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 Manufacture
2	**Programme Code**	AMRU08
3	**JACS Code**	H700
4	**Level of Study**	Undergraduate
5a	**Final Qualification**	BEng
5b	**FHEQ Level**	6
6	**Intermediate Qualifications**	Foundation Degree
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Engineering
9	**Department**	AMRC
10	**Other Departments involved in teaching the programme**	Management School – Professional Development for Engineers MG142 10 credits
11	**Mode of Attendance**	Full-time
12	**Duration of the Programme**	3 years
13	**Accrediting Professional or Statutory Body**	IMechE
14	**Date of production/revision**	March 2018

15. Background to the programme and subject area

The Bachelor's Degree in Mechanical Manufacture will be offered to students (via their employers) as the technical element of a degree apprenticeship. Degree apprenticeships offer an apprentice the opportunity to combine working while studying for a work-based academic or vocational high-level qualification.

These apprenticeships include the achievement of academic and vocational qualifications and learning from Level 4 upwards. Degree apprenticeships:

- are the latest model to be developed as part of higher apprenticeship standards, with apprentices achieving a full bachelor's or master's degree as a core component of the apprenticeship;
- combine both higher and vocational education and fully test both the wider occupational competence and academic learning, either using a fully-integrated degree co-designed by employers and Higher Education Institutions, or using a degree plus separate end test of professional competence.

This programme has been developed with employers and with reference to the Apprentice Standards which are developed by employer groups (known as 'trailblazers') and approved by Government.

It has been designed as a progression route for Advanced Apprentices (in work in local engineering and manufacturing firms), for Degree Apprentices either with significant experience or as new employees, and aims to provide the specialist knowledge and skills to complement the professional competence that the apprentices will be required to demonstrate.

The Bachelor's Degree in Mechanical Manufacture applies the principles of engineering, physics and materials science to the design, analysis, and resolution of engineering problems examining the manufacturing processes through which raw materials are transformed into final products.

Students on the programme will be working in a variety of organisations from power systems providers; stainless steel and specialist alloy materials producers; manufacturers of mechanical products, components and magnets, as well as engineering design consultancies. Students will be working for original equipment manufacturers and the many companies along their supply chains.

Student will develop the range of skills, knowledge and practical application needed to work towards Incorporated Engineer registration within a range of engineering contexts.

In addition to the vocational emphasis of the programme, students will also benefit from the AMRC's research activity, which informs its teaching. The AMRC lecturers are active researchers solving real-life industrial problems in a variety of disciplines from design, tooling, factory layouts and manufacturing systems, machining and material selection. Their knowledge is up-to-date and includes relevant, current case studies.

16. Programme aims

The University's Mission is to educate others and ourselves and to learn through doing so, as a civic institution proud of its urban character, driving growth and vibrancy for the city, the region, and the globe. Our vision is research, teaching and learning together create a positive culture of higher education.

The AMRC implements this through a strong commitment to local industry, with a large number of employers both within Sheffield and the region working with the AMRC to address the engineering skills gap by training and educating Advanced, Higher and Degree Apprentices. The AMRC has a strong commitment to both teaching and research and works to create and stimulate a commitment to self-learning and development in its students.

The aims of the Bachelor's Degree in Mechanical Manufacture are to:

1. Provide access to a bachelor's degree in mechanical manufacture to degree apprentice students from a range of academic, social and employer backgrounds;
2. Produce Mechanical Manufacture engineering graduates who are equipped with the technical and scientific knowledge, understanding and skills appropriate to graduate roles in their organisations, developing students within their professional working career;
3. Develop in students an independence of thought, intellectual curiosity and critical approach to evidence, theories and concepts and their application;
4. Develop in students a range of subject specific and generic skills appropriate to their employment;
5. Develop in students the social, commercial and ethical awareness for a professional engineer;
6. Enabling students to maximise their potential throughout the programme;
7. Assess a range of student skills, identify and support academic excellence and their application to work-based situations;
8. Develop interpersonal, problem solving and transferable skills appropriate to an engineer;
9. Develop students' appreciation of the wider engineering context, including the social, business and commercial considerations necessary for a professional engineer;
10. Engender attitudes and provide skills which will promote lifelong learning;
11. Prepare students for Incorporated Engineer status, post-graduate work and their career in mechanical manufacture.

17. Programme learning outcomes

Knowledge and Understanding	
Students will have a knowledge and understanding of the:	
K1	the concepts, theories and principles of mechanical manufacturing;
K2	mathematics necessary to apply engineering science to mechanical manufacture;
K3	analytical and design methods used in engineering;
K4	use of information technology for analysis, design and simulation/modelling;
K5	operation of the mechanical manufacturing engineering industry, including business practice, quality and project management;
K6	professional responsibility of mechanical manufacture engineers and the influence of social, environmental, ethical, economic and commercial considerations on their activities.

Skills and other attributes	
Intellectual Skills - Students will be able to:	
I1	use engineering science, mathematics and, where appropriate, information technology to analyse engineering problems;
I2	acquire, analyse and interpret experimental and other numerical data;
I3	carry out a health and safety risk assessment and devise a safe system of working;
I4	exercise independent thought and judgement;
I5	solve unfamiliar problems using creativity and innovation.

Practical Skills - Students will be able to:	
P1	use appropriate mathematical methods for modelling and analysing mechanical manufacturing problems;
P2	conduct experimental laboratory work and analyse the results;
P3	use IT tools for design, computational and analytical purposes;
P4	produce designs in a professional manner, taking account of social, environmental, practical and commercial considerations;
P5	design systems, components or processes and test design ideas in the laboratory or through simulation;
P6	use commercial software for analysis and design;
P7	prepare technical reports and presentations.

Transferable Skills - Students will be able to:	
T1	use information technology effectively;
T2	communicate effectively, orally and in writing;
T3	collaborate with others in teams;
T4	manage their time efficiently;
T5	find information and learn independently;
T6	solve problems logically;
T7	scope out and manage a work-based project.

18. Teaching, learning and assessment

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

Students will be trained on practical skills at the AMRC Training Centre including machining and tooling, material handling and health and safety, which will support the practical learning outcomes throughout the course.

All of the students taking this course of study will be in full time employment with an engineering employer. The professional skills developed during the students' employment, e.g. operation of manufacturing processes, professional conduct and social responsibility, report writing, team work and communication are expected to support many of the learning outcomes assessed through the course. Where specific opportunities arise for students to develop their learning based on their employment, job related skills will be embedded into the module design. Where students are working in the areas of industry which are studied in the course, students will be actively encouraged to contribute knowledge and experience from their employment to enrich group learning, for example by bringing videos, examples of products or practical engineering projects.

The main teaching, learning and assessment methods adopted for each learning outcome are shown below. In most cases a combination of methods is used.

The blended learning pedagogical model will be adopted where appropriate, with instructional content provided for independent study time so that contact time can be used for exercises, problem cases and discussion.

Independent study is relevant to all modules and is intended to be used by students to watch pre-recorded lectures, with quizzes, available on-line through computers, laptops and tablets; read chapters from nominated

textbooks and other material; prepare for contact time i.e. tutorials, problem classes, seminars; and develop coursework to improve the understanding of presented topics during the classes.

Lectures (whether during contact time or recorded) are the principal means of imparting knowledge. They will be pre-recorded for independent study or captured by My Echo and made available on-line through computers, laptops and tablets.

Tutorials will be used to briefly and formatively assess independent study (the instructional content from lecture captures, case study examples and reading material). The main aim of tutorials is to explore topics in more detail either through structured discussion or case studies.

Problem solving classes will provide time for students to identify specific and problems, difficulties and solutions, to develop their confidence and competence in problem solving. Students will also be given more complex problems to solve in small groups or individually, with lecturer support.

Laboratory classes provide opportunities for students to practice and develop a range of discipline-based techniques; apply and investigate theoretical and conceptual knowledge; develop experimental techniques and approaches, analysing, interpreting and presenting their findings and data; developing personal and transferable skills such as problem solving, team working, following protocols and working safely.

Design classes enable students to practice design methods and to offer a design solution relevant to their workplace. The students will test their creativity, problem solving skills and will utilise team working, communication and presentation skills. Tackling a design challenge within their own organisation will also test students' commercial awareness.

In addition to planned teaching and learning activities, students are also expected to learn through the preparation of coursework assignments and other assessment activities which generally require students to seek additional information and work on their own, or in small groups, to develop understanding of the subject matter.

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

Knowledge and understanding are primarily assessed through written examinations and coursework, which includes oral presentations and written reports.

Written examinations – unseen examinations.

Coursework submission – designed to test knowledge and communication skills; these include design studies, computing assignments, and laboratory reports.

Oral presentations – these take the form of individual oral presentations or group presentations in which each group member plays a part.

LEARNING OUTCOME (abbreviated - see Section 17 for full text)	Teaching/Learning							Assessment					
	Lectures	Tutorials, problem solving class	Laboratory practicals	Computing classes	Design classes	Coursework, presentations	Tutorials with personal tutor	Formal unseen examination	Laboratory reports	Coursework and presentations	Design portfolio	Project work	Presentations
K1 Fundamental principles	·	·	·			·	·	·	·	·			
K2 Mathematics	·	·				·	·	·		·			
K3 Analytical / design methods	·	·				·	·				·	·	·
K4 Information technology	·	·		·		·	·		·	·	·	·	·

K5 Industry / business	·	·			·	·	·			·	·	·	·	
K6 Professional responsibility	·	·			·	·	·	·			·	·	·	
I1 Analyse problems		·	·	·		·	·	·	·	·	·	·	·	
I2 Analyse / interpret data		·	·	·		·	·	·	·	·			·	
I3 Carry out risk assessment			·			·			·	·				
I4 Independent thought		·	·	·		·	·		·	·	·	·	·	
I5 Creativity		·			·						·	·	·	
P1 Use mathematical methods		·	·	·	·	·	·	·	·	·	·			
P2 Labs			·		·	·	·		·	·	·	·	·	
P3 IT			·	·					·	·				
P4 produce designs				·	·	·	·		·	·	·	·	·	
P5 Use IT and software				·	·	·	·		·	·	·	·	·	
P6 Commercial software				·	·	·	·				·	·	·	
P7 Technical reports					·	·	·			·	·	·	·	
T1 Use IT effectively				·	·	·			·	·	·	·	·	
T2 Communicate effectively		·			·	·	·	·	·	·	·	·	·	
T3 Collaborate in teams		·				·						·		
T4 Manage time efficiently	·	·	·			·	·	·			·	·	·	
T5 Learn independently	·	·	·			·	·			·	·	·	·	
T6 Solve problems logically		·	·	·	·	·	·	·	·	·	·	·	·	
T7 Scope out project	·	·				·	·			·	·	·	·	

19. Reference points

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

Subject Benchmark Statements
http://www.qaa.ac.uk/assuring-standards-and-quality/the-quality-code/subject-benchmark-statements

Framework for Higher Education Qualifications
http://www.qaa.ac.uk/publications

University Strategic Plan
http://www.sheffield.ac.uk/ourplan/

Learning and Teaching Strategy (2016-21)
http://www.sheffield.ac.uk/lets/strategy/lts

Advanced manufacturing engineering apprenticeships
https://www.gov.uk/guidance/advanced-manufacturing-engineering-apprenticeships

Degree apprenticeship standards and frameworks
http://semta.org.uk/careers/higher-apprenticeships

20. Programme structure and regulations

The programme structure is modular and in each year students study modules worth a total of 120 credits.

The first year of the programme is taught through a series of compulsory 20 credit modules and are shared with students registered on the Foundation Degree programmes in Manufacturing Technology and Maintenance Engineering. The core syllabus of six key threads (mathematics; electrical systems, manufacturing systems and materials, mechanical science, design, engineering practice) aim to develop the essential skills and knowledge in the fundamentals of engineering science, mathematics, professional engineering practice and design required of a professional engineer. The common first year also provides students with an opportunity to apply to transfer to either of these programmes at any time up the end of the first year.

The second year continues with compulsory 20 credit modules within the six threads such as Further Mathematics and Computing for Engineering; Engineering Systems and Control; Professional Responsibility and the Engineering Society, which are shared with other degree programmes, a 30 credit Multidisciplinary project. Two 20 credit modules, Engineering Mechanics for Manufacture, and Thermofluid Processes are particular to the Mechanical Manufacture programme. The multidisciplinary design project provides an

opportunity for students to work on a real design project from within their own organisation and to apply knowledge from other areas of the curriculum.

Students will then be ready for the third year which includes mechanics and manufacture of modern materials; wear and lubrication; machine element design and failure analysis; FEA for machine analysis; project management and an industrial project which will be a work-based project (as apprentices the students are in employment) to enable students to apply their knowledge to their own organisation and for employers to realise a return on their investment.

In addition to the vocational emphasis of the programme, students will also benefit from the AMRC's research activity, which informs its teaching. The AMRC lecturers are active researchers solving real-life industrial problems in a variety of disciplines from design, tooling, factory layouts and manufacturing systems, machining and material selection. Their knowledge is up-to-date and includes relevant, current case studies.

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.sheffield.ac.uk/calendar.

21. Student development over the course of study

Level 1 (1st year)	Students will consolidate their mathematical and scientific knowledge and begin their academic introduction to manufacturing processes and materials, professional development for engineers, electrical engineering and instrumentation and design. They will embark on practical experiments and be able to present, interpret and evaluate data. Design will require conceptual thinking, analysis, logical problem solving and presentation of a solution, enabling the development of communication and presentation skills. Students will develop their independent learning skills, team working and time management.
Level 2 (2nd year)	Students will develop a more extensive knowledge and deeper understanding of the principal areas of mechanical manufacture, continuing with the main themes (mathematics, electrical systems, manufacturing and materials, mechanical science, design and engineering practice). Students will apply their knowledge to more advanced problems and a larger interdisciplinary design project.
Level 3 (3rd year)	The third year will continue the engineering practice, mechanical science and manufacturing materials threads in the mechanics and manufacture of modern materials; wear and lubrication; machine element design and failure analysis; finite element analysis for machine analysis; project management; and a 30 credit industrial project which will be work-based in the student's own organisation. Students will develop more extensive specialist knowledge of the principal areas of mechanical manufacture.

22. Criteria for admission to the programme

Students with two good A levels (BB or higher) in Maths and Physics or Design. As the programme will form part of an apprenticeship, students will be accepted with BTEC Level 3 National Diploma (Merit or higher). Students are also required to pass a maths and physics diagnostic test.

23. Additional information

Further information is available at http://www.amrctraining.co.uk/degree-apprenticeships