vision to remain a learner for life.

The department maintains very close contact with industry through a joint academic-industry advisory board that was specifically constituted to provide input to the structure and syllabus of the programme.

Members of the board include key academics from within the department (Head of Department, Director of Undergraduate Studies, Careers Advisor plus several others) and senior members from a wide variety of UK engineering companies that are influential in the aerospace sector and that might constitute career destinations for the student cohort (Airbus, ARA, BMT Fluid Mechanics Ltd, BAE Systems, QinetiQ, Rolls-Royce, Mercedes AMG F1, Jaguar Land Rover). Detailed syllabus information is reviewed on a regular basis by the board, and, twice yearly, meetings are held at which a series of prepared papers on the state and future direction of both industry and academia are presented and discussed. The ideas generated at these meetings are transferred back into the department via its various strategic committees.

Contact between students and industry occurs through talks and seminars, specific lecture courses, and projects. For more general talks, a number of visiting industrial speakers are invited each year to present either short lunch-time talks to all undergraduates on their experiences. For specific areas, an industrial speaker may provide a talk to add complementary material to a particular lecture course (e.g. energy and environment in propulsion). Courses in Helicopter Dynamics, Applications of Fluid Dynamics, Structural Dynamics and Design of Experiments are taught in full or in part by industry experts. Input from industry into project work is significant, where undergraduate students benefit in many cases from working with internationally leading engineering companies (normally at their sites) across a broad span of areas. This enables our students to undertake significant project work in demanding areas, either internally or on external placements, which constitutes one of the most significant drivers of our curriculum. Students in placements for a final-year project will be assigned an academic supervisor to monitor their learning experience and also to provide progress feedback and expert advice.

Learning Outcomes

Underpinning science, mathematics and associated engineering disciplines

- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of historical, current and future developments and technologies.
- A comprehensive understanding of the scientific principles of own specialisation and related disciplines.
- Knowledge and understanding of mathematical principles necessary to underpin their education in engineering discipline and to enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems.
- An awareness of developing technologies related to own specialisation.
  US3 Ability to apply and integrate knowledge and understand of other engineering disciplines to support study of their own engineering discipline.
- A comprehensive knowledge and understanding of mathematical and computer models relevant to the engineering discipline, and an appreciation of their limitations.
- An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

Engineering Analysis

- Understanding of engineering principles and the ability to apply them to analyse key engineering processes.
- Ability to use fundamental knowledge to investigate new and emerging technologies.
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques.

- Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.
- Ability to apply quantitative methods and computer software relevant to the engineering discipline, in order to solve engineering problems.
- Ability to extract data pertinent to an unfamiliar problem, and apply in its solution using computer based engineering tools when appropriate.
- Understanding of and ability to apply a systems approach to engineering problems and to work with uncertainty.

Design

- Investigate and define a problem and identify constraints including environmental and sustainability limitation, health and safety and risk assessment issues.
- Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.
- Understand customer and user needs and the importance of considerations such as aesthetics.
- Ability to generate an innovative design for products, systems, components or processes to fulfil new needs.
- Identify and manage cost drivers.
- Use creativity to establish innovative solutions.
- Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal.
- Manage the design process and evaluate outcomes.

Economic, social, and environmental context

- Knowledge and understanding of commercial and economic context of engineering processes.
- Extensive knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately.
- Knowledge of management techniques which may be used to achieve engineering objectives within that context.
- The ability to make general evaluations of commercial risks through some understanding of the basis of such risks.
- Understanding of the requirement for engineering activities to promote sustainable development.
- Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk).
- Understanding of the need for a high level of professional and ethical conduct in engineering.

Engineering Practice

- Knowledge of characteristics of particular materials, equipment, processes, or products. P1m A thorough understanding of current practice and its limitations, and some appreciation of likely new developments.
- Workshop and laboratory skills.
- Extensive knowledge and understand of a wide range of engineering materials and components
- Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc.)
- Ability to apply engineering techniques taking account of a range of commercial and industrial constraints.
- Understanding use of technical literature and other information sources. P5 Awareness of nature of intellectual property and contractual issues
- Awareness of appropriate codes of practice and industry standards.

- Awareness of quality issues.

Ability to work with technical uncertainty.

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

Entry Requirements		
Academic Requirement	Grade Requirement	Normally a minimum **A*AAA** *or* **A*A*A** overall or equivalent.
	Subject Requirements	**A*** in Mathematics **A*/A** in Physics Further Mathematics is strongly encouraged (or a comparable qualifications recognised by the College).
	Excluded Subjects	Critical Thinking General Studies
International Baccalaureate (IB)	Grade Requirement	Minimum **40** overall
	Subject Requirements	**7** in Mathematics at higher level **7** in Physics at higher level (or a comparable qualification recognised by the College).
English Language Requirement		Standard requirement IELTS score of 6.5 overall (minimum 6.0 in all elements)
Admissions Tests		Candidates may be asked to undertake an admissions test set by the College in order to provide additional information for the Admissions Tutor in support of an application.
Interview		Yes

The programme's competency standards document can be found at:
http://www.imperial.ac.uk/engineering/departments/aeronautics/study/ug/current/

Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Lectures • Tutorials • Associated Problems Sessions
Project Learning Methods	• Research Project • Industrial Internship Project
Assessment Strategy	

Assessment Methods	• Written Examinations • Coursework • Tutorial Material • Oral Presentations • Progress Reports

Academic Feedback Policy

Feedback is an essential part of learning and the Department gives high priority to the timeliness and quality of assessment/feedback to students on all modules. The primary purpose of feedback is to assist learning and the development of skills, by highlighting strengths and weaknesses on one hand, and by identifying actions for improvement on the other. It is important to recognize that: 1) feedback comes in various forms and 2) feedback requires student active engagement.

The various forms of feedback we undertake are:

- Unstructured - for example, from fellow students in group work, or perhaps via dialogue with a lecturer or teacher in or outside of a tutorial, class or laboratory, or by email;
- More structured - for example, via the assessment of practical, laboratory, coursework or project submissions;
- Formal - via progress tests (examinable and non-examinable) or examinations.
- Scheduled surgery sessions for coursework and laboratories (for 2nd 3rd/4th labs only) after marking to explain the criteria used in assessment, common errors made, where marks are lost etc.

Blackboard is our Virtual Learning Environment (VLE) and is used to deliver our courses. All coursework is submitted/marked and feedback-given via Blackboard. Every module has a dedicated "Feedback Forum" in BlackBoard to provide an additional space and a historical repository for Question & Answers.

Re-sit Policy

The College's Policy on Re-sits is available at: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/

Mitigating Circumstances Policy

The College's Policy on Mitigating Circumstances is available at: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/

Programme Structure

Year One	Pre-session	Term One	Term Two	Term Three	Term Four
Core Modules	0	9	11	0	0
Elective Modules	0	0	0	0	0
Projects	0	0	0	0	0

Year Two	Pre-session	Term One	Term Two	Term Three	Term Four
Core Modules	0	9	9	0	0
Elective Modules	0	0	0	0	0
Projects	0	0	0	0	0
Year Three	Pre-session	Term One	Term Two	Term Three	Term Four
Core Modules	1	4	4	0	0
Elective Modules (students select 2)	0	10	10	0	0
Projects	0	0	0	1	0
Year Four (MEng/MSci only)	Pre-session	Term One	Term Two	Term Three	Term Four
Core Modules	0	2	0	0	0
Elective Modules (students select 3)	0	9	10	0	0
Projects (same project all terms)	0	1	1	1	0

Assessment Dates & Deadlines	
Year One	
Written Examinations	January, May and June
Coursework Assessments	Continuous
Project Deadlines	N/A
Practical Assessments	Continuous
Year Two	
Written Examinations	January, May and June
Coursework Assessments	Continuous
Project Deadlines	N/A
Practical Assessments	Continuous
Year Three	
Written Examinations	January, April and May
Coursework Assessments	Continuous

Project Deadlines	June
Practical Assessments	Continuous
Year Four	
Written Examinations	January, April and May
Coursework Assessments	Continuous
Project Deadlines	May
Practical Assessments	Continuous
Assessment Structure	
Marking Scheme	

Year One

A student must:

- Achieve a mark of at least 40% in each individual examination
- Achieve an aggregate mark of at least 40% in the combined coursework assessments

Year Two

A student must:

- Achieve a mark of at least 40% in each individual examination
- Achieve an aggregate mark of at least 40% in the combined coursework assessments

Year Three

A student must:

- Achieve a mark of at least 40% in each individual core course examination
- Achieve an aggregate examination mark of at least 40%
- Achieve an aggregate mark of at least 40% in the combined coursework assessments

Year Four

A student must:

- Achieve an overall mark of at least 40%
- Achieve an aggregate mark of at least 40% in the final year project

Final Degree Classifications

Third – a student must achieve an aggregate mark of 40%
Lower Second – a student must achieve an aggregate mark of 50%
Upper Second – a student must achieve an aggregate mark of 60%
First - a student must achieve an aggregate mark of 70%

Year	% Year Weighting	Module	% Module Weighting
Year One	11.1%	Introduction to Aerodynamics & Aircraft Performance	13.24%
		Computing	8.8%
		Engineering Design	4.6%
		Properties of Materials	8.82%
		Mathematics	13.24%
		Mechanics	13.24%
		Introduction to Structural Analysis	8.82%
		Thermodynamics	8.82%
		Engineering Ethics	1%
		Experimental Methods (5 Labs)	6%
		L1 Applications	4.6%
		Management and Business for Aeronautical Engineers	8.82%
Year Two	22.2%	Aerodynamics	9.29%
		Numerical Analysis	6.19%
		Manufacturing Processes	4.94%
		Circuits, Signals and Systems	9.29%
		Materials	6.19%
		Mathematics	9.29%
		Mechanics of Flight	6.19%
		Propulsion and Turbomachinery	6.19%
		Structural Mechanics and Dynamics	9.29%
		Experimental Methods (8 Labs)	14.58%
		L2 Applications	9.29%
		Technology, Business and the Market for Aeronautical Engineers	9.29%
Year Three	33.3%	Aircraft Aerodynamics	12.5%
		Finite Elements	8.33%

Year	% Year Weighting	Module	% Module Weighting
		Aircraft Structures	12.5%
		Aerospace Vehicle Design	16.68%
		Group Design Project	25%
		Control Systems	8.33%
		2 x modules from elective group (A)	8.33% each
Year Four	33.3%	Structural Dynamics	8.33%
		Applied Computational Aerodynamics	8.33%
		3 x modules from elective group (A/B)	8.33% each
		Individual Project	58.35%

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
AE1-101	Introduction to Aerodynamics	CORE	1	30	82.5	0	112.5	100%	0%	0%	4	4.50
AE1-102	Aircraft Performance	CORE	1	15	35	0	50	100%	0%	0%	4	2.00
AE1-103	Computing	CORE	1	41	84	0	125	0%	100%	0%	4	5.00
AE1-104	Engineering Design	CORE	1	48	27	0	75	0%	100%	0%	4	3.00
AE1-106	Properties of Materials	CORE	1	24	101	0	125	100%	0%	0%	4	5.00
AE1-107	Mathematics	CORE	1	64	286	0	350	100%	0%	0%	4	14.00
AE1-109	Mechanics	CORE	1	36	64	0	100	100%	0%	0%	4	4.00
AE1-110	Introduction to Structural Analysis	CORE	1	30	70	0	100	100%	0%	0%	4	4.00
AE1-111	Thermodynamics	CORE	1	31	94	0	125	100%	0%	0%	4	5.00
AE1-112	Engineering Ethics	CORE	1	4	8.5	0	12.5	0%	100%	0%	4	0.50
AE1-113	Experimental Methods (5 Labs)	CORE	1	20	80	0	100	0%	100%	0%	4	4.00
AE1-114	L1 Applications	CORE	1	22	53	0	75	0%	100%	0%	4	3.00
AE1-116	Management and Business for Aeronautical Engineers	CORE	1	20	130	0	150	100%	0%	0%	4	6.00
AE2-201	Aerodynamics	CORE	2	40	135	0	175	100%	0%	0%	5	7.00

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
AE2-202	Numerical Analysis	CORE	2	32	68	0	100	0%	100%	0%	5	4.00
AE2-203	Manufacturing Processes	CORE	2	16	46.5	0	62.5	0%	100%	0%	5	2.50
AE2-205	Circuits, Signals and Systems	CORE	2	36	126.5	0	162.5	90%	10%	0%	5	6.50
AE2-208	Materials	CORE	2	26	124	0	150	100%	0%	0%	5	6.00
AE2-209	Mathematics	CORE	2	75	175	0	250	100%	0%	0%	5	10.00
AE2-211	Mechanics of Flight	CORE	2	26	74	0	100	100%	0%	0%	5	4.00
AE2-212	Propulsion and Turbomachinery	CORE	2	25	75	0	100	100%	0%	0%	5	4.00
AE2-213	Structural Mechanics and Dynamics	CORE	2	40	122.5	0	162.5	100%	0%	0%	5	6.50
AE2-214	Experimental Methods (8 Labs)	CORE	2	12	13	0	25	0%	100%	0%	5	1.00
AE2-215	L2 Applications	CORE	2	30	32.5	0	62.5	0%	100%	0%	5	2.50
AE2-216	Technology, Business and the Market for Aeronautical Engineers	CORE	2	20	130	0	150	100%	0%	0%	5	6.00
AE3-301	Aircraft Aerodynamics	CORE	3	40	147.5	0	187.5	80%	20%	0%	6	7.50
AE3-302	Control Systems	CORE	3	24	101	0	125	65%	35%	0%	6	5.00
AE3-303	Finite Elements	CORE	3	25	100	0	125	90%	10%	0%	6	5.00

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
AE3-304	Aircraft Structures	CORE	3	40	147.5	0	187.5	80%	20%	0%	6	7.5
AE3-306	Group Design Project	CORE	3	20	355	0	375	0%	100%	0%	6	15.00
AE3-403	Aerospace Vehicle Design	CORE	3	20	230	0	250	0%	100%	0%	6	10.00
AEM-AAE02	Aircraft Systems Engineering and Aerial Vehicle Technologies	ELECTIVE	3	24	101	0	125	85%	15%	0%	6	5.00
BE4-MBMX	Biomechanics	ELECTIVE	3	28	122	0	150	95%	5%	0%	6	6.00
EE4-29	Optimisation	ELECTIVE	3	25	100	0	125	100%	0%	0%	7	5.00
DE3-DLIE	Design-led Innovation and Enterprise	ELECTIVE	3	31	119	0	150	0%	70%	30%	6	6.00
AE3-402	Separated Flows and Fluid-Structure Interaction	ELECTIVE (A)	3	24	101	0	125	100%	0%	0%	6	5.00
AE3-410	Mathematics	ELECTIVE (A)	3	29	96	0	125	100%	0%	0%	6	5.00
AE3-416	Advanced Propulsion	ELECTIVE (A)	3	24	101	0	12	100%	0%	0%	6	5.00
AE3-422	High-Performance Computing	ELECTIVE (A)	3	20	105	0	125	0%	100%	0%	6	5.00
AE3-401	Advanced Mechanics of Flight	ELECTIVE (A/B)	3/4	20	105	0	125	70%	30%	0%	6	5.00
AE3-408	Materials in Action	ELECTIVE (A/B)	3/4	25	100	0	125	100%	0%	0%	6	5.00

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
AE3-409	Materials Modelling	ELECTIVE (A/B)	3/4	20	105	0	125	100%	0%	0%	6	5.00
AE3-412	Introduction to Turbulence and Turbulence Modelling	ELECTIVE (A/B)	3/4	26	99	0	125	100%	0%	0%	6	5.00
AE3-414	Computational Fluid Dynamics	ELECTIVE (A/B)	3/4	26	99	0	125	70%	30%	0%	6	5.00
AE3-415	Computational Mechanics	ELECTIVE (A/B)	3/4	25	100	0	125	85%	15%	0%	6	5.00
AE3-420	Innovation Management	ELECTIVE (A/B)	3/4	20	105	0	125	100%	0%	0%	6	5.00
AE3-421	Advanced Manufacturing	ELECTIVE (A/B)	3/4	20	105	0	125	100%	0%	0%	6	5.00
N/A	Business for Professional Engineers & Scientists	ELECTIVE (A/B)	3/4	Various			150	Various			6	6.00
N/A	Horizons	ELECTIVE (A/B)	3/4	Various			150	Various			6	6.00
AE3-451	Spacecraft Systems	ELECTIVE (A/B)	3/4	25	100	0	125	100%	0%	0%	6	5.00
AE3-452	Spacecraft Structures	ELECTIVE (B)	4	25	100	0	125	100%	0%	0%	6	5.00
AE4-401	Applications of Fluid Dynamics	ELECTIVE (B)	4	30	95	0	125	100%	0%	0%	7	5.00
AE4-450	Aerothermodynamics of Launchers and Re-Entry Vehicles	ELECTIVE (B)	4	26	99	0	125	0%	100%	0%	7	5.00
AE4-403	Structural Dynamics	CORE	4	28	97	0	125	100%	0%	0%	7	5.00

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
AE4-404	Applied Computational Aerodynamics	CORE	4	26	99	0	125	0%	100%	0%	7	5.00
AE4-406	Individual Project	CORE	4	0	750	0	750	10%	90%	0%	7	35.00

Supporting Information
The Programme Handbook is available at: http://www.imperial.ac.uk/aeronautics/study/ug/current-students/
The Module Handbook is available at: http://www.imperial.ac.uk/aeronautics/study/ug/current-students/
The College's entry requirements for postgraduate programmes can be found at: http://www.imperial.ac.uk/study/ug/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: https://www.imperial.ac.uk/about/governance/academic-governance/regulations
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters-statutes-ordinances-and-regulations
Imperial College London is regulated by the Higher Education Funding Council for England (HEFCE) http://www.hefce.ac.uk/reg/register/