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

Programme Details

1. Programme title	Chemical Engineering with an Industrial Placement Year
2. Programme code	CMBU009 / CPEU40
3. QAA FHEQ level	Masters - 7
4. Faculty	Engineering
5. School	Chemical, Materials and Biological Engineering
6. Other Schools providing credit bearing modules for the programme	Mathematical and Physical Sciences, Electrical and Electronic Engineering
7. Accrediting Professional or Statutory Body	IChemE
8. Date of production/revision	March 2023

Awards	Type of award	Duration
9. Final award	MEng	5 years
10. Intermediate awards	BEng - exit award	3 years
	BEng with an Industrial Placement Year – exit award	4 years

Programme Codes

11. JACS code(s) *Select between one and three codes from the HESA website.*	H810		
12. HECoS code(s) *Select between one and three codes from the HECoS vocabulary.*	100143		

Programme Delivery

13. Mode of study	Full-time
14. Mode of delivery	Face to face

15. Background to the programme and subject area

Chemical engineering is concerned with the application of science to the design, construction and operation of processes in which materials undergo changes. The applications of these changes are necessary for the production of commodities essential to our everyday life. These include food and drink, pharmaceuticals, fertilisers, man-made fibres, plastics, fuels and energy. Manufacturing activities require processes that provide the efficient and safe conversion of raw materials into useful products. This should be achieved at the lowest possible cost, with minimum energy consumption whilst ensuring safe operation and minimum impact on the environment. Chemical Engineers are involved in developing new processes, both chemical and biological, for synthesising new products and optimising the performance of existing process systems. Qualified Chemical Engineers can choose from a wide variety of career opportunities including plant management, research, commissioning, process safety, environmental protection, process control, consultancy or marketing and sales.

Students choosing to study this subject at the University of Sheffield are provided with a thorough understanding of chemical engineering by combining theoretical aspects of the discipline with hands-on practical experience. The programme also provides the first part of the academic qualifications for students wanting to enter the chemical engineering profession and progress to Chartered Engineer (CEng) status. All students are encouraged to become student members of the Institution of Chemical Engineers and/or the Energy Institute. Both professional bodies have active local branches which organise seminars and visits. Through these experiences, graduates are therefore well-equipped to meet the challenge of working within an ever-changing discipline and succeed in the wide range of career areas described above.

In addition to the clearly vocational orientation of the programme, students also benefit from the School's research activity, which informs its teaching. The School has four internationally leading research themes: Biological Engineering, Processes and Systems, Materials & Products and Circular Economy. The specialist subjects available in the 3rd and 4th year reflect the interests of staff in these groups and in the 4th year, students have the opportunity to carry out a novel research project on their own, with guidance from a member of staff, in one of these research areas.

The School's MEng programme provides an increased breadth and depth of study beyond that of the BEng in Chemical Engineering, with additional emphasis on industrial relevance. At MEng level, additional emphasis is placed on team/group working, an increase in the use of industrially relevant applications of engineering analysis, and an enhanced capability for independent learning and work. This is excellent preparation for spending the year in industry, where students apply and develop their experience on real projects. Students are responsible for finding their own industrial placements but are assisted by staff in the School, the Faculty Placement Team and the University Careers Service.

Students on the MEng in Chemical Engineering with an Industrial Placement Year spend the fourth year of the five-year degree working in a chemical engineering related company of their choice. This provides them with wide-ranging experiences and opportunities to put their academic studies into context, and to improve their technical and professional skills. It also enhances their employment prospects, enabling them to gain direct experience of industry culture, make contacts and strengthen their CV. Students who complete their placements successfully may be offered full-time graduate employment with the same company following their final year.

Several streams are available to students in 3rd and 5th years:

- **Non-specialised Stream:** Students can choose modules from the different technical streams

according to their interests, without specialisation.

- **Energy Stream:** This stream focuses on all aspects of the energy sources, supply, processing and use of various fuels. It includes the efficient utilisation of renewable (e.g. biomass, solar) and non-renewable fuels (e.g. coal, oil and natural gas), the generation of electricity and heat from fossil, biomass or nuclear fuels and the refining of petroleum.
- **Biological Engineering Stream:** This stream focuses on the discipline of biological engineering. Biological systems and processes are used in various industries including industrial/agricultural biotechnology, pharmaceutical industry, tissue engineering and the biofuels industry.
- **Pharmaceutical Engineering Stream:** This stream specialises on product development, pharmaceutical (bio) manufacturing and pharmaceutical industry. Specialised advanced modules in chemical and pharmaceutical engineering involve extensive hands-on experience in the Chemical Engineering Pilot Plant, open-ended and design problems, individual research project and industry inputs.

16. Programme aims

The MEng Chemical Engineering with an Industrial Placement Year aims to:	
A1	provide access to an engineering degree to students from a range of academic and social backgrounds.
A2	deliver a coherent curriculum embedded in design and practice with an emphasis on critical thinking, problem solving, professionalism, ethics and sustainability.
A3	offer flexible learning environments and pathways to facilitate deep engagement.
A4	promote and facilitate industry involvement by focusing on both process and product engineering to develop industry ready practical graduates with hands on experience.
A5	produce graduates who are integrators, change agents and self-directed learners to lead multidisciplinary teams, and be at the forefront of innovation.
A6	provide exposure to niche research areas built on a strong core in engineering fundamentals.
A7	produce graduates capable of Engineering from molecules by applying systems level thinking at many length scales.
A8	foster safe and good laboratory practice.
A9	encourage students to think for themselves and develop a social awareness of the impact of chemical engineering on society.
A10	promote the free pursuit of knowledge and develop an ability to find, understand and analyse information.
A11	meet the requirements for the associate membership level of the relevant professional bodies.
A12	provide students with direct experience of working in industry, applying and developing their technical and professional skills.

17. Programme learning outcomes

Knowledge and understanding On successful completion of the programme, students will be able to demonstrate knowledge and understanding of:		
		Links to Aim(s)
K1	fundamental principles of engineering science relevant to chemical and biological engineering.	A1, A2
K2	mathematics necessary to apply engineering science to chemical and biological engineering.	A6, A7, A10
K3	analytical and design methods used in chemical and biological engineering.	A6, A7, A10
K4	use of information technology for analysis, design and management.	A4, A11, A3
K5	operation of the chemical and biological engineering industry, including business practice and project management.	A12, A4, A5, A8
K6	professional responsibility of chemical engineers and the influence of social, environmental, ethical, economic and commercial considerations on their activities.	A8, A9, A11, A12
K7	working experience and appreciation of how subject specific knowledge gained during the degree applies in the workplace.	A12, A4
Skills and other attributes (I for Intellectual Skills, P for Practical Skills, T for Transferable Skills) On successful completion of the programme, students will be able to:		
I1	use engineering science, mathematics and, where appropriate, information technology to analyse engineering problems.	A7, A10
I2	analyse and interpret experimental and other numerical data.	A8, A10
I3	produce designs in a professional manner, taking account of social, environmental, ethical and commercial considerations.	A9, A2
I4	carry out a health and safety risk assessment and devise a safe system of working.	A8
I5	display creativity and innovation in solving unfamiliar problems.	A10
I6	exercise independent thought, critical thinking and judgement.	A2
I7	perform a technical investigation.	A6, A8
P1	use appropriate mathematical methods for modelling and analysing chemical and biological engineering problems.	A10, A7
P2	use relevant test and measurement equipment.	A8

P3	design and conduct experimental laboratory work.	A8
P4	use chemical and biological engineering IT tools and programming.	A6, A3
P5	design systems, components or processes and test design ideas in the laboratory or through simulation.	A8, A6
P6	prepare technical reports and presentations.	A2, A3, A11
P7	undertake the safe handling of chemical materials, taking into account their physical and chemical properties, including a risk assessment of any specific hazards associated with their use.	A8
T1	use information technology effectively.	A3, A6
T2	communicate effectively, orally and in writing; to a range of audiences.	A2, A3, A11, A12
T3	lead and collaborate with others in teams.	A5, A12
T4	manage time, teams and projects efficiently.	A5, A12
T5	find information and learn independently.	A2, A10
T6	develop employability skills.	A4, A12

18. Learning and teaching methods

The main teaching methods adopted for each learning outcome are shown below. In most cases a combination of methods is used. Emphasis is on 'learning by doing', in particular for developing self-directed learners. Knowledge and understanding are gained through a combination of lectures, tutorials, example classes, design classes, laboratory experience, open-ended problem solving and coursework assignments. Skills are acquired mainly through coursework and individual and group projects.

The teaching will be delivered by a team of highly skilled academics with specific background in chemical engineering and pharmaceutical engineering. Guest lectures from industry/practitioners will be included. A range of learning spaces will be used, including the Diamond Pilot Plant. The teaching and learning material will be shared via Blackboard.

Lectures – used to transmit information, explain theories and concepts, and illustrate methods of analysis or design. For most lecture courses tutorial sheets are provided to enable students to develop their understanding during private study.

Practical activities – students undertake laboratory experiments, open-ended problem solving and computing tasks to gain practical skills.

Tutorials and example classes – run for individuals, small groups or a whole class to help students with their understanding and to resolve open-ended problems in their programme materials.

Research project – individual project contributing to novel research in chemical and biological engineering.

Research seminars – there is a regular schedule of School research seminars during the teaching session. Level 4 students are encouraged to attend.

The approach to teaching design encourages students to take a wide perspective on problems and to develop their powers of synthesis, analysis, creativity and judgement as well as clarity of thinking. Students are provided with the context and framework for the application of the scientific, technical and other knowledge which is taught elsewhere in the programme through the methods described

above. The principal methods for design teaching are:

Design classes – students work to solve design problems related to real chemical and biological engineering situations in order to learn design methods and to practice associated analytical techniques.

Design projects – teams of 6-7 students tackle a chemical engineering problem by working through conceptual and detailed design stages.

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 further understanding of the subject matter.

Individual industrial placement: Year 4 is spent in industry. This provides students with experience of working in a chemical engineering related company, consolidates knowledge gained during their academic studies in years 1 to 3, and enhances their understanding of how to apply this in practice. It also provides students with opportunities to develop professionally and plan for further development towards a professional qualification.

19. Assessment and feedback methods

Opportunities to demonstrate achievement of the learning outcomes are provided through a variety of assessment methods.

Knowledge and understanding are primarily assessed in written examinations. However, in the later years further knowledge and understanding is gained through project work and assessed in written reports and oral presentations. A range of methods will be employed to provide formative feedback, in particular, during tutorials, projects, coursework and class tests.

Written examinations – unseen examinations.

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

Class tests and online tests – tests conducted in a lecture theatre or on the virtual learning portal during the main teaching periods to assess progress.

Oral presentations – most group projects include an oral presentation in which each group member plays a part.

Individual and group project reports – these include intermediate and final reports for the Design Project and Research Project.

Industrial placement – A variety of methods are used to assess the placement undertaken in Year 4. These include one written report describing and reflecting on personal professional development through experience gained in the year in industry, and a post-placement poster presentation.

We will use a range of feedback mechanisms that we have designed and successfully utilised in the School. They include written and verbal, group and individual feedback from tutors; peer to peer feedback, self-reflection via keeping a skills journal, concept-check online quizzes and personal tutorials. All students receive a Feedback Handbook when they first arrive, which describes in depth the different types of feedback provided in the School. This handbook is available throughout their studies on the UG Community on Blackboard. For each module, a ‘Module Assessment and Feedback’ Form is provided at the beginning of the term on Blackboard, which clearly outlines feedback details and date for each assessment component. In addition, the School provides an ‘Assessment and Feedback Overview’ which summarises all assessment and feedback details per Level per Semester.

20. Programme structure and student development

The programme structure is modular and in each year students study modules worth a total of 120 credits. The first two years (Levels 1 and 2) are taught through a series of compulsory 10-20 credit modules.

At Levels 1 & 2, students also participate in a cross-faculty week-long group project: “Global Engineering Challenge” in Year 1 and “Engineering: You’re Hired” in Year 2. These are an opportunity for students across the Faculty of Engineering to work together in multi-disciplinary teams, enabling them to develop a range of professional and technical competences, including awareness of the global context of their decisions, communication skills, cultural agility and enterprising problem solving. Neither of these group projects are credit bearing, but both are compulsory for progression to year 3. In addition, all students take a core ‘CBE Skills for Employability’ module, which has been developed as a programme level non-credit bearing module, designed to help students in planning their career development, and to equip them with the essential knowledge, know-how and practical skills needed to succeed in the recruitment process and be competitive in the job market.

In year 3, the core curriculum includes a series of compulsory modules to the value of 45 credits plus a 45-credit design project, which involves working in a small, supervised group on the process design of a chemical plant. The remaining 30 credits are available for optional module choices. Students who choose one of the technical streams are guided in their module selection.

In year 4, students work in a chemical engineering related company for a minimum of 38 weeks. At the end of the placement, they write a report and present a poster showcasing their achievements. The placement is assessed on a pass/fail basis and does not contribute to the degree classification: a pass in this placement year is required for the degree title to reflect the industry experience.

In year 5, the major feature is a 45-credit individual research project. Some of the projects are linked to industry. Students also undertake further compulsory 15-credit modules totalling 30 credits again with the remaining 45 credits available for studying of optional modules. Again, students who choose one of the technical streams are guided in their module selection.

To enable graduates to become Chartered Engineers (CEng), the Engineering Applications component specified by the Engineering Council (the application of scientific and engineering principles to the solution of practical problems of engineering systems and processes) is embedded throughout the programme. It is initially introduced during Levels 1 and 2 and includes dedicated design weeks and a week of practical activities along with visits to local chemical engineering industry. It is then continued through the Level 3 design project and requires both group and individual work.

Changing programmes of study
All students follow exactly the same modules during Levels 1 and 2. As students become more familiar with the material covered within the programme, their special interests may change. The programmes have therefore been designed to be flexible, with several technical streams at Levels 3 and 5 available for students who want to specialise in a specific area (Energy, Biological Engineering, Pharmaceutical Engineering).

At the end of Level 2, students also have the option of changing to the BEng in Chemical Engineering (*see separate Programme Specification*), and so complete a degree in one further year. Also at this time, students who have not attained the necessary academic standard during the first two years, currently set at an overall average of 54.5% in the second-year examinations, will normally be required to transfer to the BEng programme.

Student development over the course of study:

Year 1
The first year of the programme aims to consolidate students’ existing scientific knowledge of mathematics and science and also provide some relevant knowledge of other sciences to fill any gaps, while at the same time introducing the basic principles of chemical engineering. Students will undertake practical experiments and will be able to present, interpret and evaluate data reliably. They will develop communication skills and teamwork through participation in design and tutorial exercises

which will require them to have developed lines of argument and make sound judgements in accordance with basic theories and concepts of chemical engineering.

Year 2
Over the following year, students will develop a more extensive knowledge and deeper understanding of the principal chemical engineering subjects, with an emphasis on real applications. Students will also extend their knowledge of computing and background information on other relevant engineering applications. They will further develop their practical skills and solve more difficult chemical engineering problems. Students will undertake more detailed design work in which some elements of professional practice are introduced.

Year 3
At Level 3, the programme is aimed at broadening knowledge of the chemical process industries by introducing further topics together with more advanced treatment of the subjects covered during Level 2. Students will carry out a complex realistic design project which will require the application of knowledge and understanding gained in earlier years, both of technical subjects and of professional issues. Students will work in self-directed groups, enhancing communication and team-working skills.

Year 4 (Industrial Placement Year)
Students will spend a year in industry, working with an employer on graduate-level projects (or series of projects), applying and developing their knowledge and skills in the context of the employer's area of work and within relevant time and funding constraints. In addition to an industry mentor, a university tutor will be in contact during the year, and where possible, will visit the student in their place of employment. The student will produce a report and create a poster covering their industry experience.

Year 5
Students will study current issues at the forefront of chemical engineering. Their knowledge and understanding of professional issues and management will be enhanced. They will carry out an individual research project and demonstrate an ability to carry out independent research and critically evaluate the results. They will display levels of creativity, originality and judgement comparable with those expected of Masters' degree graduates and upon successful completion of the programme, will have developed and demonstrated achievement of the overall programme outcomes.

Detailed information about the structure of programmes, regulations concerning assessment and progression and descriptions of individual modules are published in the University Calendar available online at http://www.sheffield.ac.uk/calendar/.

21. Criteria for admission to the programme

Detailed information regarding admission to programmes is available from the University's On-Line Prospectus at

Chemical Engineering with an Industrial Placement Year | Undergraduate study | The University of Sheffield

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

23. Additional information

Students are expected to find their own placement (either in the UK or abroad), although we are able to assist through the many contacts University staff have with industry. We regularly update students with details of companies with suitable placements. The University has a Careers Service, who support students in years 2 and 3 on CV writing, strategies for securing a placement and the practicalities of placement work. It is expected that students receive a salary for their work. The Year in Industry Tutor and the administrative staff maintain regular contact with the student and the placement provider throughout the year to check that the placement is going well. For all UK-based placements, a member of academic staff also visits the company. The Faculty Placement Team will also assist with placement visit and provide support to students from pre-placement till post-placement.

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 School(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.