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**	Mechanical Engineering
2	**Programme Code**	MECU001
3	**JACS Code**	H300
4	**Level of Study**	Undergraduate
5a	**Final Qualification**	Master of Engineering (MEng)
5b	**QAA FHEQ Level**	Masters
6	**Intermediate Qualification(s)**	Bachelor of Engineering (BEng) for students transferring their registration in years 1 and 2 (see separate programme specification for MECU002)
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Engineering
9	**Department**	Mechanical Engineering
10	**Other Department(s) involved in teaching the programme**	Core modules: Electronic and Electrical Engineering, Management School, Materials Science and Engineering, Mathematics and Statistics Optional modules: Automatic Control and Systems Engineering, Chemical and Biological Engineering, Electronic and Electrical Engineering, Materials Science and Engineering, Mathematics and Statistics, Modern Language Teaching Centre, Computer Science, Department of Infection, Immunity & Cardiovascular Disease
11	**Mode(s) of Attendance**	Full-time
12	**Duration of the Programme**	4 years
13	**Accrediting Professional or Statutory Body**	Institution of Mechanical Engineers
14	**Date of production/revision**	March 2021

15. Background to the programme and subject area

Professional mechanical engineers are concerned with the design, development, production and marketing of all kinds of artefacts that improve and support our way of life. They are creative people and synthesize information, solve problems and innovate. A career in mechanical engineering can involve graduates in any stage of the conception, design, production, finance and marketing of all manufactured goods - from the largest power station, aeroplane, space craft and car plant to delicate mechanisms required for scientific instruments, heart valves or micro-surgery. Graduate mechanical engineers can end up working for a small to medium sized company, or a larger employer such as BAE Systems, Rolls Royce Plc, Jaguar Landrover or ICI. They can also work independently, begin their own business, or work in a variety of employment where innovation and numeracy are required, or become established in research.

At Sheffield we aim to provide the academic qualifications and practical engineering applications experience for students wishing to enter the mechanical engineering profession, without specialising in any particular aspect of mechanical engineering in their first degree. The MEng degree in Mechanical Engineering fully satisfies the academic and practical requirements for the award of Chartered Engineer Status and is accredited by the Institution of Mechanical Engineers. The programme will equip graduates to enter and succeed in a wide range of careers, both within mechanical engineering and more generally, and to meet the challenges of working within an ever-changing discipline.

Providing that they have a suitable qualification in the relevant European language (normally GCSE A or A*), students may take the opportunity to learn, or develop their skills in a European language during their first year.

Should this opportunity be taken, then it is possible to transfer at the end of the first year onto the related courses MEng Mechanical Engineering with French, or German, or Italian, or Spanish where the third year is spent at a leading European engineering university.

Further information about the programme may be found at http://www.shef.ac.uk/mecheng/

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 using staff working at the frontiers of academic enquiry. The Department of Mechanical Engineering implements this through its strong commitment to both teaching and research. It also aims to engender in its students a commitment to future self-learning and social responsibility.

The overall aim of the programme is to admit intelligent and motivated students and in a research-led environment to create graduates who will become the future leaders and 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 mechanical engineering together with a more detailed and critical understanding in selected areas of mechanical engineering;

3. developing in students an independence of thought, intellectual curiosity and critical approach to evidence, theories and concepts;

4. nurturing in students their powers of creativity, innovation and leadership;

5. developing in students a range of subject-specific and generic skills appropriate to graduate employment both within and outside mechanical engineering;

6. developing the social and business skills and ethical awareness necessary for a professional engineer;

7. enabling students to maximise their potential in all aspects of their programme;

8. assessing students over a range of skills and identifying and supporting academic excellence;

9. imparting in students a commitment to life-long learning;

10. engendering a versatile and enterprising ethos to prepare students for postgraduate work and a career in mechanical engineering;

11. enabling students to become Chartered Engineers, post-graduation, by meeting the latest accreditation requirements of the Engineering Council UK Spec (UK Standard for Professional Engineering Competence) and IMechE.

17. Programme learning outcomes

Knowledge and understanding: By graduation students will have:	
K1	a broad knowledge and understanding of the concepts, theories and principles of mechanical engineering science;
K2	a broad knowledge and understanding of the mathematics necessary for the application of mechanical engineering science;
K3	advanced knowledge and critical understanding in selected areas of mechanical engineering;
K4	developed an understanding of the social and ethical awareness necessary for a professional engineer;
K5	an understanding of the analytical and design methods used in mechanical engineering;
K6	a broad knowledge and understanding of management techniques and issues used in mechanical engineering;
K7	an understanding of the use of information technology for analysis, design and management.

Intellectual abilities: By graduation students will be able to:	
I1	use mechanical engineering science, mathematics and information technology to analyse engineering problems;
I2	demonstrate skills in the acquisition, analysis, use and critical evaluation of experimental and other subject-related information;
I3	produce designs in a professional manner, both individually and in a collaborative team, taking account of technical, environmental, ethical, and commercial considerations;
I4	display creativity and innovation in solving unfamiliar problems;
I5	exercise independent thought and judgement;
I6	conduct a technical investigation;
I7	draw on fundamental knowledge of mechanical engineering to investigate new and emerging technologies and applications.

Practical Skills: By graduation students will be able to:	
P1	safely conduct experimental investigations;
P2	prepare technical sketches and drawings, using hand or computer methods as appropriate;
P3	write computer programmes to solve engineering problems;
P4	use commercial computer software for analysis and design;
P5	safely use equipment and processes to make products and prototypes from a range of engineering materials relevant to a mechanical engineer.

General transferable skills: By graduation students will be able to:	
G1	use Information Technology effectively;
G2	communicate at a professional level, orally, in writing, and through visual presentations;
G3	work in collaboration with others;
G4	manage their time effectively;
G5	find information and learn independently;
G6	Appreciate the way in which an engineering company operates;
G7	prepare technical reports and presentations.

18. Teaching, learning and assessment

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

The following are the main teaching and learning methods used:

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.

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.

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

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.

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 often included as part of coursework assignments to provide opportunities for developing essential presentation and communication skills.

Group Design Project - This is undertaken in year 3 and involves groups of typically 6 students working on a design. It enables students to demonstrate their academic and design skills obtained during the first 2½ years of the course. Additionally, it develops project-management, time-management, team-working and communication skills.

Individual Investigative Project - This is undertaken in year 4 and is an individual research and/or industrial project at the frontiers of mechanical engineering. It is done under the supervision of a member of staff and provides an excellent opportunity for the student to pull together every aspect of their development during the programme.

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

The following are the main assessment methods used:

Written Examinations - can be 1.5 - 3 hours in duration, depending on module size and the presence of complementary assessment methods. Some modules use examinations as the only or major assessment method.

Coursework Assignments, Oral and Poster Presentations - coursework assignments are widely used in design studies, computational work, 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 as an alternative to more formal examinations.

Group Design Project - This is a major group design project undertaken in year 3. It is assessed by a group report containing a joint chapter covering the overall design and individual chapters on specific elements of the design. The group also make oral and poster presentations to a student audience and a panel of staff and respond to questioning from staff. It is expected to be at a professional level.

Individual Investigative Project - This is the final and largest individual project on the programme and is undertaken in year 4. The project is assessed on the student's commitment and progress throughout the project, the written report, an oral presentation to a panel of staff and the response to questions from the panel. It 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.

	TEACHING / LEARNING								ASSESSMENT				
LEARNING OUTCOME (abbreviated - see Section 17 for full text) Items shown thus (·) are included depending on the nature of the project	Lectures	Laboratory classes	Coursework assignments, oral and poster presentations	Tutorials / examples classes	Design classes	Group design project	Individual project		Written examinations	Coursework assignments, oral and poster presentations	Class tests	Group design project	Individual project
K1 Broad understanding	·	·	·	·	·	·	·		·	·	·	·	·
K2 Mathematics	·			·		(·)	(·)		·	·	·	(·)	(·)
K3 Critical knowledge	·		·	·		(·)	·		·	·		(·)	·
K4 Professional responsibility	·		·	·		(·)	(·)		·	·		(·)	(·)
K5 Analytical/ design methods	·		·	·	·	·	(·)		·	·		·	(·)
K6 Management techniques	·		·	·		(·)	(·)		·	·	·	(·)	(·)
K7 Information Technology	·	·	·		·	(·)	(·)			·		(·)	(·)
I1 Analyse problems	·	·	·	·	·	·	·		·	·	·	·	·
I2 Acquisition / Evaluation of data	·	·	·	·	·	·	·			·		·	·
I3 Produce designs	·		·		·	·	(·)			·		·	(·)
I4 Display creativity and innovation					·	·	·			·		·	·
I5 Exercise independent thought			·		·	·	·			·		·	·
I6 Conduct technical investigation							·						·
P1 Conduct experiments		·					(·)			·			(·)
P2 Prepare sketches / drawings	·		·		·	(·)	(·)			·		(·)	(·)
P3 Write computer programs	·	·	·			(·)	(·)			·		(·)	(·)
P4 Use commercial software		·	·		·	(·)	(·)			·		(·)	(·)
P5 Engineering applications	·	·	·		·					·	·		
P6 Prepare technical reports	·	·	·	·		·	·			·		·	·
G1 Use IT effectively	·	·	·			·	·			·		·	·
G2 Communicate effectively	·		·	·	·	·	·		·	·		·	·
G3 Collaborate in teams		·		·	·	·				·		·	
G4 Manage time efficiently	·	·		·		·	·					·	·
G5 Learn independently			·			·	·			·		·	·

G6 Appreciation of the operation of an engineering company	·		·	·	·	·	(·)		·	·	·	(·)	(·)

The weightings at each Year towards the overall classification of the degree are

Year 1 0

Year 2 20%

Year 3 40%

Year 4 40%

19. Reference points

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

Subject Benchmark Statements
https://www.qaa.ac.uk/quality-code/subject-benchmark-statements

Framework for Higher Education Qualifications (2014)
https://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf

University Vision
https://www.sheffield.ac.uk/vision

Learning and Teaching Strategy (2016-21)
https://www.sheffield.ac.uk/polopoly_fs/1.661828!/file/FinalStrategy.pdf

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

20. Programme structure and regulations

The programme structure is modular and at each year students study modules worth a total of 120 credits. During the first 2½ years students follow a core syllabus aimed at developing the essential skills and knowledge in the fundamentals of mechanical engineering, mathematics and management required of a professional mechanical engineer. In the final 1½ years students can choose from a wide range of advanced modules which enables them to follow their areas of particular interest and to prepare them for their initial career.

In year 1 students undertake four 20 and four 10 credit modules which aim to consolidate mathematical and scientific knowledge while introducing the fundamentals of mechanical engineering. We also aim to develop the enthusiasm of the student for engineering. Year 1 is primarily aimed at bringing all students to a common base-line of knowledge and skills, irrespective of their differing backgrounds and so does not contribute to the final degree grade. All students also undertake a 0 credit module in practical Engineering Applications, covering basic workshop skills that is a crucial part of the accreditation of the Institution of Mechanical Engineers. Additionally, all students attend the Skills Weeks, which include training in Engineering Drawing and Computer Aided Design. The Global Engineering Challenge is a week-long project, in which all first year students in the Engineering Faculty tackle real-world problems from global perspective. This challenges the students to think about not only the technical issues in engineering developments, but also the social, ethical and environmental implications of decisions made. In year 1 students with a GCSE Grade A or A* in the relevant language can also opt to study 20 credits of French, German, Italian or Spanish at an appropriate standard. This is done by replacing a specified 20 credit module by the two 10 credit language modules. At the end of year 1 such students' may be able to transfer onto the related courses MEng Mechanical Engineering with French, or German, or Italian, or Spanish where the third year is spent at a leading European university.

In year 2 students undertake five 10 credit modules which aim to develop the fundamentals of mechanical engineering, and a further two 10 credit modules with an emphasis on the application to real engineering components. Two 10 credit mathematics modules are taken to continue the development of essential skills but these now concentrate on modelling and computational aspects. Two 10 credit management modules introduce fundamental aspects of engineering management and business skills, and an electric circuits module contributes with 10 more credits. Students also take part in the Faculty-wide Engineering - You're Hired Week which is designed to develop student academic, transferable and employability skills. Working in teams, students deal with a real world problem over an intensive week-long project. The projects are based on problems provided by industrial partners, and students will come up with ideas to solve them and proposals for a project to develop these ideas further.

In year 3 students undertake six 10 credit modules aimed at completing the essential education required of a professional mechanical engineer. The modules include the integration of modules in the major mechanical engineering subject areas, design, management and manufacturing. In the second semester students undertake a 20 credit group design project, typically in groups of 6 students. Students must also choose 10 or 20 credits of modules aimed at developing their Finite Element or Computational Fluid Dynamics skills. The student can choose the other two or three 10 credit modules from a choice of 6 modules. These are chosen to reflect the individual student's interests, and to prepare for year 4 modules and their initial career. Advice to students is specifically available from their Personal Tutor and the 3rd Year Tutor, although many students seek advice from other members of staff.

In year 4 students undertake a 45 credit individual investigative project, and one 15 credit core module which supports the personal development and self-management of students, provides a platform for preparing for professional practice, and challenges students to consider the responsibilities of practicing engineers and global citizens. The other half of Year 4's content comprises four 15 credit optional modules. The investigative project is supervised by a member of staff and is usually related to established research work or an industrial problem. It is undertaken over both semesters and provides the student with an excellent opportunity to consolidate the skills and knowledge learnt on the programme during a major piece of individual work. The four 15 credit modules are chosen from a selection of about 30 modules which are at Masters level (F7 level as defined in the framework for Higher Education Qualifications). The choice of modules again reflects the individual student's interests and career choice. Advice from staff on the choice of modules is available.

During years 1 and 2 students may transfer their registration to study for a three year BEng in Mechanical Engineering. At the end of year 2, students not meeting specified progression targets will be required to transfer their registration similarly. In years 3, changes of registration are not generally allowed. In Year 4, changes in registration are not allowed.

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 https://www.sheffield.ac.uk/calendar/regs

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 mechanical engineering. They will be able to apply these to analyse standard problems in mechanical engineering across a range of disciplines. They will undertake laboratory work and will be able to evaluate and interpret data, and present the results in a clear and reliable manner. They will also undertake design activities, both individually and in small groups, which require conceptual thinking, simple analysis, logical thought, judgment and the clear presentation of their ideas. They will develop their independent learning skills and their team-working skills. They will also undertake a practical workshop course as part of the accreditation by the IMechE.

Year 2 - Students will have a more extensive knowledge and understanding of the main areas of mechanical engineering and also in the appropriate areas of mathematics. They will be applying these to more advanced problems, design activities and laboratory work. They will continue to develop their independent learning, communication skills and their ability to work in teams. They will also be introduced to the business skills required of an engineer.

Year 3 - In the first half of year 3 students will complete the general education required of a professional mechanical engineer in the main mechanical engineering areas, design, management and manufacturing. By this stage, students are expected to have become self-motivated, efficient and organised independent learners. In the second half of year 3 students will be choosing the areas of mechanical engineering, including related management topics and computational modelling and validation, which will prepare them for their final year of study and their initial careers. They will undertake a group design project which enables them to demonstrate their mechanical engineering knowledge, design abilities and also their inter-personal and communication skills.

Year 4 - Just over one third of year 4 (45 credits) is an individual investigative project where students can demonstrate the full range of personal, communication and academic skills met within the programme. It is assessed at the end of year 4 through a report, an oral presentation and a viva to a panel of staff with other students also present. This assessment enables the student to demonstrate the overall professional level achieved at the end of the programme. The taught modules chosen reflect the interests and career aspirations of the individual student as well as considering the ethical, social, environmental and legal issues which are the responsibility of a professional engineer. These modules are at Masters level and are often at the leading edge

of the subject.

On successful completion of the programme - Students will have obtained the necessary academic qualification and practical engineering applications qualification for becoming a Chartered Mechanical Engineer. Full Chartered Engineer status will require appropriate experience working as a graduate engineer. Students will be well prepared for a career in mechanical engineering and also a wide range of other graduate careers. They will be able to assess whether they have the ability, motivation and interest to pursue postgraduate training in mechanical engineering.

22. Criteria for admission to the programme

Detailed information regarding admission to the programme is available at http://www.shef.ac.uk/study/

The programme is suitable for well-qualified and motivated students. The admissions procedure is aimed at ensuring students taken onto the course meet the requirements for successful completion regardless of the applicant's educational or other background.

Typically, applicants are expected to have A-levels in mathematics, and in a laboratory based science or design and technology. 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 a GCSE or an IELTS test.

For applicants wishing to pursue the course but who do not have the appropriate subjects the University offers a Foundation Year in Engineering.

Direct entry into the second year of the programme may be possible with suitable qualifications. These include a good BTEC HND in suitable subjects, or a diploma in mechanical engineering.

23. Additional information

Every student has a Personal Tutor who is a member of staff in the department. Students first meet their Personal Tutor in Intro Week. They see them twice per week during year 1 as they also act as academic tutor for a group of five students for the main mechanical subjects. During year 2 students meet their Personal Tutor three times per semester and in year 3 students meet their Personal Tutor twice per semester. In year 4 the arrangements are up to the individual student, however, their Personal Tutor and their Individual Project Supervisor can be a great help, for example, in advising on module choices, career decisions and providing references. The Personal Tutor is available to provide general help and advice on all aspects of university life.

The practical workshop Engineering Applications course in year 1 provides exemption from the IMechE of this requirement for becoming a Chartered Professional Engineer. The course is included within the term dates and incurs no additional cost to the student. Previous suitable experience may allow partial exemption from elements of the Engineering Applications course.

To assist students in their self-development and continuing professional development the department has introduced a system of Personal Development Planning. This forms the initial basis of the continuing professional development scheme required by the IMechE to record the progress of graduates aiming to become Chartered Engineers.

Further details about the department, courses offered and admission procedures can be found at the departmental Web site http://www.shef.ac.uk/mecheng/

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/