Programme Specification
A statement of the knowledge, understanding and skills that underpin a taught programme of study leading to an award from The University of Sheffield

1. Programme Title
   Aerospace Engineering

2. Programme Code
   AERU11

3. JACS Code
   H400

4. Level of Study
   Undergraduate

5a. Final Qualification
    Bachelor of Engineering (BEng)

5b. QAA FHEQ Level
    Honours

6a. Intermediate Qualification(s)
    Not applicable

6b. QAA FHEQ Level
    Not applicable

7. Teaching Institution (if not Sheffield)
   Not applicable

8. Faculty
   Engineering

9. Department
   Interdisciplinary Programmes

10. Other Department(s) involved in teaching the programme
    - Automatic Control and Systems Engineering
    - Computer Science
    - Electronic and Electrical Engineering
    - Management
    - Materials Science and Engineering
    - Mathematics and Statistics
    - Mechanical Engineering

11. Mode(s) of Attendance
    Full-time

12. Duration of the Programme
    Three years

13. Accrediting Professional or Statutory Body
    - Royal Aeronautical Society (RAeS)
    - Institution of Engineering and Technology (IET)
    - Institution of Mechanical Engineers (IMechE)
    - Institute of Materials, Minerals and Mining (IoM³)

14. Date of production/revision
    May 2014

15. Background to the programme and subject area

Aerospace Engineering is a complex, rapidly changing field. Its primary application is the design and development of flight vehicles such as aircraft, spacecraft, rockets and satellites. Graduate aerospace engineers can look forward to a career in the leading organisations in the sector, including Airbus UK, BAE Systems, Boeing and Rolls-Royce – companies that have significant involvement in our programmes.

Aerospace Engineering at Sheffield differs from conventional aeronautical engineering degrees, which traditionally focus on the materials, structures, aerodynamics and propulsion necessary in the design of high-speed flight and lightweight aircraft. Our degrees cover all these topics but also address concepts of systems integration and autonomous control that are essential to the production of more efficient and environmentally-friendly aircraft and aerospace systems. This means that our students study avionics, dynamic control, information and communication technology, software integration and computer-based tools, in a curriculum that draws on the expertise of six departments in the Faculties of Engineering and Science, plus the University’s Management School. Our test facilities include wind tunnels and two flight simulators – one with a dynamic platform – and students undertake a flight test
Another distinctive feature of our degrees is that at the same time as providing a breadth of knowledge, students can tailor their studies to suit their individual interests and career aspirations. Our three-year BEng Aerospace Engineering degree offers the opportunity, after Year 1, to specialise in either aeromechanics or avionic systems or our students can, if they prefer, maintain a broad knowledge of aerospace engineering by selecting a general elective. Throughout the degree, there are opportunities to participate in industrial seminars, to visit industry and to undertake research into real-life problems.

Our BEng Aerospace Engineering degree satisfies the academic and practical requirements at BEng (Hons) level. It requires further study after you have graduated to meet Engineering Council standards for Chartered Engineer status. It is accredited by the Royal Aeronautical Society (RAeS), the Institution of Engineering and Technology (IET), the Institution of Mechanical Engineers (IMechE) and the Institute of Materials, Minerals and Mining (IoM³). Our students graduate equipped with the knowledge and skills they need to meet the challenges of working within this fast-moving discipline and to succeed in their chosen career. Our graduates have also gone on to work in a wide range of other sectors including manufacturing, energy and power, consultancy, education, research and finance.

16. Programme aims

The University's Mission is to provide students from a wide variety of educational and social backgrounds with high quality education in a research-led environment, delivered by staff working at the frontiers of academic enquiry. Aerospace Engineering at Sheffield implements this through its strong commitment to both teaching and research. It also aims to engender in students a commitment to future self-learning and social responsibility. The overall aim of the degree is to admit intelligent and motivated students and, in a research-led environment, to create graduates who will become future innovators in the engineering economy by:

1. providing teaching that is informed and invigorated by the research and scholarship of its staff and alert to the benefits of student-centred learning;
2. providing a broad knowledge and understanding of aerospace engineering systems, aerodynamics, propulsion, materials and structures, together with a more detailed understanding in selected areas of aeromechanics or avionic systems, or both;
3. developing in students independence of thought, intellectual curiosity, ethical awareness and the business skills necessary for a professional engineer in aerospace engineering or a related field;
4. developing in students a diverse range of subject-specific and generic skills appropriate to graduate employment both within and outside aerospace engineering;
5. enabling students to maximise their potential and imparting in students a commitment to life-long learning;
6. satisfying the latest academic and practical accreditation requirements of the Engineering Council UK-SPEC (UK Standard for Professional Engineering Competence), the RAeS, the IET, the IMechE and the IoM³ for an award at BEng (Hons) level.

17. Programme learning outcomes

**Knowledge and understanding:**

By graduation students will have:

K1 knowledge and understanding of aerospace engineering systems, aerodynamics, propulsion,
materials and structures

K2 knowledge and understanding of the mathematics necessary to apply engineering science to aerospace engineering

K3 further knowledge in selected areas of aeromechanics or avionic systems or both

K4 an understanding of the social and ethical awareness necessary for a professional engineer

K5 an understanding of the analytical and design methods used in aerospace engineering

K6 knowledge and understanding of management techniques and the application of these in engineering

K7 an understanding of the use of information technology for analysis, design and management

Skills and other attributes:

By graduation students will be able to:

S1 use engineering science, mathematics and information technology to analyse engineering problems

S2 demonstrate skills in the acquisition, use and critical evaluation of experimental and other subject-related information

S3 produce designs in a professional manner, to meet specified requirements

S4 display creativity and innovation in solving unfamiliar problems

S5 exercise independent thought and judgement

S6 conduct a technical investigation

S7 conduct experimental investigations, and analyse and report the results

S8 prepare technical sketches and drawings, using hand or computer methods as appropriate

S9 use appropriate computer aids for analysis and design in order to solve engineering problems

S10 demonstrate that they have completed the practical engineering applications necessary for a Chartered Engineer

S11 prepare technical reports and presentations, and convey essential information using a variety of media

S12 demonstrate that they have completed basic flight instrumentation tests

S13 use information technology effectively

S14 communicate at a professional level, orally, in writing and through visual presentations

S15 work in collaboration with others

S16 manage their time effectively

S17 find information and learn independently

18. Teaching, learning and assessment

Development of the learning outcomes is promoted through the following teaching and learning methods:

- **Lectures**: The principal means of transmitting academic material and analysis techniques. Most lecture courses provide tutorial sheets to enable students to develop their understanding of the subject matter and methods during their private study.

- **Laboratory Classes**: These introduce experimental methods and provide a good opportunity for developing team-working and communication skills.

- **Coursework Assignments, Oral and Poster Presentations**: A number of modules have coursework assignments that require students to seek additional information and work on their
own, or sometimes in small groups. They are designed to enable students to develop and show their understanding of the content of the module. Oral and poster presentations are included as part of some coursework assignments to provide opportunities for developing essential presentation and communication skills.

- **Tutorials and Example Classes**: These may be small group or up to class sized tutorials and are a main source of providing help to students to resolve problems in their understanding of course material.

- **Design Classes**: These enable students to work on ‘open-ended' and often ill-defined problems related to real engineering situations. They also provide good opportunities for developing team-working and communication skills as well as individual skills.

- **Industrial and Research Seminars**: Seminars led by visiting industrialists and research academic staff take place throughout the degree. They enable students to develop their understanding of the industrial application of concepts they are learning in class, and of the role and responsibilities of a professional engineer.

- **Individual Investigative Project**: This is undertaken in Year 3. It is an individual research and/or industrial project at the frontiers of engineering. It is completed under the supervision of a member of academic staff and provides an excellent opportunity for a student to pull together every aspect of their development during the degree.

Opportunities to demonstrate achievement of the learning outcomes are provided through the following assessment methods:

- **Written Examinations**: These are typically 2 hours in duration; many modules use this as the only or major assessment method.

- **Coursework Assignments, Oral and Poster Presentations**: Coursework assignments are widely used in design studies, computational exercises, laboratory reports, essays or other work designed to assess the understanding of the module. Assignments are mainly undertaken on an individual basis but are sometimes carried out in small groups. Some assignments use oral and poster presentations in order to assess the development of presentation and communication skills. Some modules use coursework assignments as the only or main method of assessment whilst others have this as a minor part with a written examination forming the major part of the overall assessment.

- **Class Tests**: These are small tests conducted during the main teaching periods to assess progress and understanding; they supplement more formal examinations.

- **Individual Investigative Project**: This is the final and largest individual project on the degree and is undertaken in Year 3. The project is assessed on the student's commitment and progress throughout the project, a written report, an oral presentation to a panel of staff and the response to questions from the panel. The project is expected to be at a professional level.

The main teaching, learning and assessment methods adopted for each learning outcome are shown below. In most cases a combination of methods is used.
LEARNING OUTCOME
(abbreviated - see Section 17 for full text)

Items shown thus (●) are included depending on the nature of the project

<table>
<thead>
<tr>
<th>LEARNING OUTCOME</th>
<th>TEACHING / LEARNING</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lectures</td>
<td>Laboratory classes</td>
</tr>
<tr>
<td>K1 Broad understanding</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>K2 Mathematics</td>
<td>● (●) ● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>K3 Critical knowledge</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>K4 Professional responsibility</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>K5 Analytical/design methods</td>
<td>● (●) ● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<td>K6 Management techniques</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
<td>● (●) ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>K7 Information technology</td>
<td>● ● ● ● ● ● ● ● ● ● ● ● ●</td>
<td>● (●) ● ● ● ● ● ● ● ● ● ● ● ● ●</td>
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<tr>
<td>S1 Analyse problems</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>S2 Acquire/evaluate data</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S3 Produce designs</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S4 Display creativity &amp; innovation</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S5 Exercise independent thought</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S6 Conduct technical investigations</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S7 Conduct experiments</td>
<td>● ● ● ● ● ● ●</td>
<td>● (●) ● ● ● ● ● ● ●</td>
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<tr>
<td>S8 Prepare sketches / drawings</td>
<td>● ● ● ● ● ● ●</td>
<td>● (●) ● ● ● ● ● ● ●</td>
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<tr>
<td>S9 Write computer programs</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S10 Engineering applications</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S11 Prepare technical reports</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S12 Flight instrumentation tests</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S13 Use IT effectively</td>
<td>● ● ● (●) ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>S14 Communicate effectively</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
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<tr>
<td>S15 Work collaboratively</td>
<td>● (●) ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>S16 Manage time effectively</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>S17 Learn independently</td>
<td>● ● ● ● ● ● ●</td>
<td>● ● ● ● ● ● ●</td>
</tr>
</tbody>
</table>

Proportions of types of assessment by level can be found on the UniStats website:
http://unistats.direct.gov.uk/
19. Reference points

The learning outcomes have been developed to reflect the following points of reference:

Subject Benchmark Statements


University Strategic Plan (including a link to the University’s Mission Statement)
http://www.sheffield.ac.uk/strategicplan

Learning and Teaching Strategy (2011-16)
http://www.shef.ac.uk/lets/strategy/lts11_16

UK Quality Code for Higher Education (the Quality Code), available at:
http://www.qaa.ac.uk/assuring-standards-and-quality


www.engc.org.uk

In assessing the learning outcomes, the level of performance, e.g. the extent of knowledge and depth of understanding, will be compliant with guidance given in the above references.

20. Programme structure and regulations

The degree structure is modular. At each level students study modules worth a total of 120 credits. Most modules are worth 10, 15 or 20 credits with one 30 credit module in the final year.

During the first two years, the syllabus is the same for all the MEng and BEng Aerospace Engineering degrees, except those with Private Pilot Instruction in Year 2.

In Year 1 all modules are core (compulsory). The ‘Introduction to Aerospace Design’ module, taught over two semesters, introduces students to the basic concepts of aircraft and aircraft design with a particular focus on systems engineering, interdisciplinary design and aircraft performance. As part of this taught module, students undertake ‘Engineering Applications’ which covers basic manufacturing processes and workshop tools, and is a requirement for accreditation, as well as a short course in engineering drawing and computer-aided design. Students also participate in a compulsory week-long ‘Global Engineering Challenge’. Based on the Engineers without Borders Challenge (a national competition for engineering undergraduates), this gives all first-year engineering students at the University the opportunity to work together in teams to tackle a real-world problem with a global perspective. Formal credits are not awarded for participation in the Challenge Week; however, it is vital for developing the technical competence, understanding of global context and the professional skills that are the hallmark of an excellent engineer. At the end of Year 1, students choose from one of three electives – either Aeromechanics, Avionic Systems or General (which includes both Avionics and Aeromechanics topics) – and they follow their chosen elective for the remainder of the degree.

To progress to Year 2, students must pass the compulsory first-year Mathematics module.

In Year 2, half of the modules (60 credits) are taken by all students while the remaining modules are specific to their chosen elective. Students take part in a compulsory week-long project called ‘Engineering – You’re Hired’. Working again with students from other engineering disciplines, this
project enables them to put their skills in collaborative working into practice to solve a technical case-study. Formal credits are not awarded for participation in the project week; however, it enables students to develop and demonstrate many of the key general skills required by employers, including entrepreneurial problem solving, accomplished communication, and cultural agility.

At the end of Year 2 students who have pursued the Aeromechanics elective choose from one of two streams, either: 1) Aerospace Materials, Structures and Manufacturing or 2) Aerodynamics and Propulsion. They follow this stream for the remainder of their degree. The Avionic Systems and General electives only have one stream in the final year. Any student who, by the end of Year 2, has not attained a satisfactory standard in the ‘Engineering Applications’ and drawing courses usually taken in Year 1 as part of the ‘Introduction to Aerospace Design’ module is not allowed to continue into Year 3. Likewise, students must attain a satisfactory standard in the ‘Global Engineering Challenge Week’ and in ‘Engineering – You’re Hired’ by the end of Year 2.

In Year 3 all students take core modules in aerospace and project management, finance and law (60 credits). A significant part of the final year is a 30-credit individual investigative project, which allows students to specialise in their particular area of interest. The project is supervised by an academic member of staff from the engineering department appropriate to the research topic. The remaining modules taken depend on the student's chosen elective stream. As an integral part of the degree, students attend a practical flight laboratory course where flying experience is related to the theory of flight dynamics. This course is a requirement for accreditation by the RAesS, and so students must attain a satisfactory standard. Students who satisfy the appropriate progression criteria may transfer from the BEng to the MEng Aerospace Engineering degree at the end of Year 2. In Year 2 students who secure an industrial placement may transfer to the four-year BEng in Aerospace Engineering with a Year in Industry. A student who does not pass the individual investigative project at the first attempt can only be awarded a Pass degree (instead of a degree with Honours).

The weightings of each year towards the overall classification of the degree are:

<table>
<thead>
<tr>
<th>Year</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>0</td>
</tr>
<tr>
<td>Year 2</td>
<td>33.3%</td>
</tr>
<tr>
<td>Year 3</td>
<td>66.6%</td>
</tr>
</tbody>
</table>

Detailed information about the structure of programmes, regulations concerning assessment and progression and descriptions of individual modules are published in the University Calendar available on-line at [http://www.shef.ac.uk/calendar/](http://www.shef.ac.uk/calendar/).

### 21. Student development over the course of study

**Year 1:** Students will consolidate their mathematical and scientific knowledge and be introduced to the fundamentals of aerospace engineering. They will undertake laboratory work and will be enabled to evaluate and interpret data, and present the results in a clear and reliable manner. They will also undertake design and problem-solving activities, both individually and in small groups, which require conceptual thinking, simple analysis, logical thought, judgment and the clear presentation of their ideas, and which will develop their awareness of the global dimension to many real-life engineering problems. They will develop their independent learning and team-working skills. Students will have laboratory experience after which they will have knowledge of the use of basic materials processing and testing equipment, and of simple manufacturing methods. A short course in engineering drawing and computer-aided design (part of the ‘Introduction to Aerospace Design’ module) will enable them to present and understand engineering manual and computer generated drawings prepared to industry-standard conventions. Through Personal Tutorials students will develop professional skills, including professional conduct, the avoidance of unfair means, and how to prepare and deliver oral
and written presentations.

**Year 2:** Students will continue the core studies introduced in Year 1. They will also be introduced to basic computer programming. They will have a more extensive knowledge and understanding of the broad subject areas within aerospace engineering and also in the appropriate areas of mathematics. They will be applying these to more advanced laboratory work and to design activities. They will continue to develop their independent learning and communication skills and their ability to work in teams. At this stage students will follow one of three electives that will introduce a few more advanced topics in the area of interest to their future study and career.

**Year 3:** 25% of the study in Year 3 (30 credits) is an individual investigative project, undertaken over two semesters, in which students can demonstrate the full range of personal, communication and academic skills they have developed during the degree. It is assessed at the end of Year 3 through a report, the professional engineering skills displayed by the student during the project, and an oral and poster presentation at which students are questioned on their research by a panel of academic staff and industrialists. This assessment enables the student to demonstrate the level of their professional development as an aerospace engineer. The remaining modules consolidate the student’s knowledge in aerospace-specific topics and allow them to study their chosen elective in greater depth. At this level students are exposed to engineering management techniques that can be used to enhance the application of their core engineering skills. By this stage they are expected to have become self-motivated, efficient and organised independent learners. Students also gain experience of flight instrumentation by attending a flight laboratory course conducted by staff from Cranfield University. This involves flight exercises aboard a Jetstream aircraft and briefing sessions on flight mechanics.

**On successful completion of the programme:** Students have obtained the necessary academic qualification and practical engineering applications experience at BEng (Hons) level to become a Chartered Engineer. Full Chartered Engineer status requires the completion of approved further learning following graduation, and experience working as a graduate engineer. Students will be well prepared for a career in aerospace engineering, other engineering sectors, the aviation/commercial airline industry and also a wide range of other graduate careers. They will be able to assess whether or not they have the ability, motivation and interest to pursue postgraduate training in aerospace, or other engineering disciplines.

22. **Criteria for admission to the programme**

Detailed information regarding admission to the degree is available at [http://www.sheffield.ac.uk/aerospace/prospectiveug/entry](http://www.sheffield.ac.uk/aerospace/prospectiveug/entry)

Aerospace Engineering at Sheffield is suitable for well-qualified and motivated students. The admissions procedure is aimed at ensuring all new students meet the requirements for successful completion regardless of their educational or other background.

Applicants typically have A-levels in Mathematics and Physics, plus one other subject. Other equivalent qualifications are also acceptable. These include some VCE A-levels and BTEC qualifications, Scottish Advanced Highers, Irish Leaving Certificate and a range of overseas diplomas and certificates.

All applicants require an English language qualification, typically GCSE or IELTS, with a result at an appropriate level.

For applicants who have not taken Mathematics and Physics the University offers a Foundation Year in Engineering.

Direct entry into the second year of the degree may be possible with suitable qualifications, such as a good BTEC HND in aerospace engineering.
Aerospace Engineering at Sheffield has an academic Director of Undergraduate Studies, who is responsible for overseeing the degree, and an administrative team who deal with its day-to-day running. They are all available to provide general help and advice on all aspects of the degree and university life. Every student has a Personal Tutor who is an academic member of the staff in one of the engineering departments participating in the degree, and who acts as a professional mentor to guide, help and support the student. This includes advising on module choices, career decisions and providing references. Students also have the opportunity during tutorials to develop their professional skills by writing a short report or giving a presentation on a topic of their choice. Students see their Personal Tutor at least once fortnightly in the first year, at least three times a semester in Year 2, and at least one a fortnight in Year 3. Attendance at tutorials is compulsory and monitored.

Students gain part of their practical experience through: (1) practical hands-on workshop practice experience – this is a requirement for accreditation; (2) a short course in engineering drawing and computer-aided design (both 1) and 2) are taught as part of the first-year ‘Introduction to Aerospace Design’ module); (3) a flight laboratory course, which is also a requirement for accreditation, which provides flight exercises in a Jetstream aircraft and classes on flight mechanics.

Students with satisfactory academic performance can apply to study abroad for an academic year or just one semester in Year 2 at one of our exchange partner universities in Australia, Canada, Hong Kong, Singapore, the USA, or in Europe. The time spent abroad does not increase the length of the degree, but instead a student is awarded credit for the modules taken at the overseas university, in place of the study they would have completed if they had remained in Sheffield.

The University and the Faculty of Engineering place strong emphasis on ensuring our graduates have all the attributes necessary for success in their chosen career. Students are assisted in their self-development and continuing professional development through activities embedded throughout the entire degree, including personal tutorials, the ‘Global Engineering Challenge’ and the ‘Engineering – You’re Hired’ project, and via various taught modules. Students benefit from wide ranging individual support and guidance to assist them in securing industrial placements and jobs. This includes Careers events specifically for final and penultimate year Aerospace Engineering students, which provide career inspiration and guidance, and enable our students to meet potential employers, and to refine their CVs and understanding of how to succeed in the application process. This reinforces the careers support available throughout the degree from the University’s Careers Service (http://www.shef.ac.uk/careers/students). This support continues after students have graduated.

We maintain strong links with our graduates who provide input into our courses and provide practical help to students in preparing for employment.

Further details about Aerospace Engineering, including student profiles and the latest news from our students and staff, can be found at http://www.shef.ac.uk/aerospace/

This specification represents a concise statement about the main features of the programme and should be considered alongside other sources of information provided by the teaching department(s) and the University. In addition to programme specific information, further information about studying at The University of Sheffield can be accessed via our Student Services web site at http://www.shef.ac.uk/ssid