The University Of Sheffield.

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**	Materials Science and Engineering
2	**Programme Code**	MATU05
3	**JACS Code**	J500
4	**Level of Study**	Undergraduate
5a	**Final Qualification**	Bachelor of Engineering with Honours (BEng Hons)
5b	**QAA FHEQ Level**	Honours
6	**Intermediate Qualification(s)**	None
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Engineering
9	**Department**	Materials Science and Engineering
10	**Other Department(s) involved in teaching the programme**	School of Mathematics and Statistics, Management School, School of Law, Applied Mathematics
11	**Mode(s) of Attendance**	Full-time
12	**Duration of the Programme**	3 years
13	**Accrediting Professional or Statutory Body**	The Engineering Council through the Institute of Materials, Minerals and Mining.
14	**Date of production/revision**	September 2023

15. Background to the programme and subject area

Materials science and engineering involves the in-depth study of the production, processing, properties and applications of man-made materials. This study is underpinned by two central themes:

I. the link between structure (from the atomic scale through nano and micro to the macro scale) and chemical, physical and mechanical properties of materials; and,

II. how control of structure through processing can be used to optimise engineering performance.

Graduates in materials science and engineering typically work at the interface between pure science and engineering. They are involved in the development of new materials, or new technologies for making or enhancing the properties of existing materials. To do this they must determine appropriate design criteria for a particular application and consider how materials with the required properties can be synthesised. The strong research base and significant industrial links of the Department of Materials Science and Engineering at Sheffield mean that both the engineering and pure science aspects of the discipline are strongly represented in our programmes. The modules comprising these programmes give students an understanding of these themes for many different materials, with an emphasis on how they are developed in the context of structural and functional applications in both industry and research. Students on these programmes have opportunities to develop language skills by taking option modules offered by the Modern Languages Teaching Centre.

Our BEng programmes provide an effective, widely accepted route into a management role in industry or research. Our graduates have gone on to successful careers throughout the UK and the international community in materials-producing and materials-using industries, as well as in academia or research institutes.

16. Programme aims

The aims of these programmes are to**:**

1. enable students to develop a sound knowledge and understanding of materials science and engineering informed by the research interests of the staff;

2. develop in students an independence of thought and a critical approach to evidence, theories and concepts, particularly in the context of materials science and engineering;

3. develop in students an appreciation of the competitive aspects of materials and their selection;

4. provide an educational base, which, together with appropriate further study, will satisfy the academic requirements of the Engineering Council for a Chartered Engineer working in either the materials producer or user industries;

5. provide the educational base for a professional career in a manufacturing industry or in a research-based institution;

6. develop in students a variety of generic skills appropriate to a wide range of graduate level employment.

17. Programme learning outcomes

Knowledge and understanding: On successful completion of these programmes, students will have knowledge and understanding of the**:**	
K1	science and engineering of materials from the perspective of both materials producer and user industries.
K2	thermodynamic and kinetic factors that control a material's microstructure, including phase equilibria, diffusion and reaction kinetics.
K3	structure of materials from the atomic to the macro scale, and how these structures affect properties.
K4	factors that affect the key properties of structural or functional components and how these components are used in real applications.
K5	techniques of structural characterisation, including their possible applications, the interpretation of results and potential sources of error.
K6	technologies used during the production and processing of a range of materials and their surfaces.
K7	mathematics necessary to describe the underlying scientific principles of materials production and behaviour in use, and which forms the basis of modelling.
K8	materials selection and the relative merits of different materials.

Skills and other attributes

Intellectual skills: On successful completion of these programmes, students will be able to**:**	
I1	acquire, critically evaluate and use information relating to the properties, processing and use of materials, gathered from a range of sources and presented in various formats.
I2	identify and solve problems within the context of science and engineering.
I3	design and execute experiments in materials processing, property measurement and structural characterisation using a wide range of measuring equipment.
I4	analyse and interpret experimental and other numerical data with an awareness of sources of error and statistical accuracy.
I5	design and organise a substantial piece of individual research.

Practical skills: On successful completion of these programmes, students will be able to**:**	
P1	conduct practical experiments.
P2	effectively convey essential aspects of materials or metal science and engineering via high quality oral, written, numerical, graphical and visual presentations.
P3	produce some materials on a laboratory scale.
P4	Use specific research equipment effectively as part of a substantial item of individual research.

Transferable skills: On successful completion of these programmes, students will be able to**:**	
T1	use information technology for data collection, analysis and the preparation of documents and presentations.
T2	develop and present written, numerical, graphical and visual information effectively.
T3	work individually, collaboratively and in a team.
T4	work to deadlines.
T5	find information and learn independently.

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 formal means of imparting knowledge. Most lecturers provide lecture notes with suggested further reading. Many hand out problem sheets with worked examples to enable students to develop their understanding of the subject matter by independent study. Some sheets are marked and returned to the student; in other cases feedback is provided through discussion in subsequent lectures.

Practical classes – structured laboratory sessions enable students to develop their understanding of experimental design, methods and data interpretation. They provide good opportunities for developing team-working and communication skills, as well as skills in working individually.

Coursework assignments – provide students with opportunities to develop and demonstrate their understanding of the academic content of a module, and their skills in obtaining, using, analysing, interpreting and presenting information. They involve both individual and small group work.

Tutorials/examples classes – may be small group or up to class sized sessions, and are usually led by an academic staff member, who follows a structured programme of exercises. The classes provide students with the opportunity to resolve problems in their understanding of a module's subject matter to practise the application of theoretical concepts, and to integrate the subject matter from different courses.

Group research project – undertaken in Level 3, by groups of two to five students. It requires students to utilise their academic knowledge and understanding of materials industries, and their communication, teamwork, and problem-solving skills, to tackle a small industrial problem.

Individual research project – undertaken in Level 3 under the supervision of an academic staff member (or members). It provides training for research, and is an excellent opportunity for students to pull together every aspect of their development during the programme.

Group Engineering Projects - *The Global Engineering Challenge* - a week-long project for first year students to tackle real-world problems from a global perspective. They will be challenged to think about not only technical issues in engineering developments but also the social, ethical and environmental implications of their decisions. *Engineering - You're Hired!* - a second year project which concentrates on obtaining the skills, and evidence of those skills, that will make students highly employable as engineers.

Independent study (not included in the table on page 5) – vital for the successful completion of these programmes. Students are expected to develop this essential skill from Level 1.

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

Written examinations – typically of 2 or 3 hours duration.

Coursework submissions, laboratory reports, oral presentations – these are used to assess a variety of practical and transferable skills as well as the understanding of a module.

Class tests – these are short tests conducted during the main teaching periods to assess on-going progress and understanding.

Group project report – undertaken in Level 2, this project based on the analysis of a chosen artefact is assessed by a written group report and presentation. An additional group report is made in Level 3 where the students analyse a materials industry system.

Individual project report – this is undertaken in Level 3 and is the final and largest individual project on the programme. The written report, oral presentation, and the student's commitment and progress are all assessed bearing in mind the depth of understanding, the analytical and practical skills, and the knowledge of the subject demonstrated. The final written report and oral presentation (given as a poster) are expected to be to a high standard.

This combination of assessment enables achievement of all the learning outcomes outlined in Section 17 to be demonstrated over the duration of these programmes.

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

LEARNING OUTCOME (abbreviated – see Section 17 for details)	TEACHING/LEARNING								ASSESSMENT						
	Lectures	Practical classes	Coursework assignments	Tutorials/examples classes	Industrial seminars/visits	Group research project	Individual research project		Written examinations	Coursework submissions	Laboratory reports	Oral presentations	Class tests	Group project reports	Individual project reports
K1 Producer/user perspectives	.		.	.	.				.	.				.	
K2 Thermodynamics/kinetics	.	.	.	.					.	.	.		.		
K3 Structure	.	.	.	.					.	.	.		.		
K4 Key properties	.	.	.	.	.	.	.		.	.	.			.	.
K5 Characterisation techniques	.	.	.	.			.		.	.	.	.	.		.
K6 Technologies	.	.	.	.	.				.	.	.				
K7 Mathematics	.			.					.				.		
K8 Materials selection	.	.	.	.	.	.	(.)		.	.	.	.		.	(.)
I1 Use/evaluate information		.	.	.		.	.		.	.	.	.		.	.
I2 Identify/solve problems	.	.	.	.		.	.		.	.	.	.	.	.	.
I3 Design/execute experiments		.				.	.				.	.		.	.
I4 Analyse/interpret data	.	.	.	.		.	.		.	.	.	.	.	.	.
I5 Plan research programme			.			.	.			.		.			.
P1 Conduct experiments		.				.	.				.	.			.
P2 Convey information effectively		.	.	.		.	.		.	.	.	.		.	.

P3 Produce materials		.			.		.				.	.			.
P4 Use research tools		.				.	.			.		.		.	.
T1 Use IT effectively	.	.	.			.	.			.		.		.	.
T2 Communicate effectively			.	.		.	.		.	.	.	.		.	.
T3 Work individually/in teams		.	.			.	.			.		.		.	.
T4 Work to deadlines			.	.		.	.		.	.		.		.	.
T5 Learn independently			.			.	.		.	.		.		.	.

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 and Strategic Plan
https://www.sheffield.ac.uk/vision

The requirements of the Engineering Council, and as used by the Institute of Materials, Minerals and Mining for the accreditation of degree programmes intended for potential Chartered Engineers.

20. Programme structure and regulations

The structure of the programme in Materials Science and Engineering is modular. In each level students study modules worth a total of 120 credits.

In **Levels 1 and 2**, the curriculum emphasis is on introducing the theories and concepts underpinning the selection, production, processing and use of materials. The programmes comprise a balance of 10 and 20 credit modules. Individual courses have associated problem classes, tutorials and practicals. Students have the opportunity to spend Semester 1 of the second year (Level 2) studying at Alfred University in western New York State, USA, on a Departmental exchange. Students enrolled for both the materials and the specialised programmes may also take language in Level 1 as non-credit bearing modules and in level 2 options to the value of 20 credits per year.

In **Level 3**, there is an emphasis in the curriculum on both group project work and a 30-credit individual research project. The modules taken in the final year provide a systematic and quantitative understanding of the competitive aspects of materials and their selection, as well as some specialist knowledge and understanding of a range of materials.

The mark awarded in the final degree is based on the results obtained at **Levels 2 and 3** weighted in the ratio 1:2.

The first two years of this programme and that of the MEng programmes in Materials Science and Engineering or associated specialisms is common. Students registered for a BEng degree can therefore subsequently change their registration to one of the MEng degree programmes in materials or a specialism if good progress is being made **at the end of Level 2**.

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	Students will be introduced to the underlying concepts in materials science and engineering, namely**:** structure from atomic to macro scales; thermodynamics and kinetics; electrical magnetic and optical behaviour; mechanical properties of materials; aspects of materials selection, applications and properties. Practical sessions, demonstrations, works visits, tutorials, and worked examples classes will illustrate these principles and promote skills in measurement, evaluation and interpretation of qualitative and quantitative data for a range of materials. Students will be able to develop and present lines of argument and make sound judgements in accordance with these basic concepts. The course contents have been designed to ensure that all students reach a common level of understanding in Mathematics, Physics and Chemistry even if they do not start with a strong background in one of these areas.
Level 2	Students will build on the materials concepts learned in the first year and continue to expand their mathematical, practical, analytical and presentation skills via lectures, worked examples classes, tutorials and practicals. Materials characterisation will be introduced as a new theme and the links between structure, processing and properties will be developed. Materials selection principles will be extended using the concepts of reverse engineering. Students will develop the ability to apply key concepts and skills in other contexts but will also have an understanding of the limits of their knowledge and how this influences analyses and interpretations based on that knowledge.
Level 3	Students will continue to develop a systematic and quantitative approach to materials science and engineering. This will include acquisition of coherent and detailed knowledge concerning processing, structure and properties for various materials, at least some of which is at, or informed by, the forefront of the discipline. New themes for study will include interfaces and materials in combination such as composites. Students will undertake extended project work. Students' conceptual understanding will enable them to devise and sustain arguments and/or solve problems. They should appreciate the uncertainty, ambiguity and limits of knowledge and be able increasingly to manage their own learning using relevant literature and other media. They will employ their increasing skills and knowledge to undertake an individual research project, demonstrating that they can**:** carry out independent, original research; critically evaluate their own and others' results; and propose new hypotheses.
On successful completion of the programmes in Materials Science and Engineering: Students will have obtained the necessary academic understanding to become a Chartered Engineer in Materials. Full Chartered Engineer status will require appropriate additional experience working as a graduate engineer. Students will be well prepared for a career in materials engineering or one of its associated specialisms, either in research and development or in production, as well as a wide range of other graduate careers. They will be able to assess whether they have the need, ability, motivation and interest to pursue postgraduate training in materials science and engineering or one of its associated subjects.	

22. Criteria for admission to the programme

Applicants should have a strong background in two of Maths, Physics and Chemistry in GCE A levels or equivalent, with some knowledge, at least to GCSE level, of the third. A wide range of alternative qualifications is listed in the On-Line prospectus. The Materials Science and Engineering with a Foundation Level programme (MATU99) can provide a possible entry point to these programmes for students without this scientific background.

Students must also satisfy the general University matriculation requirements, including an acceptable English language qualification such as a minimum of grade C/4; IELTS grade of 6.5 with a minimum of 6.0 in each component; or an alternative acceptable English language qualification.

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

23. Additional information

Our close industrial ties facilitate optional industrial visits in Level 1 and joint final year projects. Our industrial visits form part of a Skills Week in Semester 1 of Year 1 that is also designed to demonstrate possible career directions and to develop transferable skills such as group project work and IT. Small bursaries may be available for industry-sponsored final year projects or summer placements.

Students are encouraged to spend at least one vacation working in industry. Some help is offered in finding placements.

Further details can be found on the Department's website, at**:** http://www.shef.ac.uk/materials/.

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.